A Sociotechnical Systems Approach to Disposition Decision-making in the Emergency Department for Older Adults

By

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Abstract

Disposition decision-making in the emergency department (ED), the process of determining to where a patient will transition following ED care, represents a unique opportunity to promote patient safety. Disposition decision-making has particularly important implications for older adult patients, who comprise a significant portion of ED visits annually and are vulnerable to suboptimal outcomes throughout ED care transitions. However, disposition decision-making can be challenging as the ED represent a complex, ever-changing environment with dynamic demands. Previous conceptualizations of disposition decision-making are task-oriented and do not provide the holistic description of the ED work system that is needed to develop and implement interventions and work system structures to support this complex clinical process.

The purpose of the present research was to establish a deeper understanding of the ED work system within which disposition decision-making occurs under different constraints, specifically conditions of low and high demand. I conducted a mixed methods study, consisting of a scoping literature review, a work system analysis, and a modified Delphi approach, all guided by a work systems approach, to characterize the ED work system configuration, that is the combination of work system elements that most strongly shape process performance, under high and low demands. The configural diagrams revealed that a majority of work system elements present similarly under conditions of low and high demand. However, within each work system component, at least one work system element varied in perceived influence which suggests that the variations in ED work system structure meaningfully influence disposition decision-making process performance.

This study extends our understanding of how the ED work system shapes the disposition decision-making process and introduces an innovative approach to create configural diagrams. Practically, these findings have the potential to inform the adaptive and reflexive design of interventions and system structures to support the disposition decision-making. Methodologically, this work expands the work systems analysis toolkit with a playbook for configural diagramming, which provides researchers with a mechanism to identify the work system elements most influential in shaping process performance. The ability to identify these influential elements permits the targeted translation of rigorous work system analyses into actionable change that will affect patient, care partner, clinician, and organizational outcomes.

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Chapter 1: Introduction

1.1 Problem statement

Disposition decision-making represents a unique opportunity to promote patient safety for the millions of older adults who receive care in the emergency department (ED) across nearly 30 million ED visits annually (Ashman et al., 2020; Rui & Kang, n.d.). A disposition decision determines the level of care that an individual requires after leaving the ED (Agency for Healthcare Research and Quality, 2011). A disposition decision influences how patients access and interact with the healthcare system following their ED visit (Morganti et al., 2013), making it particularly important to understanding and influencing how the patient journey unfolds (Carayon et al., 2020). In the United States, across all patient populations, 78% of patients are dispositioned home, 10% to an inpatient unit, and the remaining 12% to another care location such as a skilled nursing facility (Rui & Kang, n.d.).

If patients are readily dispositioned to locations that do not support their care needs (Chamberlain & Pollack, 1998), there can be serious adverse outcomes for the patient and care partner, the ED physician, and the healthcare system.

- For the patient and care partner, consequences can include repeat ED visits, death, admission to higher level of care (e.g., intensive care unit as opposed to a general medicine unit), and increased healthcare costs (Calder et al., 2010; Calder et al., 2012; Chen et al., 2021; Fernando et al., 2018; Gabayan et al., 2016).
- For the ED physicians, there may be legal implications and they may experience blame and stress (Bragard et al., 2015).
- For the healthcare system, there may be unnecessary admissions, which can lead to hospital overcrowding (Chamberlain & Pollack, 1998; Fernando et al., 2018).

Disposition decision-making can be challenging for a variety of reasons, especially for vulnerable and clinically complex populations such as older adults. First, the ED is a complex and dynamic environment with interruptions; continuous, changing and competing demands; time and space limitations; high patient acuity; and decisions that need to be made interdependently, frequently, and readily with limited information and resources (Daniels et al., 2018; Stiell et al., 2003; Wears & Leape, 1999; Wears et al., 2010). Taken together, these characteristics can lead to significantly high demands on physicians (Weigl et al., 2016), which can be associated with poor decision quality (Levin et al., 2006; Shanafelt et al., 2002; Soria-Oliver et al., 2017). For instance, Daniels and colleagues note that, in their description of competing demands in the ED, an ED "physician went on to explain… 'if the patient is bordering for going home or coming in, those are the patients that I want to spend the least time on, because that is at the expense of patients who are really sick'" (2018, p. 742).

ED physicians are expected to manage the structural constraints inherent to the ED work system including "continuing arrivals fueled by beliefs, expectations, and needs of the community; political and managerial expectations of efficiency of patient throughput; capacity constraints beyond the ED (such as available beds in the hospital and serves in the community); and limited resources in the ED (such as staff, space, time, and beds)" (Nugus et al., 2011, p. 1046). This means that ED physicians experience instances of high and low demands, depending on the status of other aspects of the ED work system. For example, an ED at maximum capacity is associated with increased demands (Nugus et al., 2011). The extent to which ED physicians perceive and respond to demands influences their behavior and ultimately outcomes (e.g., patient disposition) (Flowerdew et al., 2011; Nugus et al., 2011; Shanafelt et al., 2002).

Researchers have shown that physicians, across specialties, often make decisions with the intent of reducing demands (Nugus et al., 2011). For instance, in their exploration of unexpected changes in demand on the performance of EDs, Turner and colleagues note that "ED physicians may also attempt to relieve pressure through their choice of discharge destination by substituting care within the ED for care provided by alternative health care services" (2020, p. 1747). As another example, in a study of burnout in internal medicine residents, Shanafelt and colleagues (2002) found that, compared to residents who did not report experiencing burnout, residents experiencing burnout were more likely to report engaging in suboptimal patient care practices and attitudes. An example of a suboptimal patient care practice included discharging "patients to make the service [and their workload more] 'manageable' because the team was too busy" (Shanafelt et al., 2002, p. 363). An example of a suboptimal patient care attitude included paying "little attention to the social or personal impact of an illness on a patient" (Shanafelt et al., 2002, p. 363).

Second, ED healthcare processes, like disposition decision-making, are often associated with competing goals (Wears, 2010). Acute (i.e., immediate with direct consequences) goals such as efficiency are often prioritized over chronic (i.e., long-term) goals such as patient safety (Nugus & Braithwaite, 2010). Although ED physicians are trained to optimize both efficiency and safety, as a result of the influence of demands and system constraints, the ED work system may be configured such that one goal becomes the focus. For example, if there are numerous patients in the ED waiting room and all the ED beds are full, the system may require the ED physicians to focus on efficiency in an attempt to reduce demands.

Reconciling acute and chronic goals often results in physicians striving to mitigate demands while navigating the tension between "providing optimal care to the individual patient and the

need to provide care for multiple patients" (Nugus & Braithwaite, 2009, p. 512). This is further complicated by the dynamic nature of the ED in that changes in the ED work system configurations are likely to result in fluctuations in demands and vice versa. Thus, because ED physicians often operate within suboptimal conditions, they may be unable to achieve both manageable demands and their preferred balance between acute and chronic goals in their work (Nugus & Braithwaite, 2009).

Given the important role of disposition decision-making in the ED in promoting patient safety (Calder et al., 2010; Calder et al., 2012), previous work has begun to explore it and can be summarized by answering questions like what, when, and who.

- What? Disposition decision-making is a complex process that occurs within a dynamic environment (Calder et al., 2012). Disposition decision-making often spans the entire length of a patient's ED stay and is considered a core competency of ED physicians (Capan et al., 2018; Society for Academic Emergency Medicine, 2008).
- Within what timeframe? Disposition decision-making has previously been conceptualized as a rapid internal, cognitive process conducted by ED physicians (Sibbald et al., 2017).
- Who? Disposition decision-making has previously been perceived to be an ED physicians' responsibility and decision (Capan et al., 2018), but recent studies have found that two or more individuals are involved in the tasks within the process that ultimately produce a disposition decision (Calder et al., 2012; Nugus et al., 2010; Probst et al., 2015; Rutkowski et al., 2020). Further, studies report that ED physicians attempt to seek information, some of which may inform the disposition decision, from many individuals and sources (Nelson et al., 2013), suggesting that disposition decision-making may be a multi-person process.

- Influenced by? Previous research suggests that both physician and patient factors influence the disposition. Physician factors such as training, education, and risk tolerance influence the disposition decision (Capan et al., 2018; Li et al., 2016). Patient factors such as socioeconomic and insurance status influence the disposition decision and are likely to be associated with certain dispositions (Chaudhry et al., 2013).
- With what? Findings from diagnostic tools such as computerized tomography (CT) can alter the disposition decision (Barksdale et al., 2015). Further, physicians often make disposition decisions with incomplete or insufficient information (Nelson et al., 2013; Stiell et al., 2003).

A few studies have begun to map the decision points and stages of disposition decision-making in the ED (Calder et al., 2012; Capan et al., 2018). These studies represent a critical first step in understanding how disposition decision-making unfolds over the course of an ED visit. However, these studies map disposition decision-making in terms of a series of tasks or stages of the ED visit and do not consider the dynamic and adaptive nature of ED demands (Nugus et al., 2011). They offer little insight into the work system within which disposition decision-making occurs and how the system configuration influences the disposition decision-making process. Recognizing these limitations, these studies call for a deeper understanding of how disposition decision-making occurs in context; how system factors (e.g., ED physician characteristics), the decision-making process, and potential outcomes interact to result in a disposition decision; and how dynamic demands may influence system interactions and resultant outcomes (Calder et al., 2012; Capan et al., 2018).

To characterize this interaction, it is important to recognize that systems are "designed to produce exactly the results" they yield (Wears, 1999, p. 370). Thus, to understand how and why

systems operate and perform in the way that they do, it is first necessary to characterize and evaluate the work situation (i.e., the work system) (Wooldridge et al., 2020). A work systems approach provides the tools necessary to comprehensively study the work system within which disposition decision-making occurs. A work systems approach is grounded in the notion that processes occur within a work system of interacting elements, such that these interactions produce different outcomes (e.g., performance, safety) (Carayon et al., 2006; Carayon et al., 2014). Specifically, the work system consists of people who carry out tasks using technologies and tools within a physical environment, organizational structure, and external environment (Holden et al., 2013).

The work system model, originally developed by Carayon-Sainfort and Smith (1989), and adaptations of the work system model such as the Systems Engineering Initiative for Patient Safety (SEIPS) are inherently descriptive, meaning they can provide valuable insight into "aspects of the work system, their interactions, and possible outcomes" (Carayon et al., 2006, p. i56; Carayon & Wood, 2010). Findings from a work system analysis typically represent the system at a snapshot in time. Analyses of the same work system conducted at different time points or under different conditions (e.g., high demand verses low demand) can reveal the range of experience in a dynamic environment like the ED. Previous studies of ED disposition decision-making focus on ED disposition generally or a specific condition. Although useful, it is also critical to understand disposition decision-making as it occurs within the extreme constraints typical of the ED work system (i.e., high demand and low demand) (Flowerdew et al., 2011). Establishing a comprehensive description of the ED work system under extreme conditions will allow for the development of interventions and system redesigns to be adaptive to the ever-changing constraints of the ED.

1.2 Research question

The purpose of the present research was to establish a deeper understanding of the ED work system within which disposition decision-making occurs under different constraints. To do this, I used a work systems approach to characterize the ED work system configuration, that is the combination of work system elements that most strongly shape performance, under low and high demands (Holden, 2013). Specifically, my research question was: how does the ED work system configure under conditions of low and high demand to produce the disposition decision-making process?

1.3 Contributions

The dissertation provides a systems lens from which to understand how various conditions manifest within the structure of the ED work system that influences the ED disposition decision-making process. My results provide a set of configural diagrams that depict the structure within which disposition decision-making occurs under low and high demands, which lays the foundation for the future design of ED system structures to facilitate a more balanced and adaptive work system, even in times of high demand.

Methodologically, my dissertation work expands upon the methods and applications of work system configuration through configural diagramming. I used configuration to assess the ED work system under different constraints. Configuration has been described as useful for identifying variations among work systems that may account for differences in performance (Holden et al., 2013). For example, configural diagramming could be used to compare the same work system at two different times points or two entirely separate work systems (e.g., two units

of the same hospital) (Holden et al., 2013). Previous studies have used configuration to explore cross-boundary work systems (i.e., processes that extend across multiple work systems) (Werner et al., 2020), study the work system pre- and post-intervention implementation (Hay et al., 2020), and understand the interactions, barriers, and facilitators present within and among sub-systems involved in a process (Carman et al., 2021). To my knowledge, no studies have explored how configuration, specifically configural diagramming, could be used to assess differences in the same work system under different constraints. Thus, my dissertation work proposes a new application of configural diagramming. Further, previous work has provided limited insight into how to create configural diagrams. As such, my work dissertation adds to the literature by outlining a new set of methods that can be used to develop configural diagrams.

1.4 Structure of the proposal

Chapter 2 features a literature review outlining previous work exploring disposition decision-making and a summary of work systems models. Chapter 3 highlights my research question. Chapter 4 presents the researcher's worldview. Chapters 5-7 include methods and results. Finally, Chapter 8 features a synthesizing discussion.

1.5 Chapter 1 references

Agency for Healthcare Researh and Quality, (2011). *Disposition of Patient*. https://ushik.ahrq.gov/ViewItemDetails?system=mdr&itemKey=65837000

Ashman, J. J., Schappert, S. M., & Santo, L. (2020). *Emergency Department Visits Among Adults Aged 60 and Over: United States, 2014–2017* (367). N. C. f. H. Statistics. https://www.cdc.gov/nchs/products/databriefs/db367.htm#:~:text=During%202014%E2%80%932017%2C%2020%25,visits%20(3%E2%80%936).

Barksdale, A. N., Hackman, J. L., Gaddis, M., & Gratton, M. C. (2015). Diagnosis and disposition are changed when board-certified emergency physicians use CT for non-traumatic abdominal pain. *Am J Emerg Med*, *33*(11), 1646-1650. https://doi.org/10.1016/j.ajem.2015.07.082

Bragard, I., Dupuis, G., & Fleet, R. (2015). Quality of work life, burnout, and stress in emergency department physicians: a qualitative review. *European Journal of Emergency Medicine*, *22*(4). https://journals.lww.com/euro-emergencymed/Fulltext/2015/08000/Quality_of_work_life,_burnout,_and_stress_in.1.aspx

Calder, L. A., Forster, A., Nelson, M., Leclair, J., Perry, J., Vaillancourt, C., Hebert, G., Cwinn, A., Wells, G., & Stiell, I. (2010). Adverse events among patients registered in high-acuity areas of the emergency department: a prospective cohort study. *Cjem*, *12*(5), 421-430. https://doi.org/10.1017/s1481803500012574

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576.e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Capan, M., Pigeon, J., Marco, D., Powell, J., & Groner, K. (2018). We all make choices: A decision analysis framework for disposition decision in the ED. *The American Journal of Emergency Medicine*, *36*(3), 450-454. https://doi.org/https://doi.org/10.1016/j.ajem.2017.11.018

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Quality and Safety in Health Care*, *15*(suppl 1), i50. https://doi.org/10.1136/qshc.2005.015842

Carayon, P., Wetterneck, T., Rivera-Rodriguez, A. J., Hundt, A., Hoonakker, P., Holden, R. J., & Gurses, A. P. (2014). Human factors systems approach to healthcare quality and patient safety. *Appl Ergon*, *45*(1), 14-25. https://doi.org/10.1016/j.apergo.2013.04.023

Carayon, P., & Wood, K. E. (2010). Patient safety - the role of human factors and systems engineering. *Studies in health technology and informatics*, *153*, 23–46.

Carayon, P., Wooldridge, A., Hoonakker, P., Hundt, A. S., & Kelly, M. M. (2020). SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Appl Ergon*, *84*, 103033. https://doi.org/10.1016/j.apergo.2019.103033

Carman, E.-M., Fray, M., & Waterson, P. (2021). Facilitators and barriers of care transitions - Comparing the perspectives of hospital and community healthcare staff. *Applied Ergonomics*, *93*, 103339. https://doi.org/https://doi.org/10.1016/j.apergo.2020.103339

Chamberlain, J. M., & Pollack, M. M. (1998). A method for assessing emergency department performance using patient outcomes. *Acad Emerg Med*, *5*(10), 986-991. https://doi.org/10.1111/j.1553-2712.1998.tb02777.x

Chamberlain, J. M., & Pollack, M. M. (1998). A method for assessing emergency department performance using patient outcomes. *5*(10), 986-991.

Chaudhry, S. A., Tariq, N., Majidi, S., Afzal, M. R., Hassan, A. E., Watanabe, M., Rodriguez, G. J., Suri, M. F. K., Hussain, S., & Qureshi, A. I. (2013). Rates and factors associated with admission in patients presenting to the ED with TIA in the United States—2006 to 2008. *The American journal of emergency medicine*, *31*(3), 516-519.

Chen, R. A.-O., Cheng, K. A.-O., Lin, Y. A.-O., Chang, I. A.-O. X., & Tsai, C. A.-O. (2021). Predicting Unscheduled Emergency Department Return Visits Among Older Adults: Population-Based Retrospective Study. *JMIR Med Inform*(2291-9694 (Print)).

Daniels, L. M., Sorita, A., Kashiwagi, D. T., Okubo, M., Small, E., Polley, E. C., & Sawatsky, A. P. (2018). Characterizing Potentially Preventable Admissions: A Mixed Methods Study

of Rates, Associated Factors, Outcomes, and Physician Decision-Making. *Journal of general internal medicine,*, *33*(5), 1525-1497 (Electronic).

Fernando, S. M., Rochwerg, B., Reardon, P. M., Thavorn, K., Seely, A. J. E., Perry, J. J., Barnaby, D. P., Tanuseputro, P., & Kyeremanteng, K. (2018). Emergency Department disposition decisions and associated mortality and costs in ICU patients with suspected infection. *Crit Care*, *22*(1), 172. https://doi.org/10.1186/s13054-018-2096-8

Flowerdew, L., Brown, R., Russ, S., Vincent, C., & Woloshynowych, M. (2011). Teams under pressure in the emergency department: An interview study. *Emergency medicine journal : EMJ*, *29*. https://doi.org/10.1136/emermed-2011-200084

Gabayan, G. Z., Gould, M. K., Weiss, R. E., Patel, N., Donkor, K. A., Chiu, V. Y., Yiu, S. C., Jones, J. P., Hoffman, J. R., & Sarkisian, C. A. (2016). Poor Outcomes After Emergency Department Discharge of the Elderly: A Case-Control Study. *Ann Emerg Med*, *68*(1), 43-51.e42. https://doi.org/10.1016/j.annemergmed.2016.01.007

Hay, G. J., Klonek, F. E., & Parker, S. K. (2020). Diagnosing rare diseases: A sociotechnical approach to the design of complex work systems. *86*, 103095. https://www.sciencedirect.com/science/article/pii/S0003687020300582

Holden, R. J., Carayon, P., Gurses, A. P., Hoonakker, P., Hundt, A. S., Ozok, A. A., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*(11), 1669-1686. https://doi.org/10.1080/00140139.2013.838643

Levin, S., France Dj Fau - Hemphill, R., Hemphill R Fau - Jones, I., Jones I Fau - Chen, K. Y., Chen Ky Fau - Rickard, D., Rickard D Fau - Makowski, R., Makowski R Fau - Aronsky, D., & Aronsky, D. (2006). Tracking workload in the emergency department. *Human Factors*, *48*(3), 526-539. https://doi.org/10.1518/001872006778606903

Li, C.-J., Syue, Y.-J., Tsai, T.-C., Wu, K.-H., Lee, C.-H., & Lin, Y.-R. (2016). The Impact of Emergency Physician Seniority on Clinical Efficiency, Emergency Department Resource Use, Patient Outcomes, and Disposition Accuracy. *Medicine*, *95*(6), e2706-e2706. https://doi.org/10.1097/MD.0000000000002706

Medicine, S. f. A. E. (2008). *Disposition of the Emergency Department Patient*. https://www.saem.org/cdem/education/online-education/m3-curriculum/disposition/disposition-of-the-emergency-department-patient

Morganti, K. G., Bauhoff, S., Blanchard, J. C., Abir, M., Iyer, N., Smith, A., Vesely, J. V., Okeke, E. N., & Kellermann, A. L. (2013). The Evolving Role of Emergency Departments in the United States. *Rand Health Q*, *3*(2), 3.

Nelson, D., Washton, D., & Jeanmonod, R. (2013). Communication gaps in nursing home transfers to the ED: impact on turnaround time, disposition, and diagnostic testing. *Am J Emerg Med*, *31*(4), 712-716. https://doi.org/10.1016/j.ajem.2012.11.024

Nugus, P., & Braithwaite, J. (2010). The dynamic interaction of quality and efficiency in the emergency department: Squaring the circle? *Social Science & Medicine*, *70*(4), 511-517.

Nugus, P., Carroll, K., Hewett, D. G., Short, A., Forero, R., & Braithwaite, J. (2010). Integrated care in the emergency department: a complex adaptive systems perspective. *Soc Sci Med*, *71*(11), 1997-2004. https://doi.org/10.1016/j.socscimed.2010.08.013

Nugus, P., Holdgate, A., Fry, M., Forero, R., McCarthy, S., & Braithwaite, J. (2011). Work Pressure and Patient Flow Management in the Emergency Department: Findings From an Ethnographic Study. *Academic emergency medicine : official journal of the Society for*

Academic Emergency Medicine, *18*, 1045-1052. https://doi.org/10.1111/j.1553-2712.2011.01171.x

Probst, M. A., Kanzaria, H. K., Hoffman, J. R., Mower, W. R., Moheimani, R. S., Sun, B. C., & Quigley, D. D. (2015). Emergency Physicians' Perceptions and Decision-making Processes Regarding Patients Presenting with Palpitations. *J Emerg Med*, *49*(2), 236-243.e232. https://doi.org/10.1016/j.jemermed.2015.02.013

Rui, P., & Kang, K. (n.d.). *National Hospital Ambulatory Medical Care Survey: 2017 emergency department summary tables*. N. C. f. H. Statistics. https://www.cdc.gov/nchs/data/nhamcs/web_tables/2017_ed_web_tables-508.pdf

Rutkowski, R. A., Salwei, M., Barton, H., Wust, K., Hoonakker, P., Brenny-Fitzpatrick, M., King, B., Shah, M. N., Pulia, M. S., & Patterson, B. W. (2020). Physician Perceptions of Disposition Decision-making for Older Adults in the Emergency Department: A Preliminary Analysis. Proceedings of the Human Factors and Ergonomics Society Annual Meeting,

Shanafelt, T. D., Bradley Ka Fau - Wipf, J. E., Wipf Je Fau - Back, A. L., & Back, A. L. (2002). Burnout and self-reported patient care in an internal medicine residency program. *Ann Intern Med*, *136*(5), 358-367. https://doi.org/10.7326/0003-4819-136-5-200203050-00008

Sibbald, M., Sherbino, J., Preyra, I., Coffin-Simpson, T., Norman, G., & Monteiro, S. (2017). Eyeballing: the use of visual appearance to diagnose 'sick'. *Med Educ*, *51*(11), 1138-1145. https://doi.org/10.1111/medu.13396

Smith, M. J., & Carayon-Sainfort, P. (1989). A balance theory of job design for stress reduction. International Journal of Industrial Ergonomics, 4(1), 67–79.

Society for Academic Emergency Medicine (2008). Disposition of the Emergency Department Patient. from https://www.saem.org/cdem/education/online-education/m3-curriculum/disposition/disposition-of-the-emergency-department-patient

Soria-Oliver, M., López, J. S., & Torrano, F. (2017). Relations between mental workload and decision-making in an organizational setting. *Psicologia: Reflexão e Crítica*, *30*(1), 7. https://doi.org/10.1186/s41155-017-0061-0

Stiell, A., Forster, A. J., Stiell, I. G., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. *Cmaj*, *169*(10), 1023-1028.

Tanabe, P., Reddin C Fau - Thornton, V. L., Thornton Vl Fau - Todd, K. H., Todd Kh Fau - Wun, T., Wun T Fau - Lyons, J. S., & Lyons, J. S. (2010). Emergency Department Sickle Cell Assessment of Needs and Strengths (ED-SCANS), a focus group and decision support tool development project. *Academic Emergency Medicine*, *17*(8), 848-858.

Turner, A. J., Anselmi, L., Lau, Y.-S., & Sutton, M. (2020). The effects of unexpected changes in demand on the performance of emergency departments [https://doi.org/10.1002/hec.4167]. *Health Economics*, *29*(12), 1744-1763. https://doi.org/https://doi.org/10.1002/hec.4167

Wears, R., & Leape, L. L. (1999). Human error in emergency medicine. In *Ann Emerg Med* (Vol. 34, pp. 370-372). https://doi.org/10.1016/s0196-0644(99)70133-2

Wears, R. L., Woloshynowych, M., Brown, R., & Vincent, C. A. (2010). Reflective analysis of safety research in the hospital accident & emergency departments. *Human Factors and Ergonomics in Patient Safety*, *41*(5), 695-700. https://www.sciencedirect.com/science/article/pii/S0003687009001665

Weigl, M., Müller, A., Holland, S., Wedel, S., & Woloshynowych, M. (2016). Work conditions, mental workload and patient care quality: a multisource study in the emergency department. *BMJ quality & safety*, *25*(7), 499-508.

Werner, N. E., Rutkowski, R., Graske, A., Finta, M. K., Sellers, C. R., Seshadri, S., & Shah, M. N. (2020). Exploring SEIPS 2.0 as a model for analyzing care transitions across work systems. *Appl Ergon*, *88*, 103141. https://doi.org/10.1016/j.apergo.2020.103141

Chapter 2: Literature review

To contextualize and lay the foundation for my research, I have synthesized relevant literature by means of the following questions:

2.1 What has been done previously to understand disposition decision-making in the ED?

2.2 What role do decision-making models have in understanding disposition decision-making?

2.3 Which work systems approach is optimal for capturing how the ED work system configures in times of low and high demand to produce disposition decision-making?

2.1 What has been done previously to understand disposition decision-making in the ED?

2.1.1 Definition and significance

A disposition decision determines the level of care that an individual requires after leaving the ED (Agency for Healthcare Research and Quality, 2011). The determination of where the patient will go following an ED visit is important to promoting patient safety (Calder et al., 2010; Calder et al., 2012) and minimizing healthcare costs (Fernando et al., 2018). For example, if a patient is dispositioned home without the necessary support (e.g., care partner to enact discharge instructions, access to home health services), they could experience negative outcomes such as death, repeat ED visits, pain, or unanticipated admission to the hospital (Aminzadeh & Dalziel, 2002; G. Z. Gabayan et al., 2016; Probst et al., 2017). The ED physician who discharged the patient could be at risk for malpractice litigation and feelings of stress (Bragard et al., 2015). The healthcare organization could incur a penalty for a repeat ED visit or hospitalization and experience overcrowding. In effect, disposition decision-making marks the beginning of the care transition out of the ED, which is known to represent significant patient safety and healthcare quality challenges (Coleman & Berenson, 2004).

2.1.2 Disposition decision-making for older adults

The number of older adults who visit in the ED is increasing (Ringer et al., 2018). By 2030, older adults (aged 65+) are expected to compose nearly a quarter of all ED visits, meaning that all EDs are and should be treated as geriatric EDs (Frumkin, 2020; Roskos & Wilber, 2006). The ED provides critically important care both for acute and non-acute illnesses and injuries. As such, ED physicians are often the first to discover and share significant health findings (e.g., unsuspected malignancy) (Frumkin, 2020). Specifically, for older adults, ED physicians are well-positioned to identify seemingly harmless factors and work with patients and families to address those factors before they transform into acute issues (Frumkin, 2020).

Older adults have risks, considerations, challenges, and needs that influence how they are cared for and dispositioned from the ED (Burton et al., 2014). For example, standard disposition planning involves proximal planning, such as a short-term recovery protocol. However, for an older adult to be successful post-disposition, ED physicians often have to take both a proximal and distal approach to disposition planning, which could involve consulting clinicians of other specialties and considering the patient's long-term health goals. (Burton et al., 2014). As another example, many older adults reside in nursing homes. This means that when an older adult requires ED care, information related to their current status, health history, etc. must be shared by the nursing home, which may or may not happen in a timely manner. Studies found that ED physicians are often unable to obtain adequate information from nursing home transfer paperwork and from attempts to communicate with nursing home personnel, meaning that ED physicians are required to make disposition decisions with insufficient information (Nelson et al., 2013; Stiell, 2003).

After an ED visit, older adults experience an increased risk of adverse outcomes such as revisiting the ED, increased risk of admission to the hospital or nursing home, a decrease in quality of life, and an increased risk of death (Aminzadeh & Dalziel, 2002; McCusker et al., 2009; Stiell et al., 2003; Strange & Chen, 1998; Suffoletto et al., 2016). Despite the importance of disposition decision-making for older adults' health and well-being, few studies have explored the differences or intricacies of disposition decision-making for older adults (Frumkin, 2020; Rutkowski et al., 2020).

2.1.3 Previous work on disposition decision-making and gaps

Previous work on disposition decision-making in the ED for all adult populations can be divided into three categories: studies designed to understand disposition decision-making in terms of correlated factors, studies designed to understand disposition decision-making with the goal of developing or validating an intervention, and studies designed to understand the disposition decision-making process and the factors that influence it. In subsequent sections, I synthesize each of the areas of research in depth. Table 1 provides a summary of the synthesis.

Table 2.1: A summary of previous work on disposition decision-making and gaps

Category of research	**Summary of research**	**Gaps in research**
Studies designed to understand disposition decision-making in terms of correlated factors	Numerous studies focus on characterizing factors that could have implications for disposition decision-making or identifying specific sets of variables that are correlated with certain dispositions (e.g., admission).	Correlative factors or implications of factors give little insight into how disposition decision-making tangibly occurs and what specific role or influence each factor has in shaping the process
Studies designed to understand disposition decision-making with the goal of developing or validating an intervention	Numerous studies have aimed at developing or validating interventions to support various stages of the disposition decision-making process. Common	These studies describe the potential implications that current or prospective interventions may have on disposition decision-making. However, they are often

	interventions include risk stratification tools that predict, for example, the patient's likelihood of returning to the ED within 30 days. Such studies have implications for prospective tool implementation, which may influence the disposition decision-making process.	focused exclusively on the tool and do not consider the extent to which the tool may influence the broader ED work system. Further, outside of the prospective use of the tool, they provide limited insight into how disposition decision-making occurs.
Studies designed to understand the disposition decision-making process and the factors that influence it	A few studies have begun to explore disposition decision-making. Probst et al., 2015 provide a list of themes related to disposition decision-making. Pope et al., 2017 identified factors that most influenced the rate of unnecessary or avoidable admissions. Sibbald et al., 2017 determined that ED physicians are able to "eyeball" a disposition decision. Rutkowski et al., 2020 identified the roles involved and the information used to make disposition decisions. Calder et al., 2012 and Capan et al., 2018 created process maps of the disposition decision-making process.	These studies: • Offer only a limited view of disposition decision-making as a process, tending to focus on a specific task or feature of disposition decision-making such as information seeking. • Offer minimal insight into the broader context or system within which disposition decision-making occurs • Focus on disposition decision-making generally and do not consider how extreme constraints influence the disposition decision-making process These studies call for a deeper understanding of how disposition decision-making occurs in context; how system factors (e.g., ED physician characteristics), the decision-making process and potential outcomes interact to result in a disposition decision; and how dynamic demands may influence

		system interactions and resultant outcomes. These studies note that multidisciplinary systems engineering and human factors approaches will be necessary to address these gaps.

2.1.3.1 Studies designed to understand disposition decision-making in terms of correlated factors

Some of the previous work related to disposition decision-making focuses on characterizing factors that could have implications for disposition decision-making or identifying specific sets of variables that are correlated with certain dispositions or outcomes (e.g., admission) (Gabayan et al., 2016; Nadal et al., 2020; Neyman & Dalsey, 2021; Vinson et al., 2020). For example, Gabayan and colleagues found that patients with cognitive impairment or changes in mentation with a certain combination of vital signs who had a change of disposition from admission to discharge had a greater likelihood of death or admission to the intensive care unit (ICU) within 7 days of ED discharge (Gabayan et al., 2016). Studies like this one identify clinical factors and some decision-making behavior (e.g., making changes to the disposition decision plan) that are correlated with disposition outcomes, meaning they likely have implications for disposition decision-making. However, these studies give limited insight into how correlated factors influence the disposition decision-making process, as they instead focus on linking factors to outcomes. Further work is needed to understand the extent to which these factors shape the disposition decision-making process to contextualize their statistically significant effect on outcomes (i.e., how and why are these factors associates with certain disposition outcomes).

2.1.3.2 Studies designed to understand disposition decision-making with the goal of developing or validating an intervention

Numerous studies have aimed to develop or validate interventions, such as risk stratification tools, to support ED processes, including disposition decision-making (Stiell et al., 2003). In some cases, the goal of these interventions is to support disposition decision-making specifically and in other cases the potential application to disposition decision-making is incidental. Like the studies that explore correlated factors, these studies seldom explore the influence of the intervention on the disposition decision-making process. Instead, these studies describe potential implications that current or prospective interventions may have on disposition decision-making outcomes. Therefore, they provide limited insight into how the tools specifically influence the process of disposition decision-making. Further work is needed to determine the effect the implementation of these types of tools has on the broader ED context and how they influence the disposition decision-making process.

2.1.3.3 Studies designed to understand the disposition decision-making process and the factors that influence it

A limited number of studies have explored disposition decision-making as a process from the perspective of the individual(s) involved. Below I summarize key articles that lay the foundation for understanding disposition decision-making as a complex, dynamic process. The first four studies (i.e., Probst et al., 2015, Pope et al., 2017, Sibbald et al., 2017, and Rutkowski et al., 2020) identify factors that influence disposition decision-making and the last two articles (i.e., Calder et al., 2012 and Capan et al., 2018) map the disposition decision-making process.

2.1.3.3.1 Probst et al., 2015

Probst and colleagues explored ED physicians' "perceptions and decision-making processing in assessing ED patients with a chief complaint of palpitations" (Probst et al., 2015, p. 237). They conducted semi-structured interviews with ED physicians and "conducted a thematic analysis using grounded theory" to identify key topics related to their clinical approach, their perceptions of this patient population, and their disposition decision-making (Probst et al., 2015, p. 237). They identified four themes related to ED physicians' clinical approach and four themes related to disposition. Themes are summarized in Table 2.

Table 2.2: Summary of themes related to decision-making for palpitations in the ED (Probst et al., 2015)

Category of Theme	**Theme**	**Description and Examples**
Clinical approach	Risk stratification	Utilization of information including age, history of present illness, past medical history, general appearance, vital signs, and ED tests to risk stratify patients into either two (i.e., high and low) or three categories (high, medium, and low). Risk stratification often focused on characterizing the likeliness that the palpitations were associated with another, more serious condition.
	Diagnostic categorization	Determination of whether the palpitations have an organic or functional cause.
	Algorithmic management	Utilization of systematic and protocol-driven approaches to diagnosis and management.
	Case-specific gestalt	Reliance on clinical experience to respond to each patient's unique circumstances and guide management.

Disposition	Presence or absence of a serious diagnosis identified in the ED	Found to be used in coordination with risk stratification to determine the appropriate disposition according to the severity of the diagnosis and risk.
	Perceived need for further cardiac testing/monitoring	Often determined according to patient risk factors (e.g., chronic conditions, smoking status, age). For example, the patient may need in-patient stress testing or extended monitoring.
	Presence or absence of key associated symptoms	Certain complaints indicate certain dispositions. For example, one ED physician noted that syncope would indicate the need for admission.
	Request of other physicians or patient desire	Consideration of patient preference or concerns in determining disposition. For example, the patient's request to be admitted.

These themes capture the breadth of factors that influence the management and disposition of ED patients and highlight the complexity associated with disposition decision-making for this population (Probst et al., 2015). The authors note that findings from this study provide "insight in[to] the real-world decision-making" of ED physicians for patients with palpitations (Probst et al., 2015, p. 241). These findings begin to describe how disposition decision-making occurs in terms of the information used (e.g., diagnosis, need for further testing), from where the information is sourced, and how ED physicians use that information in their decision-making approach. Probst and colleagues conclude that ED physicians "use their knowledge and clinical experience to risk stratify, diagnose, and determine disposition using their clinical gestalt and input from other stakeholders (other physicians and patients)" (Probst et al., 2015, p. 241). In light of this conclusion, the authors note that further studies are needed to "confirm" these

findings and determine the importance of these findings using a quantitative approach. (Probst et al., 2015, p. 241).

When interpreting these findings, it is important to consider the study's methodological limitations. The authors state that they "conducted a thematic analysis using grounded theory" (Probst et al., 2015, p. 237). The authors provide a lean description of their methods, which could be due to journal-specific space restrictions. However, the authors fail to cite foundational grounded theory writings (e.g., Corbin, Straus, Glaser). They also do not reference the conceptual underpinnings (e.g., symbolic interaction, objects) of grounded theory (Charon, 2010). Operationally, the authors do not report using methods or language common to grounded theory (e.g., open, axial, and selective coding, diagramming, memoing, theoretical sampling) (Corbin, 2014;Strauss, 1987). Although these limitations do not invalidate their findings, these limitations introduce uncertainty about the methodological approach the Probst and colleagues used and how they identified these findings, which brings into question the study's qualitative rigor (Devers, 1999; Guba & Lincoln, 2001). As such, additional information about the authors' methodological approach is needed to fully interpret and contextualize their findings.

2.1.3.3.2 Pope et al., 2017

Pope and colleagues aimed to identify the factors associated with the management and operation of the ED that could influence the incidence of avoidable or unnecessary hospitalizations (Pope et al., 2017). To guide their data collection and analysis, the authors developed a framework based on the authors' working knowledge of the ED and "a review of the limited literature on the effect of ED-related factors on hospital admission rates" (Pope et al., 2017, p. 2). Researchers conducted semi-structured interviews with 15 physicians (both ED and hospital) three nurses, and three managers from three different sites. Researchers used an

inductive content analysis approach to identify "factors related to the way the ED is managed and operated which were deemed to be important in determining the rate of avoidable or unnecessary admissions" (Pope et al., 2017, p. 3).

Pope and colleagues identified six factors that most influenced the rate of unnecessary or avoidable admissions (Table 3).

Table 3: Summary of six factors that most influenced the rate of unnecessary or avoidable admissions as identified (Pope et al., 2017)

Factor	**Description or Examples**
Four-hour waiting time target	The federal directive that indicates that there should be no more than four hours between when a patient arrives to the ED and when they are admitted, transferred, or discharged. This has led to increased ED resources, minimized wait times, enhanced patient flow, and expanded understanding of the challenges the ED faces. This has also led to patients being admitted prematurely and junior ED physicians getting less experience managing patients.
Availability of services to enable safe and effective care at home	ED clinicians often facilitate "social admissions", which occur when the ED physician admits the patient when they are unsure whether the patient is able to be safe at home.
Availability of diagnostic and outpatient alternatives	ED clinicians rely on outpatient or previous notes to assist in their evaluation and investigation. However, these notes are not always accessible. ED clinicians also reported being unable to coordinate outpatient follow-up care which frequently led to admission.
Clinical staffing and workload	Junior ED physicians are more likely to admit because they view it as the "safer" option. Senior ED physicians are likely to be more "risk-comfortable" in sending a patient home. ED physicians also noted the time of day and ED census as influencing the decision to admit.
Departmental culture	The organizational hierarchy determines the affability of senior physicians which influences how junior physicians engage with

	senior physicians. The personality of the charge nurse and the extent to which they adhere to the four-hour target influence the time pressure ED physicians experience.
Response to patient expectations and preferences	Most patients expect and would like to be admitted. ED physicians are receptive and responsive to patient preferences.

These factors highlight the numerous clinical and non-clinical factors that ED clinicians perceive as contributing to avoidable or unnecessary hospital admissions. The exploration of factors influencing unnecessary admission is relevant as researchers and clinicians aim to optimize outcomes for patients and for the healthcare system as a whole through disposition decisions. Many of the factors identified are interdependent and provide a descriptive foundation from which to continue the exploration into disposition decision-making.

Interestingly, the authors note that "one of the reasons for conducting this study was to identify any potential reasons as to why [one of the sites] had a higher conversion rate than the other two…" (Pope et al., 2017, p. 6). The authors do not provide much commentary on this underlying goal, but this goal reinforces the notion that qualitative approaches can be used to assess differences in performance based on differences in system factors like motivation, organizational structure, availability of resources etc. (Holden et al., 2013). Although likely unbeknown to the authors, this goal overlaps with work systems principles, such as configuration (Holden et al., 2013). As such, the findings from this study could serve as a guide for further exploration into how EDs differ in terms of outcomes based on differences in system factors.

However, as with the study by Probst and colleagues, this study has numerous methodological limitations that should be considered when interpreting the findings. First, the purpose and development of the guiding framework is unclear. The authors offer a one-sentence description of the development of the guiding framework indicating it was created from the

knowledge of the authors and from a review of the literature. Likewise, the authors offer no insight into how the framework was used to guide data collection or analysis. The lack of clarity surrounding this framework introduces questions about the credibility of the framework and the methods overall (Devers, 1999; Guba & Lincoln, 2001).

Second, the sole researcher who collected the interview data and was involved in data analysis was a former employee at all three of the locations at which data were collected. The authors claim that this connection afforded the researcher the ability to provide "the study with some 'insider knowledge' which enhanced the quality and validity of the data collected" (Pope et al., 2017, p. 3). The authors note that they made a "conscious effort to minimize any potential for bias or subjectivity being introduced in the interviews" but do not provide a description of approaches used to account for bias and establish rigor (Pope et al., 2017, p. 3). The lack of transparency introduces serious questions about the trustworthiness and dependability of these findings (Devers, 1999; Guba & Lincoln, 2001).

Although these limitations do not necessarily invalidate their findings, these limitations introduce uncertainty about the methodological approach Pope and colleagues used and how they rigorously identified these findings. Additional information about the authors' methodological approach is needed to fully interpret and contextualize their findings.

2.1.3.3.3 Sibbald et al., 2017

Findings related to ED physicians' ability to quickly identify a patient's disposition using System 1 cognitive processes (e.g., based on a visual exam and review of vitals) are mixed (Cabrera et al., 2015; Sibbald et al., 2017; Wiswell et al., 2013). Sibbald and colleagues aimed to understand how accurately and reliably ED physicians could diagnose and determine a

disposition for patients based on a visual assessment. They collected videos, vital signs, and the disposition decision from patients of varying acuity, age, and chief complaint. They then asked ED physicians to review the footage and chief complaint, in some cases, on a computer and press a button as soon as they could predict the disposition (Sibbald et al., 2017). Following this, ED physicians were asked to predict the patient's disposition, determine the degree to which the patient was "sick" or "not sick" on a continuum, and indicate how they came to their decisions on a "system processing" continuum ranging from "knew immediately" to "deliberated intently".

Researchers compared ED physicians' assessments with the patient's actual disposition. Through the use of an analysis of variance (ANOVA) and descriptive statistics, they found that ED physicians' assessments were usually formed within the first 11 seconds and were 55% accurate (Sibbald et al., 2017). They also determine that there was no relationship between time taken to make the decision and judgement accuracy.

Sibbald and colleagues concluded that "eyeballing, the rapid judgement of how sick a patient is based on only visual cues with no specific knowledge of the patient's illness, is related to eventual disposition" (p. 1144). Thus, they argue that ED physicians are able to use Systems 1 cognitive processing when determining a disposition decision. However, Sibbald and colleagues do note that their percent accuracy is lower than previous study and suggest that this could be due to social and environmental factors, such as patient preferences and access to care, that influence disposition decision-making (Cabrera et al., 2015; Wiswell et al., 2013). They note that such factors cannot be fully considered through a rapid decision-making process. As such, further investigation is needed to determine how, in practice, ED physicians make these decisions.

These findings are compelling in that they suggest that ED physicians are able to make somewhat accurate disposition decisions quickly with limited information (Sibbald et al., 2017). However, further work is needed to determine whether and how ED physicians use this "eyeballing" approach to inform their disposition decision-making in practice. As Sibbald and colleagues note in their discussion, there may be some social and environmental factors that influence the disposition decision that cannot be fully accounted for when observing an ED physician's internal cognitive processes. An approach that captures such factors, like a work systems approach, is needed to comprehensively identify all factors that influence disposition decision-making.

2.1.3.3.4 Rutkowski et al., 2020

Rutkowski and colleagues aimed to understand with whom and with what information ED attendings and residents make disposition decisions for older adults who present to the ED with a fall. Researchers conducted interviews with ED physicians immediately after patients were dispositioned to their next location and used an inductive content analysis to identify key categories of roles and information (Rutkowski et al., 2020). Rutkowski and colleagues reported that ED physicians cited involving seven different roles and using 11 different types of information, both clinical and non-clinical (Table 4).

Table 4: Summary of the roles involved and information used in the disposition decision (Rutkowski et al., 2020)

Roles involved	**Type of information used**
• ED resident • Off-going ED attending • Off-going ED resident • Off-going ED physician assistant • Internal consultant* • Family • Patient	• Lab/test results • Patient's ability to ambulate • Availability of support** • Safety of living situation • Family's preference • Nature (acuity) of patient's injuries • Level of care needed

* The authors defined an internal consultant as a non-ED provider within the hospital system, including trauma providers, orthopedic providers, neurology providers, ED observation providers and hospital medicine providers	• Patient's preference • Patient's pain • Internal consultant recommendations*** • Reason for fall ** The authors defined availability of support as the patient's access to formal (e.g., home health) or informal (e.g., family) assistance in their current living situation *** The authors defined internal consultant recommendations as the results of evaluations done by internal consultants

Researchers identified some consistency in roles reported among ED residents in that all ED residents reported involving an internal consultant (i.e., a non-ED physician within the hospital system) (Rutkowski et al., 2020). They also noted that the patient and family were seldom reported as a having role in the disposition decision-making process, affirming the notion that disposition decision-making is perceived as a physician process (Dyrstad et al., 2015; Lin et al., 2018; Pope et al., 2017). These findings provide an enumerated list of the roles and information ED physicians perceived involving and using in their disposition decision-making process. However, Rutkowski and colleagues note that they did not consider the organizational context within which ED physicians operate (e.g., policies, culture), which could influence the information used and roles consulted. As such, although an important first step, these findings offer minimal insight into how and why ED physicians engage certain roles and use certain information in their disposition decision-making. An approach that captures the full system, like a work systems approach, is needed to comprehensively identify how and within what parameters ED physicians operate.

2.1.3.3.5 Calder et al., 2012

Calder and colleagues mapped the process of disposition decision-making in the ED for high-acuity patients and identified opportunities for error across the process. Although disposition decision-making has been previously conceptualized as an attending physician process (Dyrstad et al., 2015; Lin et al., 2018; Pope et al., 2017), Calder and colleagues recognized that the process requires and involves numerous other roles include nurses, social workers, ED residents, and administrators. Researchers conducted six focus groups with the first five separated by role (e.g., ED residents, ED nurses) and the last consisting of a subset of members from the first five (Calder et al., 2012). Participants were asked to consider the case of a 50-year-old man with chest pain and to create a process map of the steps required to determine a disposition (Calder et al., 2012). Maps were analyzed and reconciled by the final focus group to produce a combined process map.

The process map consisted of the following decision points: triage/re-triage, disposition to ED location, primary nursing assessment and intervention, investigations, physician assessment/re-assessment, treatment, diagnosis, consultation, disposition, and discharge or admit (Calder et al., 2012). Through the development of the maps, the researchers noted that ED nurses and social workers believed that they were deeply involved in the disposition decision-making and were able to influence the final decision. In contrast, the map developed by the ED attending group featured minimum input from other ED staff and clinicians (Calder et al., 2012).

Calder and colleagues' process map represents an important first step in linking disposition decision-making to other key ED processes (e.g., diagnosis) and identifies important findings in terms of how clinicians perceive themselves as part of disposition decision-making. The authors claim that their goal was to explicate the process involved in disposition decision-

making. However, they offer little insight into how proceeding processes like triage and treatment influence disposition decision-making, other than simply proceeding it as part of the natural order of events that occur within an ED visit (Calder et al., 2012). The steps in the process map are presented as interacting series of tasks that evidently must be completed as part of disposition decision-making, but the authors do not provide a clear explanation as to how each step contributes to the overall disposition decision-making process nor how the disposition decision is made.

2.1.3.3.6 Capan et al., 2018

Capan and colleagues developed a decision map to understand "ED providers' disposition decision and risk tolerance of associated outcomes" (Capan et al., 2018, p. 450). As part of their process, Capan and colleagues conducted interviews using an "ad hoc methodology" (Capan et al., 2018, p. 451) to develop a decision map. The decision map contained the following decision points that highlight the interrelated nature of decisions in the ED: emergency severity index (ESI) level, ED core location assignment, diagnostic tests ordered, disposition decision, discharge decision, and admission location (Capan et al., 2018). In describing the contribution of the decision map, the authors note that the map "highlighted the connections between patient-, provider-, and system-related factors contributing to disposition decision-making" (Capan et al., 2018, p. 435). However, the decision map provides little insight into how such factors influence the disposition or disposition decision-making process. Capan and colleagues note the need for future research to explore the "relationship between provider characteristics, disposition decision process, and perception of potential consequences" (Capan et al., 2018, p. 453).

2.1.3.3.7 Summary and critical analysis of research on ED disposition decision-making

Findings from Probst et al., 2015, Pope et al., 2017, Sibbald et al., 2017, and Rutkowski et al., 2020 begin to characterize element that influence the disposition decision-making process. However, the description of the methods used in Probst et al., 2015 and Pope et al., 2017 make it difficult to fully interpret their findings. The findings from Sibbald et al., 2017 and Rutkowski et al., 2020 offer only a limited view of disposition decision-making as a process, tending to focus on a specific task or feature of disposition decision-making like rapid decision-making or information seeking. These four studies point to the need for more holistic approaches to fully capture the seemingly dynamic and interacting factors that influence disposition decision-making (Carayon et al., 2015).

Given their similarities, it is worth considering the work of Capan and colleagues and Calder and colleagues jointly. Interestingly, Capan and colleagues briefly cite the 2012 paper from Calder and colleagues in their introduction but fail to acknowledge that the contributions of the two papers are remarkably similar – that is both produce a map that features the decision points of disposition decision-making. The two papers focus on different features (i.e., Calder on potential sources of error and Capan on risk tolerance) and use different methods. Despite these differences, the two maps contain many of the same components. This validates the series of decision points that both sets of authors identify as contributing to or involved in disposition decision-making.

The work from Capan and colleagues and Calder and colleagues represents the majority of the work that has been done to understand disposition decision-making as a process. Both sets of authors situate the disposition decision-making process within the larger ED visit, identifying the processes that proceed and follow. These depictions are a necessary and critical first step in

understanding the disposition decision-making process and how it is influenced by the broader ED context. However, they offer minimal insight into how the nature of the work system influences disposition decision-making. Such insights are key for developing a more robust understanding of disposition decision-making (Calder et al., 2012).

Calder and colleagues call for a deeper understanding of "how we arrive at this decision" (Calder et al., 2012, p. 574) and suggest that multidisciplinary systems engineering and human factors approaches could lead to the development of "real-time reconstructions of these decisions to enrich the context" (Calder et al., 2012, p. 574). Capan and colleagues describe a need for a deeper understanding of the interaction among clinician characteristics, the decision-making process, and potential consequences or outcomes.

2.2 What role do decision-making models have in understanding disposition decision-making?

Given the gaps in the disposition decision-making literature, exploring the decision-making literature is necessary to situate disposition decision-making in the context of the psychological and cognitive theories and principles that underpin any decision. However, after an in-depth review of key decision-making models (i.e., naturalistic decision-making, transactive memory research, shared decision-making, heuristics) (Appendix A), I concluded that the decision-making literature would not be useful in addressing my research question for a variety of reasons.

First, many of the models have yet to be validated in a healthcare setting. Second, many of the models require assumptions that do not seem reasonable given what we know about the disposition decision-making process. For example, Beach and Mitchell's Image Theory, a naturalistic decision-making model, assumes that the decision-maker (e.g., the ED physician) is

able to envision and simulate a proposed plan and evaluate whether a plan, if implemented, will achieve its goals (Lipshitz, 1993). However, it may be difficult for ED physicians to fully consider the implications of dispositioning a patient to one location over another as there is often uncertainty about the type and quality of care a patient will receive in different settings (Werner et al., 2021).

Third, many of the models do not have the features needed to fully capture the complexity of the system within which disposition decision-making occurs. Decision-making models tend to focus on a specific aspect of the system (e.g., time pressure) or consider the decision-making environment independent of the decision-maker. In doing so, these models inadvertently introduce a boundary between what occurs "inside" the decision-maker's mind and "outside" of the decision-maker (Hutchins, 1995). Because cognitive processes, like decision-making, cannot be directly observed, this boundary can lead to the "impression that individual minds operate in isolation and encourages us to mistake the properties of complex sociotechnical systems for the properties of individual minds" (Hutchins, 1995, p. 355). This misattribution can lead to mischaracterization of the decision-making and the system within which decision-making occurs (Hutchins, 1995).

To overcome the challenges with this boundary, it is necessary to identify an approach that considers the interaction between the "inside" (i.e., the cognitive decision-making process) and the "outside" (i.e., context outside of the individual's mind within which the decision-making occurs). One such approach is distributed cognition. Distributed cognition "does not expect that…[cognitive] events be encompassed by the skin or skull of an individual" (Hutchins, 2000, p. 1). In other words, distributed cognition recognizes the interaction between the "inside" and the "outside" and "locates thought as an emergent property of people interacting with other

actors and the environment" (Lippa et al., 2017). Distributed cognition can be distributed in three primary ways: across individuals of a social group, across coordination between internal and external structure, or over time. The distribution of cognitive processes across time, space, boundaries, and individuals means that "in watching people thinking in [context], we may be learning as much about their environment…as about what is inside [of] them" (Hutchins, 2000, p. 9).

Hutchins (2000) points out that "humans create their cognitive powers in part by creating the environments in which they exercise those powers" (p. 9). As such, an approach that captures how the individual influences their physical, organizational, etc. surroundings and how those surroundings influence the individual is necessary. One domain that is equipped for exploring the interaction between the decision-making process and the system is macroergonomics.

2.3 Which work systems approach is optimal for capturing how the ED work system configures in times of low and high demand to produce disposition decision-making?

Since emerging as a recognized field of study in the 1940s, human factors "has been concerned with designing sociotechnical systems to optimize people's interaction with systems, tools, products, and environments" (Hendrick & Kleiner, 2001, p. 1). Formally, the field of human factors (HF) is defined as "the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design to optimize human well-being and overall system performance" (International Ergonomics Association, n.d.). Initially, the field of HF was focused on microergonomics or the optimization of the interactions between people and their working environment. However, in light of significant societal changes in the 1970s and 1980s (e.g.,

advances in technology, an aging workforce, previous failings of more traditional ergonomic approaches), HF researchers found that "it was entirely possible to do an outstanding job of ergonomically designing a system's components…but fail to reach relevant system effectiveness goals" (Hendrick & Kleiner, 2001, p. 2). This led to the formalized study of macroergonomics, which is now considered a subdiscipline of human factors (Hendrick & Kleiner, 2001).

Macroergonomics can also be conceptualized as both a science and a practice. As a science, macroergonomics "develops knowledge about human performance capabilities, limitations, and other characteristics as they relate to the design of interfaces between people and other systems components. As a practice, [macro]ergonomics concerns the application of human-system interface technology to the design or modification of systems to enhance system safety, comfort, effectiveness, and quality of life" (Hendrick, 1991, p. 745-746). Macroergonomics draws from the sociotechnical systems (STS) tradition to provide "a holistic [human factors and ergonomics] HFE approach to improve system performance and well-being" (Carayon et al., 2015, p. 576; Hendrick & Kleiner, 2001). STS theory suggests that every organization is "made up of people (the social system) using tools, techniques and knowledge (the technical system) to produce goods or services valued by customers (who are part of the organization's external environment)" (Pasmore, 1988, p. 1). Accordingly, "an organization can achieve high [system] performance and [human] well-being if the technical and social subsystems are designed with regard to each other and with consideration of the external environment" (Carayon et al., 2015, p. 574).

The origins of STS can be traced to the long-wall coal mining studies conducted in the 1940s and 1950s by the Tavistock Institute in the United Kingdom (Hendrick & Kleiner, 2001). In these foundational studies, Trist and Bamforth conducted interviews and discussions with coal

workers, managers, and psychiatrists familiar with the problems faced by miners to understand why, despite the improved technology, wages, and amenities, productivity and interest in mining was low (Trist & Bamforth, 1951). Prior, miners performed work in small face-to-face groups, which allowed groups to be autonomous and adapt their work according to dynamic conditions (Trist & Bamforth, 1951). This approach afforded flexibility of the work, required a variety of manual and rotating tasks, and led to the development of social relationships among group members (Trist & Bamforth, 1951). A newly implemented method introduced a new work system structure such that work was split across three different shifts. Each shift performed different tasks, which resulted in miners being unable to rotate tasks and limited social interaction (Trist & Bamforth, 1951). Workers were spread out temporally and spatially which did not allow for the maintenance of the original group dynamics (Trist & Bamforth, 1951). As such, both productivity and miner well-being suffered (Carayon et al., 2015).

These findings highlighted the importance of acknowledging and designing for the interaction among the social system, the technical system, and the external environment to fulfill the dual objective of human factors - to optimize system performance and well-being. (Carayon et al., 2015; International Ergonomics Association, n.d.). Carayon and colleagues note that "because the technical subsystem and the social subsystem interact with each other and both are influenced by the external environment (joint causation), the overall sociotechnical system will be most effective if the two social and technical subsystems are optimized together (joint optimization)" (2015, p. 575). Joint optimization is the notion that mutual positive outcomes (or lack of negative outcomes) can be simultaneously achieved for both the social and technical systems through thoughtful system design (Trist & Bamforth, 1951).

To provide a holistic mechanism to conceptualize the work system and elemental interactions and explore the extent to which a system is optimized, Smith and Carayon-Sainfort proposed the Balance Theory of Job Design (1989). Balance Theory is a macroergonomic model that recognizes the need to *balance* job demands and appeal to higher level or ego needs to protect against stress and ensure that the work is fulfilling (Smith & Carayon-Sainfort, 1989). The model consists of five interacting elements that compose the work system including person, tools and technology, organization, task, and environment, with the person at the center (Smith & Carayon-Sainfort, 1989). These elements interact and can "balance" one another. The model acknowledges that the work environment, task demands, and individual resources may change over time, meaning that the configuration of the work system may change depending on the status of each of these elements to achieve balance (Smith & Carayon-Sainfort, 1989).

"Balance" can refer to balance of the entire system or compensatory balance (Carayon et al., 2015, p. 578). Overall system balance draws from the notion that work system elements interdependently influence outcomes (Carayon et al., 2015). As such, the system can become balanced when all elements of the work system and elemental interactions are considered (Carayon et al., 2015). Overall balance occurs when "the overall combination of positive and negative elements produces more benefits than problems for system outcomes (e.g., patient safety and worker well-being)" (Carayon et al., 2014, p. 13). As an example, "a major change in technology may create both positive (e.g., better access to information) and negative (e.g., possibility of electronic performance monitoring) outcomes for workers; however, the overall work system with the new technology may be balanced because it has sufficient positive elements that minimize the consequences of the negative elements" (Carayon et al., 2015, p. 578).

Compensatory balance refers to the atonement or counteraction that takes place when positive aspects of work offset negative aspects of work to achieve balance (Smith & Carayon-Sainfort, 1989). Realistically, "it may not be possible to eliminate all stressors" or obstacles (Carayon et al., 2015, p. 578). When this occurs, "other elements in the work system need to be addressed to mitigate the negative impact of this obstacle" (Carayon et al., 2014, p. 13). Thus, compensatory balance occurs "when one positive element 'compensates' for negative elements in the work system" (Carayon et al., 2014, p. 13).

With an understanding of how the work system can be depicted, researchers developed system models to connect the work system to the process and outcomes produced. Carayon and colleagues developed a dynamic, open systems model by integrating the work system (i.e., Balance Theory) and Donabedian's structure-process-outcome (SPO) model to produce the Systems Engineering Initiative for Patient Safety (SEIPS) model (Carayon et al., 2006; Donabedian, 1966; Smith & Carayon-Sainfort, 1989). The SEIPS model includes a set of five elements that interact to produce processes that produce outcomes that then feed back into the work system (Carayon et al., 2006). The work system consists of the person(s), organization, physical environment, tasks, and tools and technology (Carayon et al., 2006). Processes refer to care processes and all other related processes (e.g., housekeeping) (Carayon et al., 2006). Outcomes consist of patient outcomes (i.e., quality of care and patient safety) and employee and organizational outcomes (e.g., performance, quality of working life) (Carayon et al., 2006).

In response to a shift in the healthcare system toward a patient-centered model of care, SEIPS was adapted by both Carayon and colleagues (2014) and Holden and colleagues (2013). Carayon and colleagues (2014) offered a number of clarifications to the original SEIPS model. First, to acknowledge "the major role of regulatory, professional and consumer/patient groups [have] in

healthcare delivery", Carayon and colleagues clearly defined and explicitly added "external environment" as an element to the work system (Carayon et al., 2014, p. 3). Citing the work of Karsh (2006) and Kleiner (2006; 2008), Carayon and colleagues defined external environment as "extra-organizational rules, standards, legislation, and enforcement, as well as characteristics of the healthcare industry in general and the healthcare workforce" (Carayon et al., 2014, p. 3). Second, Carayon and colleagues reaffirm that the "person at the center" element may include patients, their family caregivers, healthcare professionals, and groups.

Likewise, SEIPS 2.0 maintains the key properties and structure of the original SEIPS model but includes clarifications and additions that expand the original model (Holden et al., 2013). First, like Carayon and colleagues (2014), SEIPS 2.0 includes the work system component "external environment", "which incorporates macro-level societal, economic, ecological, and policy factors outside an organization" (Holden et al., 2013, p. 5). Second, Holden and colleagues expanded on the concept of feedback loops through the addition of *adaptation*. Adaptation refers to the ability of the work system to change based on feedback (Holden et al., 2013). Third, the authors integrated the concept of *engagement*. Engagement allows for the differentiation of work based on who is involved in performing work activities (Holden et al., 2013). This includes professional, patient and informal caregiver, and collaborative work (Holden et al., 2013).

Fourth, Holden and colleagues highlighted the concept of *configuration*. Configuration suggests that "… only a subset of all possible [element] interactions is actually relevant in a given work process or situation … Thus, for a particular process or situation, one can distinguish a configuration of a finite number of relevant elements that interact to strongly shape the performance *of that process"* (Holden et al., 2013, p. 6). This concept allows for a more precise

definition of influential components of each process. Holden and colleagues offer a limited commentary on how to operationalize configuration using configural diagrams, with only a small number of researchers using configuration in their work to date (Hay et al., 2020; Werner et al., 2020). However, Holden and colleagues argue that configuration, specifically configural diagramming, can be used to compare two work systems to identify potential differences in process performance (Holden et al., 2013). Additional work is needed to fully understand how to create configural diagrams and define the circumstances in which they would be most useful.

Most recently, Carayon and colleagues developed SEIPS 3.0, which explores the work system, process, and outcomes in terms of the patient journey. SEIPS 3.0 depicts the spatio-temporal distribution of patients' interactions within and across multiple care settings (Carayon et al., 2020). Carayon and colleagues also offer an expanded definition of outcomes to include caregiver outcomes and expanded on feedback to include adaptation, learning, and improvements.

In summary, the SEIPS models are powerful tools that "can provide useful information on how to redesign work systems in order to improve care processes and subsequently, patient [provider, and healthcare organization] outcomes" (Carayon et al., 2014, p. 8). The SEIPS models have the potential to facilitate a deeper understanding of the effect different system structures have on the disposition decision-making process (Calder et al., 2012; Capan et al., 2018). Specifically, configuration and configural diagrams have the potential to capture and compare different states of the same work system to identify how the ED work system configures in times of low work pressure and high work pressure to produce the disposition decision-making process.

2.5 Summary

In this review, I have presented a summary of the previous work on disposition decision-making and outlined gaps in the literature. I concluded that the decision-making literature that I reviewed would not be able to capture the marco-level context needed to fully understand how ED clinicians make disposition decisions under different varied demands. Given the gaps in the decision-making literature that I reviewed, I outlined how a work systems approach is needed to achieve a richer understanding of how the ED work system configures in times of low and high demand to produce the disposition decision-making process.

2.6 Chapter 2 references

Agency for Healthcare Research and Quality (2011). *Disposition of Patient*. Retrieved 06/11/22 from https://ushik.ahrq.gov/ViewItemDetails?system=mdr&itemKey=65837000

Aminzadeh, F., & Dalziel, W. B. (2002). Older adults in the emergency department: a systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. *Ann Emerg Med*, *39*(3), 238-247. https://doi.org/10.1067/mem.2002.121523

Bragard, I., Dupuis, G., & Fleet, R. (2015). Quality of work life, burnout, and stress in emergency department physicians: a qualitative review. *European Journal of Emergency Medicine*, *22*(4). https://journals.lww.com/euro-emergencymed/Fulltext/2015/08000/Quality_of_work_life,_burnout,_and_stress_in.1.aspx

Burton, J. H., Young, J., & Bernier, C. A. (2014). The Geriatric ED: Structure, Patient Care, and Considerations for the Emergency Department Geriatric Unit. *International Journal of Gerontology*, *8*(2), 56-59. https://doi.org/10.1016/j.ijge.2014.01.002

Cabrera, D., Thomas, J. F., Wiswell, J. L., Walston, J. M., Anderson, J. R., Hess, E. P., & Bellolio, M. F. (2015). Accuracy of 'My Gut Feeling:' Comparing System 1 to System 2 Decision-Making for Acuity Prediction, Disposition and Diagnosis in an Academic Emergency Department. *West J Emerg Med*, *16*(5), 653-657. https://doi.org/10.5811/westjem.2015.5.25301

Calder, L. A., Forster, A., Nelson, M., Leclair, J., Perry, J., Vaillancourt, C., Hebert, G., Cwinn, A., Wells, G., & Stiell, I. (2010). Adverse events among patients registered in high-acuity areas of the emergency department: a prospective cohort study. *Cjem*, *12*(5), 421-430. https://doi.org/10.1017/s1481803500012574

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576.e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Capan, M., Pigeon, J., Marco, D., Powell, J., & Groner, K. (2018). We all make choices: A decision analysis framework for disposition decision in the ED. *The American Journal of Emergency Medicine*, *36*(3), 450-454. https://doi.org/https://doi.org/10.1016/j.ajem.2017.11.018

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Qual Saf Health Care*, *15 Suppl 1*, i50-58. https://doi.org/10.1136/qshc.2005.015842

Carayon, P., Wooldridge, A., Hoonakker, P., Hundt, A. S., & Kelly, M. M. (2020). SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Appl Ergon*, *84*, 103033. https://doi.org/10.1016/j.apergo.2019.103033

Charon, J. M. (2010). *Symbolic interactionism: An introduction, an interpretation, an integration*. Pearson College Division.

Coleman, E. A., & Berenson, R. A. (2004). Lost in transition: challenges and opportunities for improving the quality of transitional care. *Ann Intern Med*, *141*(7), 533-536. https://doi.org/10.7326/0003-4819-141-7-200410050-00009

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications.

Devers, K. J. (1999). How will we know" good" qualitative research when we see it? Beginning the dialogue in health services research. *Health services research*, *34*(5 Pt 2), 1153.

Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank memorial fund quarterly*, *44*(3), 166-206.

Dyrstad, D. N., Testad, I., & Storm, M. (2015). Older patients' participation in hospital admissions through the emergency department: an interview study of healthcare professionals. *BMC Health Services Research*, *15*(1), 1-9.

Fernando, S. M., Rochwerg, B., Reardon, P. M., Thavorn, K., Seely, A. J. E., Perry, J. J., Barnaby, D. P., Tanuseputro, P., & Kyeremanteng, K. (2018). Emergency Department disposition decisions and associated mortality and costs in ICU patients with suspected infection. *Crit Care*, *22*(1), 172. https://doi.org/10.1186/s13054-018-2096-8

Frumkin, K. (2020). Toppling oranges: death, disability, decline, and readmission of community-dwelling elderly patients after an emergency department visit. *The Journal of emergency medicine*, *58*(2), 339-345.

Gabayan, G. Z., Gould, M. K., Weiss, R. E., Patel, N., Donkor, K. A., Chiu, V. Y., Yiu, S. C., Jones, J. P., Hoffman, J. R., & Sarkisian, C. A. (2016). Poor Outcomes After Emergency Department Discharge of the Elderly: A Case-Control Study. *Ann Emerg Med*, *68*(1), 43-51.e42. https://doi.org/10.1016/j.annemergmed.2016.01.007

Guba, E. G., & Lincoln, Y. S. (2001). Guidelines and checklist for constructivist (aka fourth generation) evaluation. In.

Hay, G. J., Klonek, F. E., & Parker, S. K. (2020). Diagnosing rare diseases: A sociotechnical approach to the design of complex work systems. *86*, 103095. https://www.sciencedirect.com/science/article/pii/S0003687020300582

Hendrick, H. W. (1991). Ergonomics in organizational design and management. *Ergonomics*, *34*(6), 743-756. https://doi.org/10.1080/00140139108967348

Hendrick, H. W., & Kleiner, B. M. (2001). *Macroergonomics - An Introduction to Work System Design* The Human Factors and Ergonomics Society.

Holden, R. J., Carayon, P., Gurses, A. P., Hoonakker, P., Hundt, A. S., Ozok, A. A., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*(11), 1669-1686. https://doi.org/10.1080/00140139.2013.838643

Hutchins, E. (1995). *Cognition in the Wild*. MIT press.

Hutchins, E. (2000). Distributed cognition. *International Encyclopedia of the Social and Behavioral Sciences*, *138*.

International Ergonomics Association (n.d.). *Definition, Domains of Specialization, Systemic Approach*. https://iea.cc/definition-and-domains-of-ergonomics/

Karsh, B. T., Holden, R. J., Alper, S. J., & Or, C. K. L. (2006). A human factors engineering paradigm for patient safety: designing to support the performance of the healthcare professional. *BMJ Quality & Safety*, *15*(suppl 1), i59-i65.

Kleiner, B. M. (2006). Macroergonomics: analysis and design of work systems. *Applied ergonomics*, *37*(1), 81-89.

Kleiner, B. M. (2008). Macroergonomics: work system analysis and design. *Human factors, 50*(3), 461-467.

Lippa, K. D., Feufel, M. A., Robinson, F. E., & Shalin, V. L. (2017). Navigating the Decision Space: Shared Medical Decision Making as Distributed Cognition. *Qualitative Health Research*, *27*(7), 1035-1048.

Lin, M. P., Natsui, S., Sinnette, C., Ball, A., Weissman, J. S., & Schuur, J. D. (2018). Facilitators and Barriers to Reducing Emergency Department Admissions for Chest Pain: A Qualitative Study. *Critical Pathways in Cardiology*, *17*(4), 201-207.

Lipshitz, R. (1993). Converging themes in the study of decision making in realistic settings. *Decision making in action: Models and methods*, 103-137.

McCusker, J., Roberge, D., Vadeboncoeur, A., & Verdon, J. (2009). Safety of discharge of seniors from the emergency department to the community. *Healthc Q*, *12 Spec No Patient*, 24-32. https://doi.org/10.12927/hcq.2009.20963

Nadal, G., Prepoudis, A., Miró, O., Matas, A., Cepas, P., Aldea, A., Izquierdo, M., Viladot, J., Flores, D., Gualandro, D., Müller, C., & Lopez-Barbeito, B. (2020). Clinical features of pericarditis with and without myocardial involvement diagnosed in the emergency department and factors associated with need for hospitalization. *Emergencias*, *32*, 97-104.

Nelson, D., Washton D Fau - Jeanmonod, R., & Jeanmonod, R. (2013). Communication gaps in nursing home transfers to the ED: impact on turnaround time, disposition, and diagnostic testing. *The American Journal of Emergency Medicine*, *31*(4), 712-716.

Neyman, G., & Dalsey, W. (2021). A Quantification of the Impact of Awaiting Results of a Urinalysis upon Emergency Department Length of Stay. *The Journal of Emergency Medicine*, *60*(2), 158-164. https://doi.org/https://doi.org/10.1016/j.jemermed.2020.10.004

Pasmore, W. A. (1988). *Designing effective organizations: The sociotechnical systems perspective* (Vol. 6). Wiley.

Pope, I., Burn, H., Ismail, S. A., Harris, T., & McCoy, D. (2017). A qualitative study exploring the factors influencing admission to hospital from the emergency department. *BMJ open*, *7*(8), e011543.

Probst, M. A., Kanzaria, H. K., Hoffman, J. R., Mower, W. R., Moheimani, R. S., Sun, B. C., & Quigley, D. D. (2015). Emergency Physicians' Perceptions and Decision-making

Processes Regarding Patients Presenting with Palpitations. *J Emerg Med*, *49*(2), 236-243.e232. https://doi.org/10.1016/j.jemermed.2015.02.013

Probst, M. A., Kanzaria, H. K., Schoenfeld, E. M., Menchine, M. D., Breslin, M., Walsh, C., Melnick, E. R., & Hess, E. P. (2017). Shared Decisionmaking in the Emergency Department: A Guiding Framework for Clinicians. *Ann Emerg Med*, *70*(5), 688-695. https://doi.org/10.1016/j.annemergmed.2017.03.063

Ringer, T., Dougherty, M., McQuown, C., Melady, D., Ouchi, K., Southerland, L. T., & Hogan, T. M. (2018). White Paper-Geriatric Emergency Medicine Education: Current State, Challenges, and Recommendations to Enhance the Emergency Care of Older Adults. *AEM Educ Train*, *2*(Suppl Suppl 1), S5-s16. https://doi.org/10.1002/aet2.10205

Roskos, E., & Wilber, S. (2006). 210: The effect of future demographic changes on emergency medicine. *Annals of Emergency Medicine*, *48*(4), 65.

Rutkowski, R. A., Salwei, M., Barton, H., Wust, K., Hoonakker, P., Brenny-Fitzpatrick, M., King, B., Shah, M. N., Pulia, M. S., & Patterson, B. W. (2020). Physician Perceptions of Disposition Decision-making for Older Adults in the Emergency Department: A Preliminary Analysis. Proceedings of the Human Factors and Ergonomics Society Annual Meeting,

Sibbald, M., Sherbino, J., Preyra, I., Coffin-Simpson, T., Norman, G., & Monteiro, S. (2017). Eyeballing: the use of visual appearance to diagnose 'sick'. *Med Educ*, *51*(11), 1138-1145. https://doi.org/10.1111/medu.13396

Smith, M. J., & Sainfort, P. C. (1989). A balance theory of job design for stress reduction. *International journal of industrial ergonomics*, *4*(1), 67-79.

Stiell, A., Forster, A. J., Stiell, I. G., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. *Cmaj*, *169*(10), 1023-1028.

Strange, G. R., & Chen, E. H. (1998). Use of emergency departments by elder patients: a five-year follow-up study. *Acad Emerg Med*, *5*(12), 1157-1162. https://doi.org/10.1111/j.1553-2712.1998.tb02688.x

Strauss, A. L. (1987). *Qualitative Analysis for Social Scientists*. Cambridge: Cambridge University Press.

Suffoletto, B., Miller, T., Shah, R., Callaway, C., & Yealy, D. M. (2016). Predicting older adults who return to the hospital or die within 30 days of emergency department care using the ISAR tool: subjective versus objective risk factors. *Emerg Med J*, *33*(1), 4-9. https://doi.org/10.1136/emermed-2014-203936

Trist, E. L., & Bamforth, K. W. (1951). Some Social and Psychological Consequences of the Longwall Method of Coal-Getting: An Examination of the Psychological Situation and Defences of a Work Group in Relation to the Social Structure and Technological Content of the Work System. *Human Relations*, *4*(1), 3-38. https://doi.org/10.1177/001872675100400101

Vinson, D., Engelhart, D., Bahl, D., Othieno, A., Abraham, A., Huang, J., Reed, M., Swanson, W., Clague, V., Cotton, D., Krauss, W., & Mark, D. (2020). Presyncope Is Associated with Intensive Care Unit Admission in Emergency Department Patients with Acute Pulmonary Embolism. *Western Journal of Emergency Medicine*, *21*. https://doi.org/10.5811/westjem.2020.2.45028

Werner, N. E., Rutkowski, R., Graske, A., Finta, M. K., Sellers, C. R., Seshadri, S., & Shah, M. N. (2020). Exploring SEIPS 2.0 as a model for analyzing care transitions across work systems. *Appl Ergon*, *88*, 103141. https://doi.org/10.1016/j.apergo.2020.103141

Werner, N. E., Rutkowski, R. A., Krause, S., Barton, H. J., Wust, K., Hoonakker, P., ... & Carayon, P. (2021). Disparate perspectives: Exploring healthcare professionals' misaligned mental models of older adults' transitions of care between the emergency department and skilled nursing facility. *Applied Ergonomics*, *96*, 103509.

Wiswell, J., Tsao, K., Bellolio, M. F., Hess, E. P., & Cabrera, D. (2013). "Sick" or "not-sick": accuracy of System 1 diagnostic reasoning for the prediction of disposition and acuity in patients presenting to an academic ED. *Am J Emerg Med*, *31*(10), 1448-1452. https://doi.org/10.1016/j.ajem.2013.07.018

Chapter 3: Research question

3.1 Research question

As outlined in Chapter 2, despite the influence disposition decision-making has on the health and well-being of older adults', research on disposition decision-making is limited. The few papers that aim to characterize disposition decision-making are limited in scope and/or in methodology. As such, there does not exist a comprehensive conceptualization of how system elements (e.g., ED physician characteristics), the decision-making process, and potential outcomes interact to yield a disposition decision in light of extreme system conditions (Calder et al., 2012; Capan et al., 2018). Establishing a comprehensive understanding of the ED work system that produces the disposition decision-making process under extreme conditions will allow for the development of interventions and system redesigns that are adaptive to the ever-changing demands of the ED.

Using a work systems approach, specifically the concepts of configuration, I explored the following research question: How does the ED work system configure under conditions of high and low demand to produce the ED disposition decision-making process for older adults?

3.2 Chapter 3 references

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576.e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Capan, M., Pigeon, J., Marco, D., Powell, J., & Groner, K. (2018). We all make choices: A decision analysis framework for disposition decision in the ED. *The American Journal of Emergency Medicine*, *36*(3), 450-454. https://doi.org/https://doi.org/10.1016/j.ajem.2017.11.018

Chapter 4: Worldview

4.1 Researcher's worldview

To develop and carry out a research proposal, researchers must determine the methodologies and methods they will use to address their research questions and how they will justify their choice and use of those methodologies and methods (Crotty & Crotty, 1998). A researcher's epistemology or worldview informs their perception and assumptions about reality (Crotty & Crotty, 1998). These perceptions and assumptions determine what a researcher believes to be possible through research: What kind of knowledge is produced by research? What characteristics does this knowledge have? What assumptions do readers need to know to responsibly interpret a researcher's work?

The range of worldviews can be conceptualized on a continuum ranging from objectivism (e.g., positivism) to subjectivism (e.g., critical inquiry). As a researcher, I identify as a constructionist, which resides somewhere in between objectivism and subjectivism and is associated with both qualitative and quantitative methods. As the name suggests, constructionism is the *construction* as opposed to the discovery of meaning (Crotty & Crotty, 1998). This perspective informs the belief that objects (e.g., physical things, processes) do not have inherent meaning but rather humans assign meaning to objects according to their experience and interpretation (Creswell & Poth, 2016; Crotty & Crotty, 1998).

Operationally, constructionism focuses on participants' views of a situation. For example, in the case of qualitative methods, this could mean asking general and broad questions to facilitate a participant's iterative and real-time construction of a situation (Creswell & Poth, 2016). Researchers with a constructionist worldview aim to integrate participants' social, historical, and personal context (Creswell & Poth, 2016; Crotty & Crotty, 1998). Because

interpretation occurs within the researcher and within the interaction between the researcher and participant, the researcher's social, historical, and personal context must also be considered. Although a constructionist approach is often associated with methodologies like grounded theory, ethnography, and phenomenology (Creswell & Poth, 2016; Crotty & Crotty, 1998), my affinity for constructionism stems from an inherent belief that I, as a researcher, have the responsibility to share the stories and experiences of individuals in the form truest to how they experience the world. Further, I believe that the openness and inductiveness associated with constructionism was necessary in my exploration of disposition decision-making given that there are many unexplored questions.

4.2 Chapter 4 references

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

Crotty, M., & Crotty, M. F. (1998). *The foundations of social research: Meaning and perspective in the research process*. Sage.

Chapter 5: A scoping review of emergency department disposition decision-making

This chapter is presented in the form of a manuscript prepared for *Human Factors in Healthcare.*

5.1 Introduction

Emergency department (ED) disposition decision-making is a critical juncture in a patient's care journey. A patient's disposition decision determines to what level of care and support they will transition and dictates the likelihood of achieving favorable care outcomes post-disposition (Capan et al., 2018; Agency for Healthcare Research and Quality, 2011). For instance, when vulnerable patient populations such as older adults are not dispositioned to the optimal location following an ED visit, they become susceptible to a myriad of sub-optimal outcomes such as repeat ED visits (Costa et al., 2014), in-hospital mortality (Fernando et al., 2018; Mitra et al., 2012), increased healthcare costs (Fernando et al., 2018), and mortality (Chamberlain & Pollack, 1998; Stiell et al., 2013). As such, ensuring that patients are dispositioned to the location that best supports their future care needs is vital to promoting patient safety and healthcare quality.

However, disposition decision-making can be challenging as the ED is a complex and dynamic environment with interruptions; continuous, changing and competing demands; time and space limitations; high patient acuity; and decisions that need to be made interdependently, frequently, and readily with limited information and resources (Daniels et al., 2018; Nugus & Braithwaite, 2010; Nugus et al., 2014; Stiell et al., 2003; Wears & Leape, 1999; Wears et al., 2010). Taken together, these characteristics can lead to significantly high demands on physicians (Weigl et al., 2016). However, we do not yet have a comprehensive understanding of "how we

arrive at this decision," meaning we do not yet have the information we need to inform the development of interventions to support this clinical decision (Calder et al., 2012, p. 547).

Although disposition decision-making is, in part, a cognitive process, research from fields such as naturalistic decision-making, distributed cognition, and work systems theory reinforce that individuals do not operate independent of their context (Carayon, 2009; Hendrick & Kleiner, 2001; Hutchins, 1995; Hutchins, 2000; Klein, 2008; Lippa et al., 2017). Instead, individuals compose, influence, and are influenced by the work systems within which they operate (Carayon et al., 2006). As such, decision-making should not be conceptualized as occurring exclusively within "the skin or skull of an individual" (Hutchins, 2000). Rather, thought should be seen as "an emergent property of people interacting with other actors and the environment" (Lippa et al., 2017, p. 1035).

Yet, because the cognitive act of decision-making cannot be directly observed, we are often left with the "impression that individual minds operate in isolation," which "encourages us to mistake the properties of complex sociotechnical systems for the properties of individual minds" (Hutchins, 1995, p. 355). This misattribution can lead to mischaracterization of the decision-making process and the interconnected systems that influences it (Hutchins, 1995). To avoid this mischaracterization, we must take a work systems approach to meaningfully characterize cognitive processes across time, space, boundaries, and individuals. By "watching people thinking in [context], we may be learning as much about their environment…as about what is inside [of] them" (Hutchins, 1995, p. 9).

However, our understanding of the ED work system that produces the disposition decision-making process is limited (Calder et al., 2012; Capan et al., 2018; Rutkowski et al., 2020). First, there are a limited number of studies that focus on the ED disposition decision-

making process. Further exacerbating the limited literature is the varied language used to describe disposition decision-making (e.g., admission decision, transfer decision), which makes studies difficult to identify. Second, of the studies that exist, none have holistically characterized the ED work system that produces the disposition decision-making process. Rather, some studies have focused on describing the incremental or discrete steps of the disposition decision-making process (Calder et al., 2012; Capan et al., 2018). Others have focused on a specific task or feature of disposition decision-making like the ability to engage in rapid decision-making or information seeking (Rutkowski et al., 2020; Sibbald et al., 2017).

Although these studies offer important insights about how the ED disposition decision-making process occurs procedurally or at the individual work system level, they offer limited holistic insights into work system that informs disposition decision-making. As a first step, we must converge previous findings using a work systems approach. A work systems approach will permit the systematic characterization of previous work to produce a "state of the knowledge" of which element compose the ED work system and how previous work conceptualizes the influence each element has the disposition decision-making process.

The Systems Engineering Initiative for Patient Safety Model (SEIPS) is a work systems model that characterizes processes by way of the people who perform relevant tasks using tools and technologies within an organization, physical environment, and external environment (Carayon et al., 2006). Given its holistic approach, the SEIPS model is well-equipped to capture the complexity and nuances of distributed cognitive processes, like disposition decision-making. Further, the SEIPS model has demonstrated utility in characterizing the work system of other clinical processes (e.g., interruptions, medication errors) (Frith, 2013; Werner & Holden, 2015). The goal of the present study is to use the SEIPS model to elucidate what previous studies have

learned about ED disposition decision-making and expose gaps in our understanding of the ED work system that warrant further investigation. Such an understanding can identify and facilitate opportunities for work system redesign to promote optimal patient, clinician, and organizational outcomes (Carayon et al., 2006). Thus, the objective of this scoping review is to identify and synthesize what previous studies reveal about the elements that compose the ED work system that influences the ED disposition decision-making process.

5.2 Methods

We conducted a scoping review of peer-reviewed studies focused on the disposition decision-making process in the ED. We selected a scoping review as it best aligned with the objective of summarizing the quantity and quality of the disposition decision-making literature (Grant, 2009).

5.2.1 Search strategy

Our search strategy was developed iteratively in collaboration with an expert health sciences librarian with the input from ED physician researchers and human factors researchers. We conducted searches in the following databases: PubMed, Scopus, Web of Science, CINAHL, and PyschInfo. Our search included papers published between January 1995 and May 2022. We limited our review to include peer-reviewed journal publications and conference proceedings published in English. The strategy included key terms such as emergency medicine, decision, decision-making, admission, discharge, and transfers (Appendix B).

5.2.2 Inclusion and exclusion criteria

We included articles that met the following criteria: based in the ED, related to disposition decision-making in the ED, focused on an adult population (i.e., aged 18+). If the study included both adult and pediatric patient populations, at least 50% of the participants or study sites must have been adult-focused. We excluded studies that met any of the following criteria: related to civil detention or involuntary hospitalization, related to a psychiatric complaint, related to response to intentional harm (e.g., intentional drug overdose, attempted suicide), related to leaving against medical advisement, related to "forensic" patients (e.g., patients who are incarcerated), focused on maternal and newborn health, or if more than 50% of participants were non-ED clinicians or patients. We elected to exclude these patient populations and circumstances as the decision-making process for these populations is likely to be highly specialized.

5.2.3 Study selection

Articles identified in the database searches were uploaded to Covidence for screening. We screened articles at the title, abstract, and full-text level. Each article was screened by at least two trained reviewers. A third reviewer resolved conflicts. The coding team met weekly to discuss the progress of the review, update eligibility criteria, and resolve any outstanding conflicts. We removed studies that were duplicates or that met exclusion criteria.

5.2.4 Data extraction and synthesis

The research team developed a data extraction form in Excel. The form was piloted on a subset of articles to ensure efficacy and establish consensus among reviewers in its use. The form

consisted of two parts: 1) demographic data: objective, setting, hypothesis (if present), the patient population of focus (if applicable), study design, and study sample; and 2) the six SEIPS work systems components: person, task, tools and technology, organization, physical environment, and external environment (Carayon et al., 2006).

Once the data were extracted, a team of reviewers underwent an affinity diagramming process to identify categories of work system elements within each component. The goal of this affinity diagraming process was to identify similarities and differences among the extracted data to synthesize article findings. This process involved documenting each extracted finding on a sticky note. Each sticky note included the work system component(s) that characterized the finding, a summary of the element, and the article citation. An example of the type of content included on a sticky note includes: Organization: Social admissions were common when it was unclear whether the patient could be safe at home (Pope et al., 2017). Reviewers began by individually organizing work system elements within the same component according to similarity (e.g., numerous articles noted the importance of the patient's ability to access follow up care following an ED visit). The reviewers then discussed each emergent category and assigned a label to describe the category content.

5.2.5 Risk of bias

We used the risk of bias on systematic reviews (ROBIS) tool to identify and assess concerns in the review process, which has shown utility in assessing bias in scoping reviews (Liebzeit et al., 2021; Whiting et al., 2016). We categorized concerns with respect to the review process into the following categories: article eligibility, criteria, identification and selection of articles, data collection and study appraisal, and synthesis and findings (Whiting et al., 2016).

5.2.5.1 Article eligibility criteria

We identified the objectives of the review and the associated inclusion/exclusion criteria a priori. Thus, concern with respect to specification of article eligibility criteria was low (Whiting et al., 2016).

5.2.5.2 Identification and selection of articles

Our search was conducted by a trained health sciences librarian which facilitated "an unbiased selection of studies based on the search results…to ensure that all relevant studies identified by the searches" were included in our review (Whiting et al., 2016, p. 230). We developed a broad search strategy with ED physician researchers to include all terms known to describe disposition decision-making (e.g., admission, discharge, transfer, disposition). We ran our search in multiple databases. We also manually screened the bibliographies of all included studies to identify any additional studies that met our criteria. At each stage of the review screening process (i.e., title, abstract, full text), articles were screened by at least two reviewers. Thus, concern with respect to the identification and selection of articles is low (Whiting et al., 2016).

5.2.5.3 Data collection and study appraisal

A data extraction form was developed prior to data collection and was piloted on a subset of studies. Articles were extracted by two reviewers. Thus, concern with respect to data collection and study appraisal is low (Whiting et al., 2016).

5.2.5.4 Synthesis and findings

Data were synthesized using a rigorous affinity diagramming process carried out by three researchers trained in sociotechnical systems theory and qualitative methods. Thus, concern with respect to synthesis and findings is low.

Given the aforementioned strategies used to mitigate bias, the overall risk of bias in this review is low (Whiting et al., 2016).

5.3 Results

5.3.1 Search results

Our search resulted in 5,345 articles. Figure 5.1 depicts the outcomes screening process. Ultimately, 25 studies were included in this review.

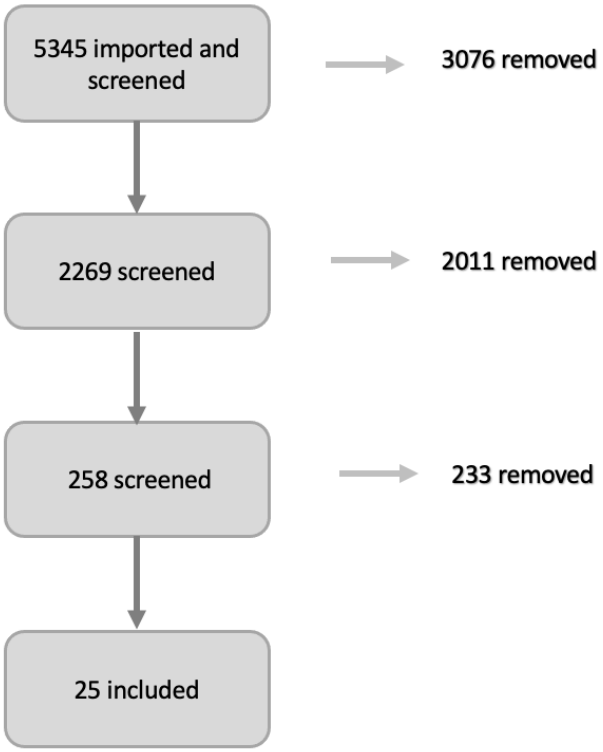

Figure 5.1: Prisma diagram

5.3.1 Setting and design characteristics

Table 5.1 outlines the key characteristics of included studies. Most studies took place in the United States (n=16), Canada (n=3), or the United Kingdom (n=4). Nearly all the study designs were either qualitative or mixed methods with observational, focus group, interview, or survey methods being most common. The patient populations of focus and study participants varied, with some studies including only clinicians and some including both clinicians and patients and care partners.

Table 5.1: Study design and participants

Study	**Country**	**Methods**	**Participants**
Adams et al., 2017	England	Constructive grounded theory with semi-structured interviews and focus groups	27 junior ED physicians
Calder et al., 2012	Canada	6 focus groups	42 participants across the following roles: ED resident physician, registered nurse, social work, ED attending physician, physician consultants, non-ED registered nurse, administrators
Calder et al., 2015	Canada	Real-time qualitative interviews	32 ED physicians
Capan et al., 2018	US	Decision mapping, survey research, and wordclouds and statistical analysis	46 ED clinicians (i.e., ED attendings, residents, and APPs)
Daniels et al., 2018	US	Comparative cohort study and qualitative case study	Comparative cohort study: 44 ED and 38 GM physicians Qualitative case study: 10 ED and 9 GM attending physicians
Davis et al., 1996	US	Prospective survey	89 patients who presented to the ED with chest pain 19 senior ED residents

			12 internal medicine residents
Dyrstad et al., 2015	Norway	Qualitative and descriptive design with face-to-face interviews	9 ED nurses 8 ambulance workers 4 medical doctors (either from medical or orthopedic wards with a focus on emergency medicine) 6 interns (rotated between medical and orthopedic wards while working in the ED)
Emerson et al., 2017	Scotland	Mixed-methods design	11 ED consultants 11 ICU consultants
Gordon et al., 2015	US	Prospective observational mixed-methods study	29 ED clinicians (i.e., attending, resident, and physician assistant)
Kabrhel et al., 2010	US	Prospective survey	292 emergency physicians
Lewis Hunter et al., 2016	US	Cross-sectional study	34 ED attending physicians
Lin et al., 2018	US	Qualitative study with semi-structured interviews	19 ED physicians 4 clinical directors 2 case managers 1 primary care provider 1 cardiologist
Mutrie et al., 2009	Canada	Survey	27 ED physicians
Nelson et al., 2013	US	Exploratory prospective cohort study	100 patients # of ED clinicians surveyed: Not reported
Nugus, 2019	Australia	Ethnography	Observation: 6 ED doctors 6 ED nurses Interviews: 20 ED doctors 20 ED nurses 20 in-patient doctors

			20 in-patient nurses
Pope et al., 2017	UK	Qualitative study with semi-structured interviews	15 physicians (EM consultant = 6; Acute inpatient = 4; 2 senior specialists; 3 senior house officers) 3 nurses 3 managers
Probst et al., 2015	US	Thematic qualitative study using grounded theory	21 ED physicians
Probst et al., 2016	US	Cross-sectional convenience sample survey	709 ED physicians
Rance et al., 2020	UK	Ethnography	13 patients 17 accompanying persons 26 health professionals (e.g., ED consultants, nurses, junior doctors)
Rutkowski et al., 2020	US	Interview	11 ED physicians
Schechtman et al., 2019	US	Mixed-methods design	11 clinicians in leadership roles (9 physicians and 2 nurses)
Siddique et al., 2018	US	Multi-center cross-sectional survey study	196 EM and hepatology providers (65% EM)
Stuck et al., 2017	US	Survey and focus group	Survey: 48 ED attending physicians Focus group: 18 attending physicians
Tanabe et al., 2007	US	Qualitative study with grounded theory	14 patients 17 emergency nurses 16 emergency physicians
Wright et al., 2018	US and England	Semi-structured interviews	24 emergency medicine physicians

US = United States; UK = United Kingdom; ED = Emergency department; GM = General medicine

5.3.2 Work system components examined by included articles

The work system components explored by each article are documented in Table 5.2. We found that a majority of articles included at least two work system components, with only one article focusing on only one work system component. Three articles captured five work system

components, but no articles included all six components. We did not identify any article findings that related to the physical environment. Notably, the included articles used varied terms to describe the roles held by study participants (e.g., physicians, providers, clinicians, nurses, family). For clarity, we refer to all healthcare providers as "clinicians", and all family members or accompanying persons as "care partners".

Table 5.2: Summary of work system components captured by each article

	Work system component					
Article	**Person**	**Task**	**Organization**	**Tools and technology**	**Physical environment**	**External environment**
Adams et al., 2017	X	X	X	X		X
Calder et al., 2012	X		X	X		
Calder et al., 2015	X		X			
Capan et al., 2018	X		X			
Daniels et al., 2018	X	X	X			
Davis et al., 1996	X		X			
Dyrstad et al., 2015	X	X	X			
Emerson et al., 2017	X		X			X
Gordon et al., 2015				X		
Kabrhel et al., 2010	X					X
LewisHunter et al., 2016	X		X	X		X
Lin et al.,2018	X	X	X	X		X
Mutrie et al., 2009	X		X			
Nelson et al., 2013				X		
Nugus 2019			X	X		
Pope et al., 2017	X	X	X	X		X
Probst et al., 2015	X		X			X
Probst et al., 2016			X			
Rance et al., 2020	X	X	X	X		
Rutkowski et al., 2020	X		X	X		
Schechtman et al., 2019	X	X	X			
Siddique et al., 2018	X		X			X
Stuck et al., 2017	X	X	X	X		X
Tanabe et al., 2007	X					

Wright et al., 2018	X		X			X
Total	21	8	21	11	0	10

5.3.2.1 Person elements

Person elements are summarized in Table 5.3. Twenty-one articles featured a person element related to either patient factors, care partner factors, consulting clinician factors, and/or ED clinician factors. Eighteen studies highlighted patient factors (i.e., psychosocial factors, clinical factors, preference, knowledge) as influencing the disposition decision. Of the patient factors, patient clinical factors were cited most frequently. Three studies named consulting clinician preference as influential on the disposition decision. Five studies highlighted the importance of care partner preference in shaping the disposition decision. Fifteen studies identified ED clinician factors (e.g., risk tolerance, cognitive processing, beliefs about patient and/or care partner efficacy, and knowledge). Factors reported to influence ED clinicians' risk tolerance included seniority, stage of shift (e.g., more likely to be risk-adverse toward end of shift), hospital census, patient's access to follow up care, and patient triage rating (Adams et al., 2017; Capan et al., 2018; Lin et al., 2018; Pope et al., 2017; Stuck et al., 2017).

Table 5.3: Summary of person elements

Person element category	**Examples**	**Associated articles**
Patient psychosocial factors	Transportation Patient living situation and level of social support	Pope et al., 2017; Lewis Hunter et al., 2016; Schechtman et al., 2019; Calder et al., 2012; Capan et al., 2018; Lewis Hunter et al., 2016; Kabrhel et al., 2010; Rutkowski et al., 2020; Schechtman et al., 2019; Siddique et al., 2018; Tanabe et al., 2007
Patient clinical factors	Symptoms, cognitive status, age, medical history	Adams et al., 2017; Calder et al., 2012; Calder et al., 2015; Capan et al., 2018; Daniels et

		al., 2018; Dystrad et al., 2015; Emerson et al., 2017; Kabrhel et al., 2010; Lewis-Hunter et al., 2016; Mutrie et al., 2009; Probst et al., 2015; Rutkowski et al., 2020; Siddique et al., 2018; Stuck et al., 2017; Tanabe et al., 2007
Patient preference	Priority of patient preference Patient's preference for disposition alternatives	Davis et al., 1996; Dystrad et al., 2015; Emerson et al., 2017; Pope et al., 2017; Probst et al., 2015; Tanabe et al., 2007;
Patient knowledge	Knowledge, understanding, and ability to engage in conversations about care in ED and disposition alternatives	Calder et al., 2012; Dystrad et al., 2015
Consulting clinician preference	Preference of consulting clinician	Probst et al., 2015; Rutkowski et al., 2020; Schechtman, et al., 2019
Care partner preference	Priority of care partner preference Willingness to provide care Comfort with the disposition alternatives	Dystrad et al., 2015; Emerson et al., 2017; Rance et al., 2020; Schechtman et al., 2019; Stuck et al., 2017
ED clinician risk tolerance	Perception of risk of adverse outcome post disposition Informed by explicit or implicit risk stratification	Adams et al., 2017; Capan et al., 2018; Daniels et al., 2018; Lin et al., 2018; Pope et al., 2017; Probst et al., 2015; Stuck et al., 2017; Wright et al., 2018
ED clinician cognitive processing	Gestalt or gut instinct Combination of clinical assessment and evidence-based guidelines Personal strategies and algorithms	Adams et al., 2017; Calder et al., 2012; Calder et al., 2015; Probst et al., 2015; Wright et al., 2018
ED clinician beliefs about patient and/or care partner efficacy	Trust in the patient to adhere to the discharge plan Beliefs about patient's likely quality of life post-disposition	Calder et al., 2012; Emerson et al., 2017; Kabrhel et al., 2010; Lewis Hunter et al., 2016; Rance et al., 2020; Schechtman et al., 2019

	Assumptions about care partner's willingness to support the patient post-disposition	
ED clinician knowledge	Knowledge of subspecialities and outpatient resources Perceptions and gestalt developed over time as they treated patients affirmed their predictions Training and tendency to use evidence-based practices	Adams et al., 2017; Calder et al., 2015; Daniels et al., 2018; Emerson et al., 2017; Stuck et al., 2017

5.3.2.2 Task elements

Studies focused on the task factor of time pressure (n=8), with only one study focused on task sequence (Table 5.4). Studies reported perceptions of time pressure related to ED clinicians' need to balance numerous patients and competing demands while maintaining ED throughput, coordinating time-consuming follow up care, and adhering to federal length of stay guidelines. Task sequence was related to ED clinicians' requirement to address the patient's clinical needs before considering the patient's preference in the disposition decision (Dyrstad et al., 2015).

Table 5.4: Summary of task elements

Task element category	**Examples**	**Citations**
Time pressure	Balance time among multiple patients Four-hour waiting time led ED clinicians to sense of time-pressure Competing demands Time-consuming tasks	Adams et al., 2017; Daniels et al., 2018; Dystrad et al., 2015; Lin et al., 2018; Pope et al., 2017; Rance et al., 2020; Schechtman et al., 2019; Stuck et al., 2017
Task sequence	Prioritize medical factors over patient preferences	Dystrad et al., 2015

5.3.2.3 Organization elements

The studies reported organizational factors related to ED busyness/capacity (n=5), ED staffing (n=3), patient/care partner involvement (n=6), ED clinician and inpatient communication (n=7), use of the observation unit (n=4), access to case management/social work (n=6), access to/ability to coordinate follow up care (n=9), ED guidelines and pathways (n=4), home health coordination (n=2), communication with primary care clinicians (n=4), disposition culture (n=9), ED culture (n=2), organizational hierarchy (n=1), and inpatient culture (n=1) (Table 5.5).

A busy ED led ED clinicians to ration care and alter how they allocated their time and efforts among their patients based on patient acuity, demands, etc. (Nugus, 2019). This subsequently influenced the disposition decision-making process. For example, ED clinicians reported that when they had insufficient time to evaluate patients, it was faster and safer to admit the patient (Pope et al., 2017; Stuck et al., 2017). Hospital capacity and inpatient clinician bed management practices (e.g., ICU bed rationing) also influenced the disposition decision-making process (Calder et al., 2012; Emerson et al., 2017; Pope et al., 2017).

ED staffing came into effect when there were insufficient staffing levels or during periods of high employee turnover. For instance, insufficient staffing led ED clinicians to feel like they could not spend adequate time conducting disposition-related tasks (e.g., having in-depth conversations with patients) (Dyrstad et al., 2015; Pope et al., 2017). Another article reported that limited staffing led to a lack of oversight of junior-level physicians, which often led to more conservative disposition outcomes (Stuck et al., 2017).

Patient and care partner involvement and how it reportedly contributed to the disposition decision-making process varied. Many articles highlighted the importance and value of shared or adaptive decision-making (Adams et al., 2017; Dyrstad et al., 2015; Probst et al., 2016; Rance et

al., 2020; Schechtman et al., 2019). However, a couple of articles reported limited efficacy of shared decision-making in ED clinical decision-making. Specifically, Rance and colleagues found that ED clinicians were sometimes perceived by care partners as not acknowledging their contributions (2020). Further, they found a significant power imbalance between ED clinicians and care partners, often leading to ED clinicians seeming to dismiss care partners' concerns (Rance et al., 2020). Similarly, Dystrad and colleagues noted that some ED clinicians did not see the need or value of involving patients in ED clinical decision-making (2015).

Some articles reported care partners to be a good source of information and that their presence in the ED led the patient to be "taken more seriously" (Dyrstad et al., 2015, p. 7; Rance et al., 2020). Yet, some articles noted that it may not be possible for ED clinicians to fully leverage the value that care partners offer. For instance, one article noted that ED policies encouraged ED clinicians to seek information directly from the patient as much as possible, sometimes leading the care partner to feel disregarded (Rance et al., 2020). Further, patient and care partners were found to self-rationalization of their demands or requests in response to the busyness of the ED (Rance et al., 2020). Another article noted the misalignment between ED clinician and patient or care partner priorities, specifically related to the financial implications of disposition alternatives (Davis et al., 1996).

Numerous articles highlighted the varied nature of the communication and collaboration between ED and inpatient clinicians. Many studies noted that ED clinicians sought the input of inpatient clinicians on a patient's disposition decision (Adams et al., 2017; Lin et al., 2018; Mutrie et al., 2009; Nugus, 2019; Rutkowski et al., 2020; Schechtman et al., 2019; Siddique et al., 2018). Daniels and colleagues found that ED clinicians and general medicine clinicians saw their roles and different but complimentary (2018). However, a few papers described a strained

relationship between ED and inpatient providers (e.g., differing opinions on the disposition, perception that inpatient providers unjustifiably withhold beds, interdepartmental hierarchy) (Nugus, 2019; Pope et al., 2017; Siddique et al., 2018).

Articles reported varied approaches to the presence and use of an observation unit. Some EDs did not have an observation unit. The perspectives on the of observation units reflected in remaining articles can be classified into two categories: 1) the observation unit is a safe disposition alternative (e.g., allows ED clinicians more time to collect information and standardize patient care) (Wright et al., 2018) or 2) the observation unit is used as a tactic to delay making a disposition decision either to defer to the oncoming ED clinician or until treatment has had time to take effect (Adams et al., 2017; Wright et al., 2018).

Disparate perspectives on the influence of case management or social work were identified. In light of varied accessibility, multiple articles reported that ED clinicians did not feel that the perspectives of case managers or social workers influenced the disposition decision (Calder et al., 2012; Capan et al., 2018; Lewis Hunter et al., 2016; Lin et al., 2018; Schechtman et al., 2019; Stuck et al., 2017). Despite this, one article noted the important role case managers have in coordinating follow up care, an organization element highlighted below (Schechtman et al., 2019). However, in one study, social workers reported that they felt were involved in and influenced the disposition decision-making process (Calder et al., 2012).

Numerous articles described the importance of follow up care to the disposition decision. This included the accessibility of the care, timeliness of the care relative to ED discharge, and the ability of the ED clinician, patient, or other party (e.g., case manager) to coordinate the care (Calder et al., 2015; Capan et al., 2018; Lewis Hunter et al., 2016; Lin et al., 2018; Pope et al., 2017; Probst et al., 2015; Schechtman et al., 2019; Siddique et al., 2018; Stuck et al., 2017). One

study described overcoming challenges related to ensuring access to timely follow up care by implementing a pathway to connect patients without an outpatient clinician to outpatient care post-disposition (Schechtman et al., 2019).

One specific type of follow up, ancillary care mentioned was home health. A few studies noted the general lack of home health options and, of the options available, the lack of processes in place for ED clinicians to refer patients to home health (Schechtman et al., 2019; Stuck et al., 2017). Another element identified related to follow up was the relationship between the ED clinician and primary care clinicians. A few studies noted both the challenges (e.g., difficult to coordinate follow up care) and benefits (e.g., able to ensure follow up care) of establishing strong relationships with outpatient clinicians (Lin et al., 2018; Pope et al., 2017; Schechtman et al., 2019; Stuck et al., 2017).

More broadly, a few studies identified the importance of ED guidelines and pathways in promoting the efficiency of care, guiding initial diagnosis and evaluation, and facilitating an appropriate disposition (Calder et al., 2012; Schechtman et al., 2019; Wright et al., 2018). However, as Lin and colleagues point out, ED clinicians were often unaware of the presence of protocols or elected not to use them (2018).

There were several factors that shaped the ED disposition culture. First, ED clinicians perceived themselves as primarily responsible for the disposition decision (Nugus, 2019). Second, the attitudes and beliefs of lead ED clinicians set the expectation for how disposition decisions would be made during a given shift. For example, Pope and colleagues found that the culture and personality of the lead ED clinicians informed the extent to which entire ED adhered to federal guidelines and established an acceptable risk threshold for discharging patients (2017). Third, many papers cited the importance of organizational norms, priorities, and incentives, both

ED and hospital-level, on shaping the disposition decision-making process (e.g., acceptability of "social admissions", incentive to reduce unnecessary hospitalizations, potential of being an outlier in one's decision-making) (Adams et al., 2017; Emerson et al., 2017; Lin et al., 2018; Pope et al., 2017; Schechtman et al., 2019; Siddique et al., 2018; Stuck et al., 2017). Fourth, with respect to disposition outcomes, Pope and colleagues found that ED clinicians perceived disposition decision quality to decrease when the ED is busy, and Wright and colleagues found that ED clinicians reported only getting feedback on quality of their disposition performance when patients had adverse outcomes.

Table 5.5: Summary of organization elements

Organization element category	**Examples**	**Citations**
ED busyness/capacity	Care rationing Hospital capacity and bed management practices	Calder et al., 2012; Emerson et al., 2017; Pope et al., 2017; Rance et al., 2020; Stuck et al., 2017
ED staffing	Insufficient staffing Employee turnover	Dystrad et al., 2015; Pope et al., 2017; Stuck et al., 2017
Patient/care partner involvement	Shared or adaptive decision-making and safety netting Perception that care partner contribution is not always acknowledged Power imbalance between ED clinicians and care partner Perception that patient participation was not relevant in the ED Organizational policies regarding who must be consulted Presence or absence of a care partner in the ED	Adams et al. 2017; Dystrad et al., 2015; Probst et al., 2016; Rance et al., 2020; Rutkowski et al., 2020; Schechtman et al., 2019

	Patients and care partners rationed their demands of ED clinicians Misalignment between ED clinician and patient priorities	
ED and inpatient clinician communication	ED clinician seeks input from inpatient clinician ED clinician perception of collaboration between ED and inpatient units	Adams et al., 2017; Daniels et al., 2018; Lin et al., 2018; Mutrie et al., 2009; Nugus et al., 2019; Pope et al., 2017; Rutkowski et al., 2020; Schechtman et al., 2019; Siddique et al., 2018
Use of observation unit*	Lack of observation unit Perception that the observation unit as a safe disposition alternative Perception that the observation unit is used as way to delay making a disposition decision	Adams et al., 2017; Lin et al., 2018; Schechtman et al., 2019; Wright et al., 2018
Access to case management/social work	ED clinician perception that case management did not influence the disposition decision Social workers perception that they were involved in and influenced the disposition decision Limited access to social work/case management in the ED	Calder et al., 2012; Capan et al., 2018; Lewis Hunter et al., 2016; Lin et al., 2018; Schechtman et al., 2019; Stuck et al., 2017
Access to/ability to coordinate follow up care	Accessibility, timeliness, and ability to ensure or coordinate follow up care post-discharge Pathways to ensure that patients without an outpatient clinician connect are promptly connected to outpatient care	Calder et al., 2015; Capan et al., 2018; Lewis Hunter et al., 2016; Lin et al., 2018; Pope et al., 2017; Probst et al., 2015; Schechtman et al., 2019; Siddique et al., 2018; Stuck et al., 2017
ED guidelines and pathways	Pathways and protocols to support ED clinical decisions Despite presence of protocols, ED clinicians were either unaware of or elected not to use protocols in place for certain patient populations	Calder et al., 2012; Lin et al., 2018; Schechtman et al., 2019; Wright et al., 2018

Home health coordination	Limited home health services and no process in place for ED physician to refer patient for home health services	Schechtman et al., 2019; Stuck et al., 2017
Communication with primary care clinicians	Relationship between ED clinicians and outpatient clinicians (e.g., community clinicians, primary care providers)	Lin et al., 2018; Pope et al., 2017; Schechtman et al., 2019; Stuck et al., 2017
Disposition culture	ED clinicians perceived themselves as primarily responsible for the disposition decision Attitudes and beliefs of lead ED clinicians shape the behavior of other ED clinicians Organizational norms, priorities, and incentives Perception that disposition decision quality decreases when the ED is busier Only feedback on disposition performance provided when patients are wrongfully discharged	Adams et al., 2017; Emerson et al., 2017; Lin et al., 2018; Nugus et al., 2019; Pope et al., 2017; Schechtman, et al., 2019; Siddique et al., 2018; Stuck et al., 2017; Wright et al., 2018

* A number of papers described the use of an observation unit. This related to a sub-section of the ED where patients could be held for a set period of time for observation.

5.3.2.4 Tools & technology elements

Tools and technology elements are summarized in Table (5.6). Information accuracy and accessibility was the most common tool and technology element (n=8). “Information” referred to historical information (e.g., medical history, history of present illness) or information being generated in real time (e.g., results of diagnostic tests) (Adams et al., 2017; Calder et al., 2012; Gordon et al., 2015; Lewis Hunter et al., 2016; Lin et al., 2018; Nelson et al., 2013; Rance et al., 2020; Rutkowski et al., 2020; Stuck et al., 2017). Studies reported the phone (n=3) and electronic

health record (n=1) as the mechanism for communication and information sharing (Lin et al., 2018; Nugus, 2019; Rutkowski et al., 2020).

Table 5.6: Summary of tools and technology elements

Tools and technology element category	Examples	Citations
Information accuracy and accessibility	Ability to source or verify patient's clinical information	Adams et al., 2017; Calder et al., 2012; Gordon et al., 2015; Lewis Hunter et al., 2016; Lin et al., 2018; Nelson et al., 2013; Rance et al., 2020; Rutkowski et al., 2020; Stuck et al., 2017
Electronic health record	ED physicians reported using shared EHRs and automatic emails to establish follow up care plans	Lin et al., 2018
Phone	ED physicians used real-time phone calls to inpatient providers	Lin et al., 2018; Nugus et al., 2019; Rutkowski et al., 2020

5.3.2.5 External environment elements

Perspectives were mixed on the influence of insurance and reimbursement (Table 5.7). Two studies highlighted that potential for insurance reimbursement was considered (Lewis Hunter et al., 2016; Stuck et al., 2017) while one study noted that insurance status was not a factor in disposition decision-making (Kabrhel et al., 2010). Potential for medicolegal repercussions was cited by one paper (Siddique et al., 2018). Public policy, specifically the four-hour wait time rule, was cited as informing care in the disposition (Adams et al., 2017; Pope et al., 2017; Wright et al., 2018). The four-hour wait time rule refers to the federal directive that there should be no more than four hours between when a patient arrives to the ED and when they are admitted, transferred, or discharged in effect in some countries. Finally, evidence-based practice or lack thereof was cited as informing the disposition decision (Emerson et al., 2017; Lin et al., 2018; Probst et al., 2015).

Table 5.7: Summary of external environment elements

External environment element category	Examples	Citations
Insurance/reimbursement	Potential for reimbursement	Kabrhel et al., 2010; Lewis Hunter et al., 2013; Stuck et al., 2017
Medical legal risk	Risk of litigation	Siddique et al., 2018
Public policy	4-hour wait time	Adams et al., 2017; Pope et al., 2017; Wright et al., 2018
Evidence-based practice	Use of guidelines for specific patient populations Limited or changing guidelines	Emerson et al., 2017; Lin et al., 2018; Probst et al., 2015

5.4 Discussion

The purpose of the present scoping review was to identify and synthesize what previous studies reveal about the elements that compose the ED work system that influences the ED disposition decision-making process. Our results suggest that the literature captures some of the complexity of disposition decision-making, with some key facets left unexplored. Namely, certain work system elements are underexplored (i.e., physical and external environment) or limited in scope (e.g., the description of person tended to focus on the clinical characteristics of the patient). Further, no one study comprehensively described all aspects of the ED work system, thereby failing to capture the critical interactions among elements that are known to strongly influence process performance (Carayon et al., 2006; Holden et al., 2013). Thus, we lack the ability to connect the influence of the ED work system to the disposition decision-making process and related outcomes, a necessary step to facilitate meaningful system redesign or intervention (Carayon et al., 2006).

A majority of studies (21/25) described person elements. The focus on person elements is unsurprising given the nature of the disposition decision-making process – that is – an ED clinician evaluates a patient to determine the appropriate setting for the next stage of care (e.g.,

home versus inpatient) based on their clinical status and intensity of care they will require. In line with previous, highly clinical conceptualizations of disposition decision-making, included studies tended to focus on describing patient clinical (e.g., medical history, vital signs) and psychosocial factors (e.g., transportation). Although such factors arguably form the basis for the disposition decision, as our findings demonstrate, they only represent a portion of the factors that shape the disposition decision-making process.

For instance, a majority of studies citing person elements also cited organization elements (18/25). This suggests that patient factors are not the only factors that shape the disposition decision and that there are meaningful interactions within and among work system elements that warrant further investigation (Capan et al., 2018). To fully understand the influence that the ED work system has on the disposition decision-making process, future work must further explicate all elements that shape the disposition decision-making process and further illuminate the nature of interactions among work system elements.

Disposition decision-making has historically been conceptualized as solely based on the ED clinician's cognitive process (Dyrstad et al., 2015; Lin et al., 2018; Pope et al., 2017). However, the presence of work system elements like patient preference, consulting clinician preference, ED and inpatient clinician communication, etc. suggest that disposition decision-making may be more of a shared process than previously understood (Probst et al., 2016; Rutkowski et al., 2020). While the disposition decision is ultimately made by the ED clinician, future work may consider approaches such as social network mapping to determine the scope and nature of patient, care partner, and others' (e.g., primary care clinician) involvement in the formation of the disposition decision (Ponnala et al., 2020). A robust understanding of who is

involved and at what point in the disposition decision-making process will be key to developing adaptive and comprehensive tools to support this critical decision point.

Although our findings suggest that there are multiple factors that contributed to ED disposition decision-making, ultimately, some studies concluded that ED physicians had a responsibility to not discharge a patient who was ill. For example, Adams and colleagues note that "despite the complex reasoning process that preceded, if junior doctors had ongoing concerns about their patient, a destination decision was distilled to whether they were considered to be unwell, in which case admission was mandatory" (2017, p. 74). As such, patient acuity, a patient clinical factor, seems to be a strongly influential and potentially superseding element. This suggests that there may be a hierarchy among work system elements such that some elements more strongly influence the disposition process and subsequent outcomes than others depending on the clinical scenario. This notion of work system elements shaping a process to varied degrees has been previously conceptualized through a concept called configuration. Configuration suggests that although "all components of the work system potentially interact, only a subset of all possible interactions is actually relevant in a given work process or situation" (Holden et al., 2013, p. 6). Future work should consider exploring which factors most strongly influence the performance of this process and in what scenarios, given the sheer number of factors identified in the present review. Determining, among the numerous factors, which most strongly shape the disposition decision-making process will identify areas of the work system where intervention or redesign is likely to have the greatest effect.

5.5 Limitations

First, our review was limited to databases of peer-reviewed journals and conference proceedings, and therefore, did not include "gray" literature. Second, the decision to exclude protected or vulnerable populations (e.g., forensic patients, maternal and newborn patients) may have limited our scope. Third, we present our findings in terms of individual, siloed work system components. However, according to work systems theory, work occurs within the interactions among elements (Carayon et al., 2006). Thus, our approach may not fully reflect the complexity of the ED work system nor the elemental interactions that produce the disposition decision-making process (Werner et al., 2021). Lastly, a formal quality appraisal was not conducted. However, the goal of scoping reviews is to provide an overall summary of the state of the literature with respect to a topic and identify gaps in understanding and implications for future research agendas.

5.6 Conclusion

Disposition decision-making in the ED is a key juncture in a patient's care journey. Yet, this process has only begun to be conceptualized, with numerous gaps still to address to improve the context within which this complex process occurs. However, the use of work system concepts like configuration show promise in expanding our understanding of this critical clinical process and laying the foundation for future research and ED system redesign to promote optimal patient, clinician, and organizational outcomes (Werner et al., 2021).

5.7 Chapter 5 acknowledgements

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5.8 Chapter 5 references

Agency for Healthcare Research and Quality (2011). *Disposition of Patient*. Retrieved 06/11/22 from https://ushik.ahrq.gov/ViewItemDetails?system=mdr&itemKey=65837000

Adams, E., Goyder, C., Heneghan, C., Brand, L., & Ajjawi, R. (2017). Clinical reasoning of junior doctors in emergency medicine: a grounded theory study. *Emerg Med J*, *34*(2), 70-75. https://doi.org/10.1136/emermed-2015-205650

Calder, L. A., Arnason, T., Vaillancourt, C., Perry, J. J., Stiell, I. G., & Forster, A. J. (2015). How do emergency physicians make discharge decisions? *Emergency Medicine Journal*, *32*(1), 9-14.

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576 e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Capan, M., Pigeon, J., Marco, D., Powell, J., & Groner, K. (2018). We all make choices: A decision analysis framework for disposition decision in the ED. *The American journal of emergency medicine*, *36*(3), 450-454.

Carayon, P. (2009). The Balance Theory and the Work System Model … Twenty Years Later. *Int. J. Hum. Comput. Interaction*, *25*, 313-327. https://doi.org/10.1080/10447310902864928

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Quality and Safety in Health Care*, *15*(suppl 1), i50. https://doi.org/10.1136/qshc.2005.015842

Chamberlain, J. M., & Pollack, M. M. (1998). A method for assessing emergency department performance using patient outcomes. *Academic emergency medicine*, *5*(10), 986-991.

Costa, A. P., Hirdes Jp Fau - Heckman, G. A., Heckman Ga Fau - Dey, A. B., Dey Ab Fau - Jonsson, P. V., Jonsson Pv Fau - Lakhan, P., Lakhan P Fau - Ljunggren, G., Ljunggren G Fau - Singler, K., Singler K Fau - Sjostrand, F., Sjostrand F Fau - Swoboda, W., Swoboda W Fau - Wellens, N. I. H., Wellens Ni Fau - Gray, L. C., & Gray, L. C. (2014). Geriatric syndromes predict postdischarge outcomes among older emergency department patients: findings from the interRAI Multinational Emergency Department Study. *Academic Emergency Medicine*, *21*(4), 422-433.

Daniels, L. M., Sorita, A., Kashiwagi, D. T., Okubo, M., Small, E., Polley, E. C., & Sawatsky, A. P. (2018). Characterizing Potentially Preventable Admissions: A Mixed Methods Study of Rates, Associated Factors, Outcomes, and Physician Decision-Making. *Journal of general internal medicine,*, *33*(5), 1525-1497 (Electronic).

Davis, M. A., Keerbs A Fau - Hoffman, J. R., Hoffman Jr Fau - Baraff, L. J., & Baraff, L. J. (1996). Admission decisions in emergency department chest pain patients at low risk for myocardial infarction: patient versus physician preferences. *Annals of emergency medicine,*, *28*(6), 606-611.

Dyrstad, D. N., Testad, I., & Storm, M. (2015). Older patients' participation in hospital admissions through the emergency department: an interview study of healthcare professionals. *BMC Health Services Research*, *15*(1), 1-9.

Emerson, P., Brooks D Fau - Quasim, T., Quasim T Fau - Puxty, A., Puxty A Fau - Kinsella, J., Kinsella J Fau - Lowe, D. J., & Lowe, D. J. (2017). Factors influencing intensive care admission: a mixed methods study of EM and ICU. *European Journal of Emergency Medicine*, *24*(1), 29-35.

Fernando, S. A.-O., Rochwerg, B., Reardon, P. M., Thavorn, K., Seely, A. J. E., Perry, J. J., Barnaby, D. P., Tanuseputro, P., & Kyeremanteng, K. (2018). Emergency Department disposition decisions and associated mortality and costs in ICU patients with suspected infection. *Critical Care*, *22*(1), 1-10.

Frith, K. H. (2013). Medication errors in the intensive care unit: literature review using the SEIPS model. *AACN advanced critical care*, *24*(4), 389-404.

Gordon, B. D., Bernard, K., Salzman, J., & Whitebird, R. R. (2015). Impact of Health Information Exchange on Emergency Medicine Clinical Decision Making. *Western Journal of Emergency Medicine*, *16*(7), 1047.

Grant, M. J., & Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health information & libraries journal*, *26*(2), 91-108.

Hendrick, H. W., & Kleiner, B. M. (2001). *Macroergonomics - An Introduction to Work System Design*.

Holden, R. J., Carayon P Fau - Gurses, A. P., Gurses Ap Fau - Hoonakker, P., Hoonakker P Fau - Hundt, A. S., Hundt As Fau - Ozok, A. A., Ozok Aa Fau - Rivera-Rodriguez, A. J., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*(11), 1669-1686.

Hutchins, E. (1995). *Cognition in the Wild*. MIT press.

Hutchins, E. (2000). Distributed cognition. *International Encyclopedia of the Social and Behavioral Sciences*, *138*.

Kabrhel C Fau - Sacco, W., Sacco W Fau - Liu, S., Liu S Fau - Hariharan, P., & Hariharan, P. (2010). Outcomes considered most important by emergency physicians when determining

disposition of patients with pulmonary embolism. *International journal of emergency medicine*, *3*(4).

Klein, G. (2008). Naturalistic decision making. *Human factors: : The Journal of the Human Factors and Ergonomics Society*, *50*, 456-460.

Lewis Hunter, A. E., Spatz, E. S., Bernstein, S. L., & Rosenthal, M. S. (2016). Factors Influencing Hospital Admission of Non-critically Ill Patients Presenting to the Emergency Department: a Cross-sectional Study. *Journal of general internal medicine*, *31*(37-44).

Liebzeit, D. A.-O., Rutkowski, R., Arbaje, A. I., Fields, B., & Werner, N. E. (2021). A scoping review of interventions for older adults transitioning from hospital to home. *Journal of the American Geriatrics Society*, *69*(10), 2950-2962.

Lin, M. P., Natsui, S., Sinnette, C., Ball, A., Weissman, J. S., & Schuur, J. D. (2018). Facilitators and Barriers to Reducing Emergency Department Admissions for Chest Pain: A Qualitative Study. *Critical Pathways in Cardiology*, *17*(4), 201-207.

Lippa, K. D., Feufel, M. A., Robinson, F. E., & Shalin, V. L. (2017). Navigating the Decision Space: Shared Medical Decision Making as Distributed Cognition. *Qualitative Health Research*, *27*(7), 1035-1048.

Mitra, B., Cameron Pa Fau - Archer, P., Archer P Fau - Bailey, M., Bailey M Fau - Pielage, P., Pielage P Fau - Mele, G., Mele G Fau - Smit, D. V., Smit Dv Fau - Newnham, H., & Newnham, H. (2012). The association between time to disposition plan in the emergency department and in-hospital mortality of general medical patients. *Internal medicine journal*, *42*(4), 444-450.

Mutrie, D., Bailey Sk Fau - Malik, S., & Malik, S. (2009). Individual emergency physician admission rates: predictably unpredictable. *Canadian Journal of Emergency Medicine*, *11*(2), 149-155.

Nelson, D., Washton D Fau - Jeanmonod, R., & Jeanmonod, R. (2013). Communication gaps in nursing home transfers to the ED: impact on turnaround time, disposition, and diagnostic testing. *The American Journal of Emergency Medicine*, *31*(4), 712-716.

Nugus, P. (2019). Re-structuring the negotiated order of the hospital. *Sociology of Health & Illness*, *41*(2), 1467-9566 (Electronic).

Nugus, P., & Braithwaite, J. (2010). The dynamic interaction of quality and efficiency in the emergency department: Squaring the circle? *Social Science & Medicine*, *70*(4), 511-517.

Nugus, P., Forero, R., McCarthy, S., McDonnell, G., Travaglia, J., Hilman, K., & Braithwaite, J. (2014). The emergency department "carousel": an ethnographically-derived model of the dynamics of patient flow. *International emergency nursing*, *22*(1), 3-9.

Ponnala, S., Block, L., Lingg, A. J., Kind, A. J., & Werner, N. E. (2020). Conceptualizing caregiving activities for persons with dementia (PwD) through a patient work lens. *Applied ergonomics*, *85*, 103070.

Pope, I., Burn, H., Ismail, S. A., Harris, T., & McCoy, D. (2017). A qualitative study exploring the factors influencing admission to hospital from the emergency department. *BMJ open*, *7*(8), e011543.

Probst, M. A., Kanzaria, H. K., Frosch, D. L., Hess, E. P., Winkel, G., Ngai, K. M., & Richardson, L. D. (2016). Perceived Appropriateness of Shared Decision-making in the Emergency Department: A Survey Study. *Academic Emergency Medicine*, *23*(4), 375-381.

Probst, M. A., Kanzaria, H. K., Hoffman, J. R., Mower, W. R., Moheimani, R. S., Sun, B. C., & Quigley, D. D. (2015). Emergency Physicians' Perceptions and Decision-making Processes Regarding Patients Presenting with Palpitations. *The Journal of emergency medicine*, *49*(2), 236-243.

Rance, S. A.-O., Westlake, D. A.-O., Brant, H., Holme, I., Endacott, R., Pinkney, J., & Byng, R. (2020). Admission Decision-Making in Hospital Emergency Departments: The Role of the Accompanying Person. *Global qualitative nursing research*, *7*, 2333393620930024.

Rutkowski, R. A., Salwei, M., Barton, H., Wust, K., Hoonakker, P., Brenny-Fitzpatrick, M., King, B., Shah, M. N., Pulia, M. S., Patterson, B. W., Dáil, P. V., Smith, M., Carayon, P., & Werner, N. E. (2020). Physician Perceptions of Disposition Decision-making for Older Adults in the Emergency Department: A Preliminary Analysis. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *34*(1071-1813 (Print)), 648-652.

Schechtman, M., Kocher, K. E., Nypaver, M. M., Ham, J. J., Zochowski, M. K., & Macy, M. L. (2019). Michigan Emergency Department Leader Attitudes Toward and Experiences With Clinical Pathways to Guide Admission Decisions: A Mixed-methods Study. *Academic Emergency Medicine*, *26*(4), 384-393.

Sibbald, M., Sherbino, J., Preyra, I., Coffin-Simpson, T., Norman, G., & Monteiro, S. (2017). Eyeballing: The use of visual appearance to diagnose 'sick'. *Medical Education*, *51*. https://doi.org/10.1111/medu.13396

Siddique, S. M., Lane-Fall, M., McConnell, M. J., Jakhete, N., Crismale, J., Porges, S., Khungar, V., Mehta, S. J., Goldberg, D., Li, Z., Schiano, T., Regan, L., Orloski, C., & Shea, J. A. (2018). Exploring opportunities to prevent cirrhosis admissions in the emergency department: A multicenter multidisciplinary survey. *Hepatology communications*, *2*(3), 237-244.

Stiell, A., Forster Aj Fau - Stiell, I. G., Stiell Ig Fau - van Walraven, C., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. *Cmaj*, *169*(10), 1023-1028.

Stiell, I. G., Clement Cm Fau - Brison, R. J., Brison Rj Fau - Rowe, B. H., Rowe Bh Fau - Borgundvaag, B., Borgundvaag B Fau - Aaron, S. D., Aaron Sd Fau - Lang, E., Lang E Fau - Calder, L. A., Calder La Fau - Perry, J. J., Perry Jj Fau - Forster, A. J., Forster Aj Fau - Wells, G. A., & Wells, G. A. (2013). A risk scoring system to identify emergency department patients with heart failure at high risk for serious adverse events. *Academic emergency medicine*, *20*(1), 17-26.

Stuck, A., Crowley, C., Martinez, T., Wittgrove, A., Brennan, J. J., Chan, T. C., & Castillo, E. M. (2017). Perspectives on Home-based Healthcare as an Alternative to Hospital Admission After Emergency Treatment. *Western Journal of Emergency Medicine*, *18*(4), 761.

Wears, R. L., & Leape, L. L. (1999). Human error in emergency medicine. *Annals of emergency medicine*, *34*(3), 370-372.

Wears, R. L., Woloshynowych M Fau - Brown, R., Brown R Fau - Vincent, C. A., & Vincent, C. A. (2010). Reflective analysis of safety research in the hospital accident & emergency departments. *Applied Ergonomics*, *41*(5), 695-7000.

Weigl, M., Müller, A., Holland, S., Wedel, S., & Woloshynowych, M. (2016). Work conditions, mental workload and patient care quality: a multisource study in the emergency department. *BMJ quality & safety*, *25*(7), 499-508.

Werner, N. E., & Holden, R. J. (2015). Interruptions in the wild: Development of a sociotechnical systems model of interruptions in the emergency department through a systematic review. *Applied Ergonomics*, *51*, 244-254. https://doi.org/https://doi.org/10.1016/j.apergo.2015.05.010

Werner, N. E., Ponnala, S., Doutcheva, N., & Holden, R. J. (2021). Human factors/ergonomics work system analysis of patient work: state of the science and future directions. *Journal for Quality in Health Care*, *33*(3), 60-71.

Whiting, P., Savovic, J., Higgins, J. P., Caldwell, D. M., Reeves, B. C., Shea, B., Davies, P., Kleijnen, J., Churchill, R., & group, R. (2016). ROBIS: A new tool to assess risk of bias in systematic reviews was developed. *J Clin Epidemiol*, *69*, 225-234. https://doi.org/10.1016/j.jclinepi.2015.06.005

Wright, B., Martin, G. P., Ahmed, A., Banerjee, J., Mason, S., & Roland, D. (2018). How the Availability of Observation Status Affects Emergency Physician Decisionmaking. *Annals of Emergency Medicine*, *72*(4), 401-409.

Chapter 6: A work systems approach to characterizing disposition decision-making under low and high demand

This chapter is presented in the form of a manuscript prepared for *Applied Ergonomics.*

6.1 Introduction

Disposition decision-making represents a unique opportunity to promote patient safety for the millions of older adults who receive care in the emergency department (ED) across nearly 30 million ED visits annually in the US (Ashman et al., 2020; Rui & Kang, n.d.). A disposition decision determines the level of care an individual requires after leaving the ED, thereby determining to where a patient will transition (e.g., home, hospital) (Quality, 2011). If patients are dispositioned to locations that do not support their care needs, there can be serious adverse outcomes for the patient and care partner, the ED clinician, and the healthcare system.

- For the patient and care partner, consequences can include repeat ED visits, death, and admission to higher levels of care (e.g., intensive care unit as opposed to a general medicine unit) (Calder et al., 2010; Calder et al., 2012a; Chen et al., 2021; Fernando et al., 2018; Gabayan et al., 2016).
- For the ED physicians, there may be legal implications and they may experience blame and stress (Bragard et al., 2015).
- For the healthcare system, there may be unnecessary admissions which can lead to hospital overcrowding (Chamberlain & Pollack, 1998; Fernando et al., 2018).

ED disposition decision-making can be challenging. The ED is a complex and dynamic environment with interruptions; persistent, variable and competing patient and organizational demands; time, space, resource and information constraints; and decisions that require precise

communication, coordination and collaboration among multiple stakeholders (Daniels et al., 2018; Nugus et al., 2011; Stiell et al., 2003; Wears & Leape, 1999; Wears et al., 2010). Put another way, the ED is characterized by "continuing arrivals fueled by beliefs, expectations, and needs of the community; political and managerial expectations of efficiency of patient throughput; capacity constraints beyond the ED (such as available beds in the hospital and serves in the community); and limited resources in the ED (such as staff, space, time, and beds)" (Nugus et al., 2011, p. 1046). Taken together, these characteristics can lead to significantly high demands on physicians (Weigl et al., 2016), which can be associated with poor clinical decision quality (Levin et al., 2006; Shanafelt et al., 2002; Soria-Oliver et al., 2017).

Researchers have shown that physicians, across specialties, often make decisions with the intent of reducing demands (Nugus et al., 2011). For instance, in a study of burnout in internal medicine residents, Shanafelt and colleagues (2002) found that residents experiencing burnout were more likely to report engaging in suboptimal patient care practices and attitudes such as discharging "patients to make the service [and their workload more] 'manageable' because the team was too busy" (Shanafelt et al., 2002, p. 363). Specific to the ED, an ED physician participant within Daniels and colleagues' study commented, "if the patient is bordering for going home or coming in, those are the patients that I want to spend the least time on, because that is at the expense of patients who are really sick" (p. 742). Similarly, Turner and colleagues note that "ED physicians may also attempt to relieve pressure through their choice of discharge destination by substituting care within the ED for care provided by alternative health care services" (Turner et al., 2020, p. 1747).

Given the influence that demands have on the disposition decision-making process and related outcomes, it is critical that we have a robust understanding of the work system structures

and how they may change under conditions of high and low demands. Previous work has begun to characterize disposition decision-making and the factors that influence it (Rutkowski et al., In progress). Although these studies represent a critical first step, they are limited in two primary ways. First, these studies tend to focus on disposition decision-making as vague decision points void of the context that influences and is influenced by the decision-making process (Calder et al., 2012; Capan et al., 2018). Second, these studies explore disposition decision-making and related outcomes in general or under one specific set of conditions (Calder et al., 2012, Capan et al., 2018, Rutkowski et al., 2020). Previous work has neither considered how the ED work system structure configures in light of emergent demands nor characterized the influence of variable demands on the disposition decision-making process.

Calder and colleagues note that "if we are seeking to improve the quality of the ED disposition decision, future efforts should focus on better understanding how we arrive at this decision" (2012, p. 574). To achieve a robust understanding of "how we arrive at this decision", we must be able to describe the range of conditions (i.e., demands) under which these disposition decisions occur (Calder et al., 2012, p. 574). Systems engineering analysis has been proposed as a next step for better characterizing the disposition decision-making process (Calder et al., 2012). The Systems Engineering Initiative for Patient Safety (SEIPS) model, a work systems model, is well suited to address this gap (Carayon et al., 2006; Carayon et al., 2014). The SEIPS model acknowledges that processes are influenced by, influence, and occur within work system structures. The SEIPS model conceptualizes the work system as a set of interacting elements that define the individuals who carry out tasks using tools and technologies within the context of an organization, physical environment, and external environment (Carayon et al., 2006; Carayon et al., 2014).

Within a given work system, there are numerous interactions among work system elements that produce the process and, subsequently, outcomes. As such, the SEIPS model acknowledges that "… only a subset of all possible [element] interactions is actually relevant in a given work process or situation … Thus, for a particular process or situation, one can distinguish a configuration of a finite number of relevant elements that interact to strongly shape the performance of that process" through a concept called configuration (Holden et al., 2013, p. 6). Configuration allows for a more precise definition of influential elements that shape a process and provides the infrastructure to compare two or more work systems to identify potential differences in process performance (Holden et al., 2013).

Configuration can be used to characterize and evaluate the ED work system under conditions of low and high demand. We conceptualize demand as an emergent property of the ED work system that determines the amount of resources required to perform a process (Hart & Staveland, 1998). Defining the configuration of the ED work system under these conditions will provide a basis from which to describe the range of ED work system structures that produce disposition decision-making. Such an understanding will be necessary to develop and implement interventions and system redesigns that are adaptive and robust. Thus, the purpose of this study is to characterize the ED work system configurations that produce the disposition decision-making process during low and high demands.

6.2 Methods

6.2.1 Study design

This qualitative work system analysis involved two forms of data collection and analysis to promote data and methodological triangulation (Robson & McCartan, 2016): contextual

inquiry-based observations with older adult patients who presented to the ED with a fall and semi-structured interviews with ED clinicians. Data collection and analysis took place concurrently. For the purposes of this study, we interviewed the following ED clinician roles: attendings, residents, and advanced practice providers (APPs). This study was approved by the Institutional Review Board.

6.2.2 Contextual inquiry data collection and participants

We conducted 20 contextual inquiry-based observations (average=4.5 hours; range=2-11.3 hours; total=102.6 hours) with older adults who presented to the ED of an academic medical center with Level One trauma certification with a fall between July and December 2019. To qualify for the study older adults must have: presented to the ED for a primary complaint of fall occurring within the last 48 hours; not been categorized as a Level One trauma; if they had an activated power of attorney (POA), their POA was present at the time of the ED care; been aged 65+. We recruited participants using trained research coordinators who monitored the ED trackboard for potential participants.

Research assistants observed interactions among older adults, their care partners, and clinicians during ED care. Observations were followed by brief interviews with the ED clinicians involved (range=5-15 minutes). If the observation occurred across multiple shifts, observers interviewed the clinician(s) working at the time of disposition. Interviews included questions developed a priori and questions identified by observers during the observation, ranging from one to six questions in length depending on the availability of the ED clinician and the number of questions the observer developed during the observation (Table 6.1). Observers took handwritten notes. Notes were scanned and transcribed for analysis.

Table 6.1: Example follow-up interview questions

Who did you talk to about disposition for this patient?
How did you come to a disposition decision for this patient?
What factors or information informed your disposition decision?

6.2.3 Semi-structured interview data collection and participants

We conducted a total of 18 interviews with ED clinicians. Data collection and analysis took place concurrently. We began with an initial set of four interviews that asked ED physicians to think broadly about ED care transitions and disposition decision-making for older adults, with subsequent interviews focusing on disposition decision-making. The interview guide was designed using a modified Critical Incident Technique (CIT), an approach aimed at collecting and analyzing data about work and the effect of the work on individuals involved (Flanagan, 1954; Kirwan, 1994). A CIT data collection approach results in in-depth data that reflect contextualized experiences (Flanagan, 1954). Interview questions asked participants to recall specific instances of disposition decision-making under low and high demand and the subsequent transitions for older adults. We ceased data collection when no new information was identified.

Interviews were conducted between December 2018 and March 2022 in a location convenient for the participant (e.g., conference room) or over a video-conferencing software (average: 65 minutes; range: 34 – 71 minutes). Participants received a $50 honorarium for participating in the interviews. Interviews were audio recorded, transcribed verbatim, deidentified, and uploaded to Nvivo 11.

6.2.4 Contextual inquiry and semi-structured interview data analysis

We conducted a directed content analysis of the observation notes and semi-structured interview transcripts guided by the System Engineering Initiative for Patient Safety (SEIPS) model (Carayon et al., 2006; Carayon et al., 2014). The SEIPS model consists of six interacting components that identify the 1) people who complete certain 2) tasks with 3) tools and technologies within 4) an organizational context, 5) a physical environment, and 6) an external environment (Carayon et al., 2006; Carayon et al., 2014). The two datasets were combined and treated as one. We first conducted team-based structural coding to identify excerpts related to disposition decision-making (Saldaña, 2015). The coding team then coded one observation and interview together to develop the codebook based on the six SEIPS components. Next, we dual-coded each observation note and interview using Nvivo 11. Coders met after coding each document to compare coding and resolve discrepancies through consensus-based discussion. From there, we conducted a team-based inducive coding process to group like excerpts and identify specific elements within each component. The full research team met weekly to resolve outstanding discrepancies and discuss identified themes (Barry et al., 1999).

6.3 Results

6.3.1 Participant demographics

We enrolled 20 patients and conducted a total of 20 post-observation interviews with ED clinicians. We conducted 18 semi-structured interviews with ED clinicians. Patient and clinician demographics can be found in Table 6.2. To protect anonymity, we did not collect detailed demographic information on ED clinicians.

Table 6.2: Participant demographics

Contextual Inquiry Participants	
Patient observation participants (n=20)	
Gender of patient	
Female	13 (65%)
Presence of care partner in the ED	
Care partner present	14 (70%)
Age of patient	
65 - 69	3 (15%)
70 - 79	7 (35%)
80 - 89	5 (25%)
90+	4 (20%)
Exact age unknown but aged 65+	1 (5%)
Activated power of attorney (POA)	
No	18 (90%)
Disposition location	
Discharged home/skilled nursing facility	8 (40%)
Admitted to observation unit	3 (15%)
Admitted to hospital	9 (45%)
ED clinician follow-up interview participants (n=20)*	
Participant professional occupation	
ED attending physician	9 (45%)
ED resident physician	7 (35%)
ED physician assistant	1 (5%)
ED nurse	3 (15%)
Semi-structured Interview Participants (n=18)	
Participant professional occupation	
ED attending physician	11
ED resident physician	3
ED physician assistant	4
Participant gender	
Female	6 (32%)
Participant tenure	
Average	9 years
Minimum	0.5 years
Maximum	22.5 years

* One observation was followed by two interviews and one observation was not follow by an interview due to shift change.

6.3.1 Work system analysis

We identified 40 work system elements that influence the disposition decision making process: person (n=9), task (n=7), tools and technology (n=4), organization (n=14), physical environment (n=3), external environment (n=3). Tables 6.3 reports the work system elements identified as shaping the disposition decision-making process generally (i.e., under conditions of both low and high demand).

Table 6.3: Summary of work system elements identified in shaping the ED disposition decision-making process in both conditions of high and low demand

Element	Element description specific to the disposition process
Person	
Patient clinical factors	Clinical characteristics (e.g., medical history, results of diagnostic tests, care needs, mental status)
Patient psychosocial factors	Psychological and social characteristics (e.g., living situation, support; access to transportation, ability to fulfill own care needs)
Patient preference	Opinions, needs, and desires related to their disposition
Care partner preference	Opinion, needs, and desires related to their disposition
ED clinician risk tolerance	Risk tolerance related to disposition
ED clinician experience, training, and knowledge	Experience, knowledge, and gestalt
ED clinician sense of responsibility & motivations	Internal perception of professional duty and accountability to patients and other clinicians
Consulting clinician preference	Opinions and recommendations related to disposition
Consulting clinician experience, training, and knowledge	Experience, knowledge, and gestalt
Task	
Task demands	Requirements and effort of a disposition task
Task ownership	Extent to which a clinician is responsible for a task
Task sequence	Order in which tasks are or must be performed
Interruptions	Workflow disruptions (e.g., incoming trauma, phone call)
Autonomy	Extent to which clinicians could provide care and make the disposition decision independently; job control
Time pressure	Time-related disposition demands
Multi-tasking	Requirement to perform multiple disposition tasks at the same time
Tools & technology	
Phone	Use of phone to contact family and consulting clinicians about disposition
ED trackboard	Information from the ED trackboard (e.g., # of patients awaiting care, length of stay)

Electronic health record	Provides access to patient's medical history and ED-related metrics (e.g., length of stay), and allows for communication (e.g., ED nurses, PCP)
Information completeness	Reliability or completeness of information
Organization	
Involvement of patient and/or care partner	The extent to which patients and care partners are involved in the disposition decision-making process
Disposition culture	Organizational culture or "norms" surrounding disposition decision-making
ED clinician <> EMS CCC	Handoff and information exchange between ED clinicians and EMS personnel
ED clinician <> ED nurse CCC	Information exchange and interaction among ED clinicians and ED nurses
ED attending <> ED resident/APP CCC	Information exchange and interaction between ED attending (i.e., supervisor) and ED resident or ED APP (i.e., supervisee)
ED clinician <> consulting physician CCC	Interaction and recommendation from consulting clinicians (e.g., orthopedics)
ED clinician <> Hospitalist CCC	Interaction and recommendation from hospitalist
ED clinician <> PCP CCC	Information exchange and interaction between ED clinician and PCP
ED staffing	Extent to which staffing meeting ED patient demand
Clinical momentum	Diagnostic or disposition momentum
Standard of care	Departmental expectations or "norms" with respect to patient care
Shift change norms	Expectation that patients have a well-developed disposition plan in place at the time of shift change
Access to social work	Availability of social work in the ED
Access to physical therapy	Availability of physical therapy in the ED
Physical environment	
Patient's home characteristics	Conditions of the patient's home environment (e.g., layout, number of stairs)
ED commotion	Amount of noise, motion, and order in the physical ED space
Available space	Amount of available space in the ED (e.g., beds, rooms)
External environment	
Practice guidelines	Federal care guidelines
Insurance	Patient's insurance status, coverage, etc.
State or county malpractice policies	Local policies or law dictating malpractice

CCC = Communication, coordination, and collaboration; ED = Emergency department; EMS = Emergency medical services; inter. = interviews; obs. = observations; PA = Physician assistant; PCP = Primary care physician

We found that how elements were described as influencing the disposition decision varied depending on the level of demand. Table 6.4 reports the elements, primarily task and organization, that differed in presentation between conditions of high and low demands.

Table 6.4: Elements that differed under conditions of high and low demand

Element name	Examples under high demand	Examples under low demand
Person		
ED clinician risk tolerance	Lower risk tolerance	Higher risk tolerance
ED clinician experience, training, and knowledge	Using gut instinct to inform disposition decision Physician decision-making style becomes paternalistic, and approach becomes more conservative	More cognitive capacity to think and make decisions
Task		
Task demands	An increase in the number and difficulty of tasks (e.g., having numerous complex patients arrive at ED at the same time)	A reasonable number of tasks of moderate difficulty (e.g., balance between the number of patients you have and patient complexity)
Task ownership	Ability or need to delegate tasks to another ED clinicians (e.g., ED nurse calling the patient's family and reporting back)	Ability to perform all disposition-related tasks oneself (e.g., calling the patient's family)
Task sequence	Limited/reduced time to complete tasks	Ability to spend more time on certain tasks at preferred time
Time pressure	Sense of internal and/or departmental time pressure to quickly disposition patients (e.g., see waiting room patients, manage ED patient flow, minimize length of stay)	Sense of having sufficient time and limited pressure to disposition patients quickly
Organization		
Involvement of patient and/or care partner	Limited time to have comprehensive conversations with patient and/or care partner (e.g., only being able to ask a few pointed questions)	Ability to spend more time with each patient, ask more "social or softer" questions, and engage in more of a shared decision-making process
Disposition culture	The amount of work it takes to discharge a grey-zone patient (e.g., the "legwork" required to coordinate extensive follow-up)	May be easier to admit patients with comorbidities

ED clinician <> EMS CCC	Inability to get handoff from EMS oneself (e.g., must get information from ED nurse)	Ability to get handoff from EMS oneself
ED clinician <> ED nurse CCC	Heavy reliance on ED nurses to collect and share information (e.g., what's going on in the patient's room) ED nurses push ED clinicians to make a quick disposition decision	Less reliance on ED nurses to collect and share information
ED attending <> ED resident/PA CCC	Fewer comprehensive conversations	More frequent and more comprehensive conversations
ED clinician <> consulting physician CCC	Difficult communication with consulting clinician (e.g., awkward social interaction, consulting clinicians are "over-worked, under-slept")	Time to contact as many inpatient services as needed oneself
ED clinician <> Hospitalist CCC	ED clinician mindset of just getting the patient admitted and allowing the hospitalist to diagnose and treat	More collaboration in disposition decision-making in the ED
ED clinician <> PCP CCC	Less time spent attempting to contact PCP	More time spent sending messages to PCP
ED staffing	ED is short-staffed and unable to open all ED rooms	Sufficient staffing to cover and open all ED rooms
Access to social work	Inability to access social work in the ED	Ability to access social work in the ED
Access to physical therapy	Inability to access physical therapy in the ED	Ability to access physical therapy in the ED
Physical Environment		
ED commotion	Noisy, cramped, chaotic ED	Quiet, calm ED environment
Available space	Lack of space (e.g., full waiting room, patients boarding in the hallway, all ED beds occupied)	Sufficient space (e.g., small/empty waiting room, open ED beds, no patients boarding the in the hallway)

CCC = Communication, coordination, collaboration; ED = Emergency department; EMS = Emergency medical services; PA = Physician assistant; PCP = Primary care physician

6.3.1.1 Person

Elements that described physical (i.e., patient clinical factors), psychosocial (i.e., patient psychosocial factors), or preferences (i.e., patient, care partner, consulting clinician preference) did not vary between high and low demand. ED clinicians' sense of responsibility & motivations

also did not vary based on demand. Cognitive factors including ED clinician risk tolerance and ED clinician experience, training, and knowledge did vary with demand. ED clinicians reported having a higher risk tolerance for medical problems under conditions of low demand, often because they had greater bandwidth to source information and discuss options with the patient as one ED attending noted: "I personally am maybe more comfortable with high-risk discharges if I've had those in-depth conversations" (P118). Some ED clinicians also commented that their disposition style become more paternalistic and more conservative as demands increase. Under conditions of high demand, ED clinicians reported relying more on their "gut instinct" or gestalt to make a disposition decision. Under low demands, ED clinicians felt that they had more cognitive capacity to think through the decision.

6.3.1.2 Tasks

Task elements described the nature and dimension of ED clinicians' work. Task demands, ownership, and sequence varied with demand, as did time pressure. Participants explained that when tasks demands are high "everyone is just frantically trying to get stuff done" (P114). ED clinicians experienced high task demands when they were taking care of numerous complex patients. ED clinicians also reported that they were continually thinking about the patient's length of stay and how long the patient had been waiting, which added to the perceived cognitive burden and task demands.

Task ownership varied based on the extent to which the ED clinician could perform the task themselves. Under conditions of high demand, ED clinicians often delegated tasks that could be done by others (e.g., by the ED nurse) and prioritized performing tasks for which they were uniquely qualified. For example, although most ED clinicians noted that they preferred to contact

care partners themselves, under high demands, they regularly delegated this task to the ED nurse and then took report. Under conditions of low demand, ED clinicians preferred performing most tasks themselves.

Under conditions of high demands, ED clinicians had to alter the order in which they did tasks, often to accommodate the unpredictable or urgent needs of numerous patients or delays in receiving information. Likewise, ED clinicians reported spending less time on disposition tasks and having to quickly and frequently reprioritize their tasks during periods of high demand. Under conditions of low demand, ED clinicians were generally able to complete tasks in their preferred order across their preferred timeframe.

ED clinicians reported time pressure as an inherent trait of the ED, even during times of low demand. Most ED clinicians felt that they had the responsibility to efficiently disposition patients and maintain an ED environment that would be prepared for a massive influx of patients at any time (e.g., mass casualty event). However, most ED clinicians acknowledged that they felt a greater sense of time pressure under conditions of high demand (e.g., full waiting room) compared to low demand. Sense and source of time pressure also seemed to vary by role. For example, ED attendings reported feeling responsible for the flow of the ED. In another example, ED residents and ED APPs reported feeling time pressured to quickly disposition patients from ED attendings or ED nurses.

Interruptions, autonomy, and multitasking were generally experienced the same during high and low demands. Interruptions were ubiquitous regardless of level of demand. Autonomy was only mentioned by ED residents and APPs in the context of their interaction with ED attendings. ED residents and APPs described a range of perceived autonomy from feeling like they have very little autonomy to make clinical decisions for patients to feeling as though they operate

completely independently. The description of autonomy provided by ED residents and APPs differed. The ED residents described being allotted more autonomy as they progressed in their years of residency. ED residents were generally optimistic in their description of autonomy to make disposition decisions and acknowledged the finite nature of the oversight they experienced, recognizing that they would earn more autonomy over the course of their residency program and eventually operate entirely autonomously as an attending upon completion of the program.

However, APPs had a less optimistic perspective. APPs described feeling like "they dropped us basically into kind of a resident role" (P107). ED APPs described this as being helpful in the beginning of their tenure but frustrating as they gained more experience: "Which is fine when you're early on in your career and you are literally still learning. But as time goes by, you're like there's no learning opportunity for me with this. This is just an opportunity for me to do more work or get yelled at or deal with someone's expectations" (P107).

Multitasking also occurred under both low and high demands. However, multitasking seemed to be more prevalent under conditions of high demand. For instance, one ED clinician reported having to do chart review to elicit health history and develop a disposition plan in the patient's room as opposed to outside of the patient room due to high demands.

6.3.1.3 Tools and technology

Tools and technologies consisted of physical (e.g., phone), virtual (e.g., ED trackboard), and informational elements. How ED clinicians used tools like the phone, ED trackboard, and the electronic health record (EHR) were generally the same regardless of demands. The main difference in the use of these technologies related to the amount of time they were in use and by whom. During periods of high demand, ED clinicians spent less time conducting chart review in the EHR, for example. Further, ED clinicians often delegated potentially time-consuming tasks,

like calling care partners to gather disposition-related information, to ED nurses. During periods of low demands, ED clinicians personally carried out these tasks.

ED clinicians categorically reported having limited, inaccurate, or untimely information about the patient (e.g., medical history, living situation). Some ED clinicians were unable to find or access disposition-related information in the patient's EHR. This was due to an extensive record that was too time-consuming to review in-depth, a lack of interoperability among EHR providers, or simply a lack of comprehensive information in the EHR (e.g., sparse notes from previous visits). Many ED clinicians commented that patients were not a comprehensive source of information either due to the patient's cognitive status (e.g., dementia) or the patient's concern regarding consequences of fully divulging their situation (e.g., potential for loss of independence). Clinicians also reported challenges with the timeliness of information. For example, it could take a few hours to contact a care partner to verify information, at which point the information was less useful as a disposition decision had already been made.

6.3.1.4 Organization

Organization consisted of institutional policies, practices, and norms. The involvement of the patient and care partners varied with demand. Under conditions of high demand, ED clinicians were unable have extensive conversations with patients about their illness or injury, preferences, and next steps. ED clinicians were only able to ask "key pointed questions" that targeted "the meat and potatoes" (P118). Under conditions of low demand, ED clinicians were able to ask "a bunch of ancillary questions" (P103) about follow up care, their living situation (e.g., is the only bathroom on the second floor?), and their support resources. ED clinicians also noted that the decision felt more shared and like they have more time to educate the patient under low demands.

ED disposition culture was a result of numerous factors and influenced ED clinicians' disposition decision-making behavior. Under conditions of both high and low demands, ED clinicians commented on the increased amount of work it takes to discharge a "grey-zone patient" (i.e., a patient for whom a disposition decision is not immediately obvious). Under conditions of high demands, ED clinicians commented that dispositioning a patient "just takes a lot more legwork" and that admission is seen as the "big red easy button" (P104). One ED clinician reflected that when the ED is busy, disposition decisions "become a little bit less thoughtful" (P107).

Individual clinician and department-level thresholds for admission varied with conditions of the inpatient departments. With hospital census full, ED clinicians commented that the department's threshold for admission shifted such that more borderline patients would not be admitted. They also noted that it was relatively easy to get an older adult with numerous comorbidities admitted, as there is a softer threshold for admission for this population, especially when hospital census was manageable.

Bounceback patients, a recently-discharged patient who returns to the ED, were another factor that shaped disposition culture regardless of demand. ED clinicians receive monthly summaries of their patients who incurred an adverse outcome post-disposition, which most saw as useful for learning as opposed to a punitive. However, as one ED APP noted, "I think it's hard for it to not feel…punitive… fundamentally, I don't think it is. It still feels bad….these cases are reviewed from like a quality and safety standpoint, is was there anything we missed that, say, the standard, the average emergency physician would have done differently or would have not missed?...But, occasionally, you know, it's like human error, there's progression of disease, like there's all of those things that are just, yeah, I'm usually glad patients just listened to the return precautions as long as they're okay" (P117).

Most ED clinicians noted that they considered the possibility of boucebacks during disposition decision-making. ED clinicians reported varying levels of stigma surrounding bouncebacks. One ED attending commented: "I think [attendings] don't want to be shamed by having a higher than, you know, average percentage of bounce backs. You know, they don't love it when they're like, oh, yeah, that person you saw the other day, they came back, and like I admitted them. That doesn't feel good to people" (P113). In contrast, one ED APP commented: "You know, no one's like, oh, you had eight bounce-backs, man. I mean, usually they're like people who come to the emergency room every ten days anyway. It's not, and like every time someone leaves the emergency room, I tell them, please come back if things get worse, you know. So it's usually a good thing that they come back" (P106).

Communication, coordination, and collaboration (CCC) among ED clinicians and between ED clinicians and others varied with demand. Under conditions of high demand, ED clinicians were often unable to participate in the handoff from EMS, meaning they were unable to personally obtain critical transition-related information that would be needed to inform a disposition. The ED nurse would regularly participate and report back to the ED clinician. Under conditions of low demand, ED clinicians were able to participate in the handoff, meaning they could receive information first-hand and ask questions.

CCC between ED clinicians and ED nurses was contingent on the nature of their professional relationship. The primary factor was the level of trust or confidence the ED clinician had in the ED nurse to successfully carry out tasks. For example, under conditions of high demand, ED clinicians relied on ED nurses to collect and share information about the patient status to which they were not privy (e.g., what occurs in the room when the ED clinician is not present). Another factor influencing the dynamic between ED clinicians and ED nurses was the cascading effect

disposition had on ED nurses' work. ED nurses were often the first to experience operational effects of a disposition decision, which sometimes led them to pressure ED clinicians to make a disposition decision. For instance, when a patient is dispositioned and transferred out of the ED, their bed is either filled by a new patient or left vacant. The latter was reported to reduce ED nurse workload.

During a given shift, ED attendings work with two junior clinicians – either residents, APPs, or both. Under conditions of high demand, ED attendings and ED residents/APPs were unable to have in-depth conversations about their patients. The extent to which work was delegated among ED clinicians depended on the personalities, experience, and professional relationship among the clinicians involved. For instance, one ED APP said "I'm like, we're theoretically a team, so I'm going to ask [the ED attending] to do this because I'm doing all the work. And just, organizationally, it makes no sense for me to have seven tasks and [the ED attending] to have none" (P107). However, APPs acknowledged that not all APPs felt comfortable discussing distribution of work with their ED attending. Under conditions of low demand, as one ED attending commented, ED attendings were able to "teach and sit and talk and think critically with residents" (P118).

CCC between ED clinicians and consulting clinicians (e.g., neurosurgery) generally related to procuring an assessment and disposition recommendation. The dynamic of these interactions varied. Under conditions of high demand, the conversations could be difficult with both clinicians having limited time and with information and requests often being relayed through a resident. Further complicating the interaction, an ED APP noted that consulting residents are "massively overworked, under-slept" and can be "really rude" or "yell at you" (P107).

Under conditions of low demand, ED clinicians often contacted consultants themselves, leading to more direct and efficient communication. Regardless of demand, ED clinicians commented on the challenges of engaging consulting clinicians, especially when there was disagreement about disposition. ED clinicians rely heavily on consulting clinicians for assessment and admission support. In some cases, ED clinicians "have to like push a little bit more one way or another" to achieve the preferred disposition outcome (P102). In other cases, ED clinicians went against the consultant's recommendation, as one ED resident described: "It's tough because you, as a nonspecialist, have to decide whether or not to override the recommendation of the specialists, who, you know, by definition should outrank you in terms of knowledge of that specific problem, and who you called in the first place to gain their recommendation and expertise…And, you know, it's a double-edged sword because if you start going against their recommendations…But, you know, obviously, you've got to look out for the patient overall" (P115).

The relationship between ED clinicians and hospitalists was similar to that of consulting clinicians. ED clinicians often contacted hospitalists to discuss disposition alternatives. The dynamic of the relationship between ED clinicians and hospitalists was contingent upon the personality, experience, professionalism, and perception of one another's role. For instance, one ED attending described the dynamic as such: "Some of us conceive our job as like I decide what happens, and then it's my job to make the hospitalist do whatever I want. And then other people…try to keep an open mind, like if the hospitalist thinks it's a bad idea, they're usually very smart people, and I want to talk to them about why they think it's bad. And then, you know, the responsibility will end up on me at the end, but like I would certainly try to like take some input in there" (P103). Likewise, an ED fellow commented that "I think that's just…our emergency department's bias and not understanding all the, like all of the pressures of [the hospitalist's] job

either. And that, you know, I know they feel kind of alternatively same way. I think more so it changes like am I, like is this the patient I'm really going to advocate for or like use my political capital on?" (P117). Overall, ED clinicians noted that the nature of their interaction was dependent upon the individual hospitalist. Hospitalists were described by a range of terms such as described "collegial", "incredibly collaborative and helpful", "challenging to work with some days", "always giving you a hard time", "begrudging", "jerks", and "really rude" (P106, 115, 116, 118).

Under conditions of high demand, the relationship between ED clinicians and hospitalists was such that, ED clinicians forewent comprehensive diagnosis and treatment in the ED in favor of getting the patient admitted and allowing the hospitalist to diagnose and treat. As one ED attending described, "I'm worried about this person's safety at home. I don't think they're going to fly, or I'm worried about them at their facility. I don't think they have the resources…I don't even know what their capabilities are, and I don't have time to figure it out. Let's just bring them in the hospital for a day or two. Let [the hospitalists] sort it all out, stabilize, and then go back and figure it out" (P104).

CCC between ED clinicians and primary care physicians (PCPs) was inconsistent. Whether ED clinicians connected with a patient's PCP depended on available time, accessibility of the PCP, time of day, and patient acuity. During periods of low demand, ED clinicians had more time to message or call PCPs to give updates or ask for recommendations.

ED staffing varied to the extent to which there were sufficient staff to open and cover all ED rooms. This most often related to staffing of ED nurses. High demand was associated with understaffing. Under conditions of insufficient staffing, only a subset of all potentially available rooms could be used. Low demand was associated with sufficient staffing.

Clinical momentum referred to ED clinicians' inclination "towards doing what's been done in the past" (P103). Although prevalent both during periods of high and low demand, clinicians seemed to rely upon both proximal (e.g., the workup started by a previous ED clinician) and distal (e.g., outcomes of patient's previous ED visits) information more heavily – almost as a cognitive aid – during periods of high demand. ED clinicians noted that standard of care would be upheld regardless of demands within the ED.

Shift change norms refer to the departmental expectation that ED clinicians are "signing over patients [to the next shift] with a clear plan" (P117). ED clinicians felt a sense of personal accountability to their patients and fellow ED clinicians which resulted in an expectation of certain professional courtesies as one ED attending described: "People really want a very tight sign out, meaning an if/then plan….And if it's getting close to sign out, we haven't had time to have those discussions, or someone hasn't called back yet, that's probably a time when I'd be more likely to admit the patient as opposed to sending them home, if that makes sense, because I'm not going to be available or be there to have those complex discussions" (P118).

Access to social work and physical therapy (PT) varied. These services were generally less available on nights and weekends. However, some ED clinicians noted that these services, especially PT, were almost never available within the ED. A lack of access to these services contributed to high demands.

6.3.1.5 Physical environment

Physical environment consisted of the physical spaces that influenced the disposition decision-making process. External to the ED, the patient's home characteristics (e.g., floor plan) informed the disposition recommendation, most notably the presence of stairs: "Do they have to

go up like a million stairs to get into their house?" or "Is your bathroom on the second floor, and you can't climb stairs right now? (P115, 118).

ED commotion varied with demand. Under conditions of high demand, the ED was described as "crowded, high energy, high activity levels, and there's going to be a little bit of tension and stress in the air" (P105), which was reported to be cognitively taxing on ED clinicians and result in a lack of space to make disposition decisions (e.g., private room to have uninterrupted conversations). Under conditions of low demand, the ED was described as "less noise, less commotion, less movement" (P118).

Available space varied with demand. Under conditions of high demand, there were generally more patients in the ED which led to "seeing patients out of a hallway or a closet room" (P112). Where the patient was seen within the ED influenced how frequently they were visited by clinicians and the pace of care. For example, due to space limitations, in one observation, the patient was moved from the ED hallway to an ED observation unit room across the hallway from the main ED. During the follow up interview, the ED nurse noted that the physical distance made it difficult to conduct reassessments and communicate with patient. Under conditions of low demand, "you have the space" and there are "no people in the hallways" (P105, 112).

6.3.1.6 External environment

External environment related to the federal guidelines and insurer policies and did not vary with demand. ED clinicians noted the lack of standard practice disposition guidelines, as one ED attending noted: "these are gray-area patients where there's no guideline" (P108). ED clinicians held varied perspectives on insurance. Some ED clinicians noted that they did not consider a patient's insurance. Others indicated that they considered insurance to the extent that they try to disposition the patient to a location covered by insurance. Further, due to the Medicare requirement

that patients spend three nights in the hospital, patients who required admission to a skilled nursing facility (SNF) were unable to be directly admitted to the SNF from the ED, which some clinicians found frustrating.

State/count/local malpractice policies informed the potential for malpractice repercussions if the patient were to experience adverse outcome post-disposition. One ED attending noted that "I think [potential for malpractice is] somewhat overlooked but has no doubt a huge impact on how we decide to provide care" (P113).

6.4 Discussion

The purpose of this study was to holistically explore how the ED work system influences ED disposition decision-making and determine if there are differences in the orientation of the work system under low and high demands**.** To do this, we recruited the concept of configuration to guide the analysis of rich contextual-inquiry and interview data with ED patients and clinicians. Our findings reveal that many aspects of the ED work system remain the same under low and high demands. However, there was a subset of work system elements that varied in presentation, which suggests that the ED work system structure is meaningfully different under conditions of low and high demand. An understanding of how the ED work system structure varies, thereby influencing process performance and outcomes, can inform the development of adaptive work system redesigns such that the work system is robust and reflexive to variable demands and conditions.

6.4.1 A complete ED work system

Previous work has identified elements within every component of the ED work system, with the exception of physical environment, that shape the ED disposition decision-making

process (Rutkowski et al., In progress). Our triangulated approach resulted in the identification of additional elements and the expanded characterization of previously identified elements across all work system components, including physical environment. Our most notable contributions occur within person, task, organization, and physical environment.

Related studies have clearly defined the role that patient factors (e.g., clinical, psychosocial, preference) have in shaping the ED disposition decision-making process (Rutkowski et al., In progress - Chapter 5). These studies have also begun to outline the role that ED clinician factors (e.g., risk tolerance, training, beliefs, preference) have in informing the disposition. Our findings also revealed that an ED clinician's sense of professional and moral responsibility & motivations also inform the disposition decision-making process. Fully comprehending how ED clinicians perceive their role within the disposition decision-making process is needed to develop human-centered system structures that acknowledge the beliefs and expectations of the individuals that both compose and operate within them.

Previous descriptions of task have been limited to task sequence (i.e., the order in which tasks are preformed) and time pressure (Rutkowski et al., In progress). This is unsurprising given the process-oriented nature of the US healthcare system. Yet, our findings reveal that there are numerous task factors involved (e.g., demands, ownership, autonomy) that have the potential to shape how ED clinicians perform their work and with whom. Defining the characteristics of task elements allows us to assess how and why clinicians conduct their work in the way that they do and begin to identify whether ED clinicians are at risk for suboptimal job-related outcomes (e.g., dissatisfaction) (Hackman et al., 1975; Herzberg, 1974).

Within organization, our findings highlight the numerous roles involved in the ED disposition decision-making process. Previous work has also noted the involvement of numerous

roles across multiple touchpoints (Rutkowski et al., In progress; Salwei et al., 2020). However, our study takes these findings a step further by characterizing the nature of these touchpoints and how they are subject to change with demands, which is a necessary step in determining the nature of the interaction (e.g., teaming), the type of work being performed, and the distribution of that work (Holden et al., 2013; Ponnala et al., 2020; Valdez et al., 2015).

Our study is the first to explicitly define the role that the physical environment has in shaping the ED disposition decision-making process. Our findings reveal that aspects of the physical environment of the ED and the patient's home shape the disposition decision. This suggests that ED disposition decision-making does not occur within the boundaries of a single work system (Werner et al., 2020). Rather, it is a process that spans, influences, and is influenced by multiple work systems. The seemingly boundary-spanning nature of this process should be a key consideration in the design of work system structures. Historically, system design has occurred within the confines of a single system. However, as our study and others have demonstrated, system design must intentionally consider the boundary-spanning nature of complex clinical processes to ensure that all relevant elements, regardless of geographic location or organizational affiliation, are considered and included system design (Hendrick & Kleiner, 2001; Werner et al., 2020).

6.4.2 Work system elements varied in presentation under conditions of high and low demand

Under conditions of low and high demands, a subset of ED work system elements varied in how they manifest within the work system. At least one work system element within each work system component varied in presentation, except for tools and technologies and external environment. The degree of variation between conditions of high and low demand suggests that

the level of demand has a system-wide influence on the work system's configuration. Previous work has characterized the range or variation of specific elements (e.g., time pressure) (Rutkowski et al., In progress). Although highlighting the variation of specific, seemingly influential elements is pertinent, these elements are often explored in isolation of the broader system. To our knowledge, no previous study has characterized the entire ED work system under conditions of low and high demand. Determining where and how elements are situated within the broader work system is necessary to establish a holistic understanding of how each element individually and collectively, through interactions, shape process performance (Carayon et al., 2006; Carayon et al., 2014; Holden et al., 2013).

The configurations presented in this study represent the extreme conditions under which disposition decision-making occurs. Despite the seemingly additional cognitive, physical, and temporal capacity associated with the ED work system under conditions of low demands, ED clinicians still reported that some aspects of the work system were suboptimal. For instance, although ED clinicians reported experiencing less time pressure under conditions of low demands, time pressure was still present and reported to influence patient, clinician, and organizational outcomes. As such, it is important to avoid the fallacy that the optimal ED work system configuration to promote favorable disposition outcomes is presently being achieved under conditions of low demand.

6.4.3 Configuration: a step further

Traditionally, configuration aims to capture the subset of work system elements that most influence process performance (Holden et al., 2013). According to work systems theory, all elements are ever-present in a given work system. What varies is the extent to which each

element shapes process performance. Some elements may have very little influence on process performance to the extent that they are nearly undetectable in a work system analysis. Conversely, other elements may be the primary drivers of process performance and outcomes. Knowing the level of influence an element has on process performance gives insight into which elements, if redesigned or intervened upon, would have the greatest effect on the process and outcomes. This could indicate where researchers and practitioners should focus their efforts and explain why previous intervention on less influential elements failed to have the desired effect. In short, configuration has the potential to transform the highly descriptive outputs of a work systems analysis into perspective, actionable findings.

Although our data collection process was robust, we did not have sufficient evidence to determine the extent to which each element shaped the disposition decision-making process, a key variable in configuration (Holden et al., 2013). Rather, we were only able to identify whether an element was present in the system. Our highly descriptive findings offer a thorough representation of the ED work system under conditions of low and high demand. Such insight will inform future research, as there is much to still explore, but offer little in terms of operational insights. To translate our descriptive findings into more prescriptive insights, we must characterize the influence each element has on the disposition decision-making process.

To date, a few authors have used configuration, with only some having characterized elemental influence (Carman et al., 2021; Hay et al., 2020; Weiler et al., 2022; Werner et al., 2020). Although these studies represent an important first step in understanding the application of configuration, additional work is needed to establish a set of methods with which to operationalize configuration.

6.5 Limitations

The findings from this study should be considered considering several limitations. First, the scope of the data collection for the contextual-inquiry based observations was limited to the patient room, so observers were unable to capture situations that occurred outside of the patient's purview. Further, follow-up interviews were collected with ED clinicians during their shift, limiting the number of questions that observers could ask. As a result, our findings may not comprehensively represent all work system factors that contribute to disposition decision-making. We aimed to address this limitation by triangulating observation findings with clinician interviews.

Second, all data were collected at one academic teaching hospital with a specific patient population (i.e., older adults). The results may not be representative of disposition decision-making at other types of institutions or for other patient populations. Third, our analysis primarily depicts the ED clinician perspective. There are likely additional work system elements present within the ED work system that could be identified through the integration of additional perspectives (e.g., patient, care partner).

Fourth, this analysis relied upon the assumption that all identified work system elements interact with one another (Carayon et al., 2006). However, our findings are presented according to individual work system components. Because work occurs within the interactions among elements, it is particularly difficult to categorize and represent work systems data. Future work should focus on not only identifying work system elements but exploring the nature of their interactions (e.g., overall work system balance, compensatory work system balance) (Carayon, Kianfar, Li, & Wooldridge, 2015).

Finally, our findings represent the best/worst-case scenario or the best/worst 10% of days. We asked ED clinicians to describe days where every aspect of their work was either ideal or suboptimal. We recognize that these descriptions do not depict what most days are like for most ED clinicians. Moreover, we recognize that work system elements under both low and high demands may be present to varying degrees depending on the day. However, it is critical that we have a rich description of what the ED work system looks like under extreme conditions to understand how and why the work system changes. This will allow for the development and implementation of more adaptive tools, policies, etc.

6.6 Conclusion

Characterizing the complex system within which disposition decision-making occurs is a critical step in establishing a comprehensive understanding and improving the clinical decisions that occur within the ED for older adult patients (Calder et al., 2012; Capan et al., 2018). There are similarities and differences in how the ED work system configures under conditions of low and high demand. To fully elucidate the meaning and effect of these differences, we must develop a systematic approach to eliciting the influence each work system element has on disposition decision-making process performance. With such an approach, researchers will be able to fully realize the benefits of configuration.

6.7 Chapter 6 references

Agency for Healthcare Research and Quality (2011). *Disposition of Patient*. https://ushik.ahrq.gov/ViewItemDetails?system=mdr&itemKey=65837000

Ashman, J. J., Schappert, S. M., & Santo, L. (2020). *Emergency Department Visits Among Adults Aged 60 and Over: United States, 2014–2017* (367). N. C. f. H. Statistics. https://www.cdc.gov/nchs/products/databriefs/db367.htm#:~:text=During%202014%E2%80%932017%2C%2020%25,visits%20(3%E2%80%936).

Barry, C.A., Britten, N., Barber, N., Bradley, C., Stevenson, F., 1999. Using reflexivity to optimize teamwork in qualitative research. Qual. Health Res. 9 (1), 26–44.

Bragard, I., Dupuis, G., & Fleet, R. (2015). Quality of work life, burnout, and stress in emergency department physicians: a qualitative review. *European Journal of Emergency Medicine*, *22*(4). https://journals.lww.com/euro-emergencymed/Fulltext/2015/08000/Quality_of_work_life,_burnout,_and_stress_in.1.aspx

Calder, L. A., Forster, A., Nelson, M., Leclair, J., Perry, J., Vaillancourt, C., Hebert, G., Cwinn, A., Wells, G., & Stiell, I. (2010). Adverse events among patients registered in high-acuity areas of the emergency department: a prospective cohort study. *Cjem*, *12*(5), 421-430. https://doi.org/10.1017/s1481803500012574

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576.e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Capan, M., Pigeon, J., Marco, D., Powell, J., & Groner, K. (2018). We all make choices: A decision analysis framework for disposition decision in the ED. *The American Journal of Emergency Medicine*, *36*(3), 450-454. https://doi.org/https://doi.org/10.1016/j.ajem.2017.11.018

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Qual Saf Health Care*, *15 Suppl 1*, i50-58. https://doi.org/10.1136/qshc.2005.015842

Carayon, P., Wetterneck, T., Rivera-Rodriguez, A. J., Hundt, A., Hoonakker, P., Holden, R. J., & Gurses, A. P. (2014). Human factors systems approach to healthcare quality and patient safety. *Appl Ergon*, *45*(1), 14-25. https://doi.org/10.1016/j.apergo.2013.04.023

Carayon, P., Wetterneck, T. B., Rivera-Rodriguez, A. J., Hundt, A. S., Hoonakker, P., Holden, R., & Gurses, A. P. (2014). Human factors systems approach to healthcare quality and patient safety. *Applied ergonomics*, *45*(1), 14-25.

Carman, E.-M., Fray, M., & Waterson, P. (2021). Facilitators and barriers of care transitions - Comparing the perspectives of hospital and community healthcare staff. *Applied Ergonomics*, *93*, 103339. https://doi.org/https://doi.org/10.1016/j.apergo.2020.103339

Chamberlain, J. M., & Pollack, M. M. (1998). A method for assessing emergency department performance using patient outcomes. *5*(10), 986-991.

Chen, R. A.-O., Cheng, K. A.-O., Lin, Y. A.-O., Chang, I. A.-O. X., & Tsai, C. A.-O. (2021). Predicting Unscheduled Emergency Department Return Visits Among Older Adults: Population-Based Retrospective Study. *JMIR Med Inform*(2291-9694 (Print)).

Daniels, L. M., Sorita, A., Kashiwagi, D. T., Okubo, M., Small, E., Polley, E. C., & Sawatsky, A. P. (2018). Characterizing Potentially Preventable Admissions: A Mixed Methods Study of Rates, Associated Factors, Outcomes, and Physician Decision-Making. *Journal of general internal medicine,*, *33*(5), 1525-1497 (Electronic).

Fernando, S. M., Rochwerg, B., Reardon, P. M., Thavorn, K., Seely, A. J. E., Perry, J. J., Barnaby, D. P., Tanuseputro, P., & Kyeremanteng, K. (2018). Emergency Department disposition decisions and associated mortality and costs in ICU patients with suspected infection. *Crit Care*, *22*(1), 172. https://doi.org/10.1186/s13054-018-2096-8

Flanagan, J. C. (1954). The critical incident technique. *Psychological bulletin*, *51*(4), 327.

Gabayan, G. Z., Gould, M. K., Weiss, R. E., Patel, N., Donkor, K. A., Chiu, V. Y., Yiu, S. C., Jones, J. P., Hoffman, J. R., & Sarkisian, C. A. (2016). Poor Outcomes After Emergency Department Discharge of the Elderly: A Case-Control Study. *Ann Emerg Med*, *68*(1), 43-51.e42. https://doi.org/10.1016/j.annemergmed.2016.01.007

Hackman, J. R., Oldham, G., Janson, R., & Purdy, K. (1975). A New Strategy for Job Enrichment. *California Management Review*, *17*(4), 57-71. https://doi.org/10.2307/41164610

Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research *Advances in psychology* (Vol. 52, pp. 139-183): Elsevier.

Hay, G., Klonek, F., & Parker, S. (2020). Diagnosing rare diseases: A sociotechnical approach to the design of complex work systems. *Applied Ergonomics*, *86*, 103095. https://doi.org/10.1016/j.apergo.2020.103095

Hendrick, H. W., & Kleiner, B. M. (2001). *Macroergonomics - An Introduction to Work System Design*.

Herzberg, F. (1974). Wise Old Turk. *Harvard Business Review*, *52*(5), 70-80.

Holden, R. J., Carayon P Fau - Gurses, A. P., Gurses Ap Fau - Hoonakker, P., Hoonakker P Fau - Hundt, A. S., Hundt As Fau - Ozok, A. A., Ozok Aa Fau - Rivera-Rodriguez, A. J., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*(11), 1669-1686.

Kirwan, B. (1994). *A guide to practical human reliability assessment*. CRC press.

Nugus, P., Holdgate, A., Fry, M., Forero, R., McCarthy, S., & Braithwaite, J. (2011). Work Pressure and Patient Flow Management in the Emergency Department: Findings From an Ethnographic Study. *Academic emergency medicine : official journal of the Society for Academic Emergency Medicine*, *18*, 1045-1052. https://doi.org/10.1111/j.1553-2712.2011.01171.x

Ponnala, S., Block, L., Lingg, A., Kind, A., & Werner, N. (2020). Conceptualizing caregiving activities for persons with dementia (PwD) through a patient work lens. *Applied Ergonomics*, *85*, 103070. https://doi.org/10.1016/j.apergo.2020.103070

Robson, C., & McCartan, K. (2016). *Real world research*. John Wiley & Sons.

Rui, P., & Kang, K. (n.d.). *National Hospital Ambulatory Medical Care Survey:2017 emergency department summary tables*. N. C. f. H. Statistics. https://www.cdc.gov/nchs/data/nhamcs/web_tables/2017_ed_web_tables-508.pdf

Rutkowski, R. A., Scheer, E., Carlson, C., Parks, R., Pulia, M. S., Patterson, B. W., Shah, M. N., Hoonakker, P., Carayon, P., Smith, M., Christensen, L., & Werner, N. E. (In progress). A scoping review of emergency department disposition decision-making

Saldaña, J. (2015). *The Coding Manual for Qualitative Researchers*. SAGE Publications Ltd.

Salwei, M. E., Barton, H., Werner, N. E., Rutkowski, R., Hoonakker, P. L. T., Wust, K., Shah, M. N., Patterson, B. W., Pulia, M. S., Hamedani, A. G., Smith, M., King, B., Dail, P. v., & Carayon, P. (2020). Identifying roles in older adults' emergency department transitions. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *64*(1), 685-689. https://doi.org/10.1177/1071181320641159

Stiell, A., Forster, A. J., Stiell, I. G., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. *Cmaj*, *169*(10), 1023-1028.

Valdez, R. S., Holden, R. J., Novak, L. L., & Veinot, T. C. (2015). Transforming consumer health informatics through a patient work framework: connecting patients to context. *Journal of the American Medical Informatics Association*, *22*(1), 2-10. https://doi.org/10.1136/amiajnl-2014-002826

Wears, R., & Leape, L. L. (1999). Human error in emergency medicine. In *Ann Emerg Med* (Vol. 34, pp. 370-372). https://doi.org/10.1016/s0196-0644(99)70133-2

Wears, R. L., Woloshynowych, M., Brown, R., & Vincent, C. A. (2010). Reflective analysis of safety research in the hospital accident & emergency departments. *Human Factors and Ergonomics in Patient Safety*, *41*(5), 695-700. https://www.sciencedirect.com/science/article/pii/S0003687009001665

Weigl, M., Müller, A., Holland, S., Wedel, S., & Woloshynowych, M. (2016). Work conditions, mental workload and patient care quality: a multisource study in the emergency department. *BMJ quality & safety*, *25*(7), 499-508.

Weiler, D. T., Lingg, A. J., Eagan, B. R., Shaffer, D. W., & Werner, N. E. (2022). Quantifying the qualitative: exploring epistemic network analysis as a method to study work system interactions. *Ergonomics*, 1-16. https://doi.org/10.1080/00140139.2022.2051609

Werner, N. E., Rutkowski, R., Graske, A., Finta, M. K., Sellers, C. R., Seshadri, S., & Shah, M. N. (2020). Exploring SEIPS 2.0 as a model for analyzing care transitions across work systems. *Applied Ergonomics*, *88*, 103141.

Chapter 7: (con)Figuring out influence: A modified Delphi approach to configural diagramming to identify influential work system factors on ED disposition decision-making

This chapter is presented in the form of a manuscript prepared for *Ergonomics.*

7.1 Introduction

Disposition decision-making determines to which location a patient will transition upon the conclusion of their ED visit (e.g., hospital, home) (Agency for Healthcare Research and Quality, 2011). This decision is crucial in promoting patient safety (Calder et al., 2010; Calder et al., 2012) and minimizing healthcare costs (Fernando et al., 2018), especially for high-volume patient populations at increased risk for suboptimal outcomes post-disposition such as older adults (Ringer et al., 2018). For example, if a patient is dispositioned home without the necessary supports (e.g., care partner to enact discharge instructions, access to home health services), they could experience negative outcomes such as death, repeat ED visits, pain, or unanticipated admission to the hospital (Aminzadeh & Dalziel, 2002; Gabayan et al., 2016; Probst et al., 2017). The ED physician who discharged the patient could be at risk for malpractice litigation and feelings of stress (Bragard et al., 2015). The healthcare organization could incur penalties for repeat ED visits or hospitalizations and experience overcrowding (MedPAC, 2008). In effect, disposition decision-making marks the beginning of the care transition out of the ED, which is known to represent significant patient safety and healthcare quality challenges (Coleman & Berenson, 2004).

However, determining an older adult's disposition location can be challenging. Older adults have risks, considerations, challenges, and needs that influence how they are cared for and dispositioned from the ED (Burton et al., 2014). For example, standard disposition planning

involves proximal planning, such as a short-term recovery protocol. However, for an older adult to be successful post-disposition, ED physicians often have to take both a proximal and distal (e.g., long-term care plan) approach to disposition planning (Burton et al., 2014).

This already time-consuming and cognitively-taxing disposition decision-making process is further complicated by the competing goals and variable demands that are hallmarks of the ED (Wears et al., 2010). Acute (i.e., immediate with direct consequences) goals such as efficiency are often prioritized over chronic (i.e., long-term) goals such as patient safety (Nugus & Braithwaite, 2009). These competing goals influence the demands experienced by ED clinicians. Reconciling acute and chronic goals often results in physicians striving to mitigate demands while navigating the tension between "providing optimal care to the individual patient and the need to provide care for multiple patients" (Nugus & Braithwaite, 2009, p. 512). To achieve an optimal balance between acute and chronic goals, thereby effectively managing demands, we must first characterize the variable and extreme conditions under which ED clinicians operate. In other words, we must understand how demands inform the ED work system and how the system shapes and is shaped by the disposition decision-making process. We conceptualize demand as an emergent property of the ED work system that determines the amount of resources required to perform a process (Hart & Staveland, 1998).

A sociotechnical work systems model, such as the Systems Engineering Initiative for Patient Safety (SEIPS) model, is well-equipped to identify the factors that influence the disposition decision-making process (Carayon et al., 2006; Holden et al., 2013). The SEIPS model integrates concepts from healthcare quality and systems theory to describe the set of factors (i.e., elements) that define the system that influences a given process. Specifically, the SEIPS model identifies the *persons* who use *tools* to perform *tasks* within an *organization*, *physical environment*, and

broader *external environment*. These elements interact to produce processes and, ultimately, outcomes (Carayon et al., 2006; Carayon et al., 2014).

Previous characterizations of the ED work system capture the ED broadly, at a snapshot in time, or under a very specific set of conditions (e.g., the case of a 50-year-old male patient with chest pain) (Calder et al., 2012; Calder et al., 2015; Capan et al., 2018). Although these studies represent a necessary step in characterizing the factors that influence the ED disposition decision-making process, findings from these studies do not account for the variable demands of the ED nor explore how that variability influences the disposition decision-making process. Although the findings from these studies do begin to characterize the factors that shape the ED disposition decision-making process, their scope and thereby the ability to translate their findings into interventions or system redesigns that accommodate for the dynamic nature of the ED is limited.

Further, previous studies on disposition decision-making have identified numerous work system elements that influence the disposition decision-making process (Rutkowski, Scheer, et al., In progress). How these elements manifest within a work system also seems to vary based on broader conditions (e.g., varied demands in the ED) and the presentation of other work system elements (Holden et al., 2013; Rutkowski, Pulia, et al., In progress). Although it would be ideal to optimize each of these elements and elemental interactions through intervention or redesign, it is unrealistic to do so. Thus, a process that allows researchers to identify the elements that most strongly shape process performance, thereby having the greatest effect on outcomes, is needed to strategically target intervention and redesign efforts.

According to configuration, a work systems construct, "… only a subset of all possible [element] interactions is actually relevant in a given work process or situation … Thus, for a

particular process or situation, one can distinguish a configuration of a finite number of relevant elements that interact to strongly shape the performance *of that process"* (Holden et al., 2013, p. 6). Holden and colleagues go on to suggest that configuration can be used to "compare how two or more [hospital] units or organizations have configured their work system, by design or otherwise, for the same process" (2013, p. 7). In response, previous studies have used configuration to explore cross-boundary work systems (i.e., processes that extend across multiple work systems) (Werner et al., 2020a), study the work system pre- and post-intervention implementation (Hay et al., 2020), and understand the interactions, barriers, and facilitators present within and among sub-systems involved in a process (Carman, Fray, & Waterson, 2021). Therefore, based on Holden and colleagues' definition of configuration, the suggested use cases, and previously published applications, it follows that configuration can be used to explore differences in performance of the *same* process within the *same* work system at two different snapshots in time (e.g., under varied demands).

Conceptually, the application of configuration and its utility in addressing complex work system questions is well-established. Methodologically, though, there remains a dearth of information on how to operationalize the concept. Based on the definition, there are two key steps needed to perform a configural analysis: 1) identify the work system elements involved in shaping process performance and 2) determine the influence each work system element has on shaping process performance. Holden and colleagues note that configuration can be operationalized through the development of configural diagrams, visualizations of the most influential work system elements, using methods like "expert input, literature review, a voluntary reporting system, observations, interviews, surveys, and other[s]" (2013, p. 7). These approaches have been widely applied and successful in addressing the first step (Werner et al., 2020).

However, it is less obvious how these methods can be used to determine the influence each work system element has on shaping process performance. Previous studies that have used the concept of configuration do not provide clear descriptions of their methods (i.e., it is unclear how they specifically translated the attributes of configuration into tangible methods). Thus, the goal of this study was to use configuration to identify the factors that most strongly shape the ED disposition decision-making process under conditions of low and high demand and provide a reproducible set of methods to create configural diagrams.

7.2 Methods

7.2.1 Study design

This modified Delphi survey study took place at an academic medical center with Level One trauma certification and was approved by the University Institutional Review Board.

The Delphi technique is a "an iterative process used to collect and distill the judgments of experts using a series of questionnaires interspersed with feedback" (Skulmoski et al., 2007, p. 2). It is a systematic approach to leveraging and making sense of experts' opinions in the absence of a comprehensive theory or model (Helmer-Hirschberg, 1967). The Delphi technique has a number of advantages including anonymity, iteration, controlled feedback, and statistical aggregation of group responses (Rowe & Wright, 1999).

A traditional Delphi technique "follows a prescribed set of procedures that reflect both behavioral and statistical processes" (Powell, 2002, p. 378). In its truest form, the Delphi technique could "be continuously iterated until consensus is determined to have been achieved", meaning that there could be up to "n" rounds where "n" is the number of the round where consensus is established (Hsu & Sandford, 2007, p. 2). However, a review of studies that used

the Delphi technique found that most studies achieved consensus in two or three rounds (Diamond et al., 2014). Further, response rates are known to decrease (e.g., response fatigue) between rounds, especially among busy clinicians (Graham, 2010; Hasson et al., 2000; Keeney et al., 2005; McKenna, 1994). As such, we determined that we would be able to glean the key benefits of a Delphi technique with a modified approach within two rounds without sacrificing the quality of the study and without overburdening participants.

Our surveys asked participants to rate 32 elements on their influence on the disposition decision-making process for older adults on a 5-point Likert scale from not influential to extremely influential (Appendix C) (Vagias, 2006). To determine the work system elements on which we would survey, we conducted a qualitative work system analysis of contextual inquiry and semi-structured interview data with ED clinicians and older adult patients who presented to the ED. Details of this motivating study can be found elsewhere (Rutkowski et al., In preparation). The survey was piloted with an emergency medicine physician and a qualitative researcher trained in cognitive psychology. Their feedback was integrated into the survey.

There is no agreed upon definition or standard for establishing consensus in Delphi studies (Diamond et al., 2014; McKenna, 1994). The literature reports minimum consensus thresholds from 51% to 80% (Keeney et al., 2005; McKenna, 1994). Many previous Delphi studies coalesce around a 75% threshold (Keeney et al., 2005). However, researchers caution against using an artificially high threshold for consensus as it may be inappropriate given the goals of the study and can lead to unnecessary participant burden (Loughlin & Moore, 1979; McKenna, 1994; McKenna & Hasson, 2002). As such, we selected a consensus threshold of 65%. This threshold reduces survey burden while allowing us to draw meaningful conclusions about the perceptions of the majority of ED clinicians.

7.2.2 Data collection

The surveys were developed in and distributed through Qualtrics (Appendices D and E). ED clinicians were sent an initial mass recruitment email that contained information about the study and an invitation to participate, including the Qualtrics link to the first survey. A follow up reminder email was sent approximately two weeks later. The survey remained open for an additional two weeks (Hsu & Sandford, 2007). The second survey link was sent to ED clinicians individually and follow up reminder emails were sent every 5 days until all surveys were completed. Emails regarding the second survey included a summary of participants' responses and aggregate responses from all participants from the first survey, with the intent that participants would review this information ahead of or while taking the second survey. We collected data between May and June 2022.

We paid participants $100 in e-gift cards for their participation (i.e., $30 upon the completion of the first survey and $70 upon the completion of the second survey). There is no accepted method for determining the sample or panel size and composition appropriate for a Delphi study. As such, we elected to invite the entire population (i.e., all ED attendings, fellows, residents, and APPs) to participate (Habibi et al., 2014; Keeney et al., 2005).

7.2.3 Data analysis

We exported data from Qualtrics to Excel for further analysis. To determine whether elements on which we surveyed had achieved consensus, we used a bin approach where each bin represented a set of Likert values (i.e., proportion within a range – unrestricted) (Diamond et al., 2014). The first bin captured the value one which referred to "not influential". The second bin

captured the values two and three which referred to “slightly influential” and “somewhat influential” respectively. The third bin captured the values four and five which referred to “very influential” and “extremely influential” respectively.

Thus, for each work system element, we counted the number of responses within each bin, determined the percentage of responses that fell into each bin, and calculated the mode. If an element achieved consensus in the first round, it was not included in the second-round survey. Elements that did not achieve consensus after the second-round survey were assigned the mode value identified from the second-round survey. Appendix F features an example of the enumeration we did for each element to determine whether consensus has been established.

To visualize our results, we generated two configural diagrams using PowerPoint: one representing the ED work system that produces the disposition decision-making process under conditions of low demand and one under high demand. A configural diagram is a visual representation of the work system that features “the active and interacting work system” elements for a process (Holden et al., 2013, p. 6). Traditionally, configural diagrams consist of spheres that represent the work system elements that most influence process performance that are connected by lines that represent the interactions among the elements (Holden et al., 2013). The size of the sphere is determined by the influence it has on process performance.

Elements rated as not influential (i.e., scored a one on the Likert scale) were not included in the diagrams. Elements rated as slightly or somewhat influential (i.e., scored a two or three on the Likert scale) were assigned a small bubble size. Elements rated as very or extremely influential (i.e., scored a four or five on the Likert scale) were assigned a large bubble size. As is customary with work system visualizations, elements of the same component were grouped together.

7.3 Results

7.3.1 Participants

The survey invitation was sent to 144 ED clinicians. We had a total of 33 participants (response rate: 33/144 = 23%). We achieved a 100% completion rate between the two surveys (i.e., everyone who completed the first survey also completed the second survey). Table 7.1 outlines participant demographics.

Table 7.1: Participant demographics

Demographic variable	**Value**
Age (years)	
Average (range)	33 (27-47)
Gender (count)	
Female	16
Role (count)	
ED attending	12
Intern physician (PGY-1)	5
2nd year resident physician (PGY-2)	7
3rd year resident physician (PGY-3)	1
ED PA	7
Tenure (years)	
Average (range)	4 (1-25)

7.3.2 Survey results

Table 7.2 outlines the elements on which participants were surveyed and the value on which the element achieved consensus at a 65% threshold or the mode value assigned. Under conditions of low demand, seven elements achieved consensus in the first survey and five elements achieved consensus in the second survey. Under conditions of high demand, 11 elements achieved consensus in the first survey and four elements achieved consensus the second survey.

One element was rated as not influential under conditions of low and high demand. Twenty-six and 21 elements were rated as somewhat or slightly influential under conditions of

low and high demand respectively. Five and ten elements were rated as very or extremely influential under conditions of low and high demand respectively. Nineteen of the 33 elements were given the same rating under both low and high demands. Of the 14 elements on which ratings differed, ratings always differed by one bin category.

Table 7.2: Summary of element ratings

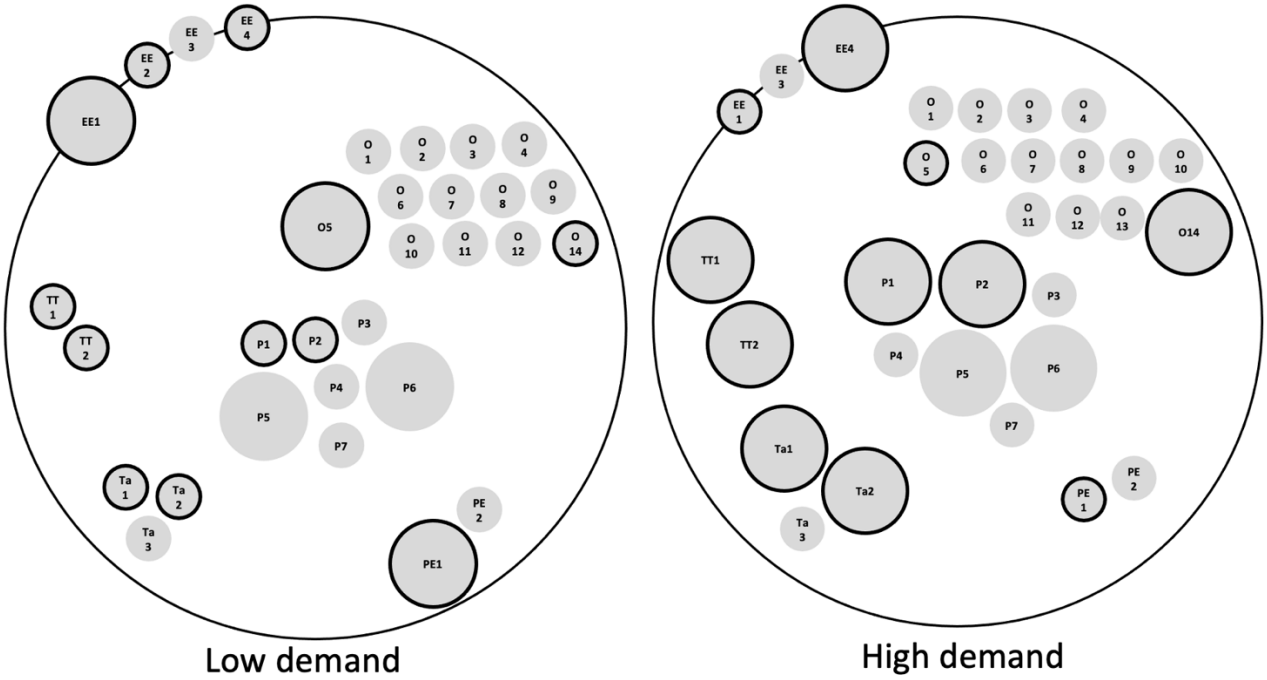
Comp.	**Element**	**Low Demand Rating**	**High Demand Rating**
P	Your "gut" reaction/instinct for a patient's disposition	2 to 3	4
P	Your personal comfort discharging a patient with a high risk of adverse outcomes	3	4
P	Your previous experience with similar patients or training in an area that is specifically relevant to your present patient	3	3
P	Patient cognitive status	3	3
P	Patient disposition preference or agreeability with your disposition recommendation	4	4 to 5
P	Patient psychosocial factors (e.g., access to transportation, living situation, ability to fulfill own future care needs)	4 to 5	4 to 5
P	Care partner disposition preference	3	3
Ta	The number and complexity of the patients to whom you're providing care	2 to 3	4
Ta	The extent to which you feel time pressure to quickly disposition patients (e.g., to see waiting room patients, manage ED patient flow, minimize length of stay)	2 to 3	4
Ta	Ability to delegate tasks to another ED clinician (e.g., ED nurse calling patient's family and reporting back)	2 to 3	2 to 3
TT	Amount and accuracy of patient information available to you (e.g., baseline status, living situation)	3	4 to 5
TT	Information available in the electronic health record (e.g., medical history, medications)	3	4
O	ED staffing (e.g., number of nurses)	2	2 to 3
O	Ease of enacting disposition alternatives (e.g., amount of follow-up care coordination required to discharge, number of phone calls required to admit)	2 to 3	2 to 3
O	Ability to get handoff from EMS yourself or by way of another ED clinician	3	2 to 3
O	Ability to contact care partner not physically in the ED (e.g., by phone)	2 to 3	2 to 3
O	Ability to have comprehensive conversations with patient and/or care partner	4 to 5	3

O	Ability to have comprehensive conversations with other ED clinicians	2	2 to 3
O	Recommendation from consulting clinicians (e.g., ortho, neuro)	2 to 3	2 to 3
O	Recommendation from hospitalist	3	2 to 3
O	Access to physical therapy in the ED	2	2
O	Access to social work in the ED	3	3
O	Ability to either call or send an inbasket message to patient's primary care physician	2 to 3	2 to 3
O	Diagnostic or disposition momentum (e.g., inclination to do what has been done before for the patient)	2 to 3	3
O	Extent to which there are departmental incentives to discharge "grey-zone" patients	1	2 to 3
O	Expectation that patients have a well-developed disposition plan in place at the time of shift change	3	4
PE	Patient's physical home environment (e.g., stairs to get into house, bathroom only on second floor)	4 to 5	3
PE	ED crowding (e.g., use of hallway beds, boarding, number of patients in waiting room)	2 to 3	2 to 3
EE	Best practice guidelines related to disposition decision-making	4	2 to 3
EE	Extent to which patient's insurance will cover subsequent care costs	3	1
EE	Potential for malpractice repercussions	3	3
EE	Potential for negative consequences if your patient were discharged and bounced back to the ED	3	4

EE = External environment; O = Organization; P = Person; PE = Physical environment; Ta = Task; Tools and technology; Greyed boxes = elements provided the same rating under low and high demand; White boxes = elements rated differently under low and high demand

7.3.3 Configural diagram

Figure 7.1 depicts the ED work system configurations under conditions of low and high demand. Elements rated as one (i.e., not influential) are not featured in the diagrams. Elements rated as two or three (i.e., slightly or somewhat influential) are represented as the small bubbles. Elements rated as four or five (i.e., very or extremely influential) are represented as large bubbles.



Element #	Element description
P1	ED clinician "gut" reaction/instinct for a patient's disposition
P2	ED clinician personal comfort discharging a patient with a high risk of adverse outcomes
P3	ED clinician previous experience with similar patients or training in an area that is specifically relevant to present patient
P4	Patient cognitive status
P5	Patient disposition preference or agreeability with your disposition recommendation
P6	Patient psychosocial factors
P7	Care partner disposition preference
Ta1	The number and complexity of the patients to whom you're providing care
Ta2	The extent to which you feel time pressure to quickly disposition patients
Ta3	Ability to delegate tasks to another ED clinician
TT1	Amount and accuracy of patient information available
TT2	Information available in the electronic health record
O1	ED staffing
O2	Ease of enacting disposition alternatives
O3	Ability to get handoff from EMS yourself or by way of another ED clinician
O4	Ability to contact care partner not physically in the ED
O5	Ability to have comprehensive conversations with patient and/or care partner
O6	Ability to have comprehensive conversations with other ED clinicians
O7	Recommendation from consulting clinicians
O8	Recommendation from hospitalist
O9	Access to physical therapy in the ED
O10	Access to social work in the ED

O11	Ability to either call or send an inbasket message to patient's primary care physician
O12	Diagnostic or disposition momentum
O13	Extent to which there are departmental incentives to discharge "grey-zone" patients
O14	Expectation that patients have a well-developed disposition plan in place at the time of shift change
PE1	Patient's physical home environment
PE2	ED crowding
EE1	Best practice guidelines related to disposition decision-making
EE2	Extent to which patient's insurance will cover subsequent care costs
EE3	Potential for malpractice repercussions
EE4	Potential for negative consequences if patient were discharged and bounced back to the ED

Figure 7.1: Configural diagrams representing the influential factors for the ED disposition decision-making process; EE = External environment; O = Organization; P = Person; PE = Physical environment; Ta = Task; TT = Tools and technologies; The bold, black outline around bubbles identifies elements that varied in influence under conditions of low and high demand.

7.4 Discussion

The goal of the present study was to characterize the ED work system factors that most strongly shape the ED disposition decision-making process under conditions of low and high demand using configural diagramming. Our findings highlight key differences in how ED clinicians perceive the influence of various work system elements on their performance of the disposition decision-making process in that only 19 out of the 33 elements (58%) were given similar ratings under low and high demand. Variations in ratings between low and high demand represent meaningful differences in the ED work system structure that ultimately change how the disposition decision-making process is performed. Understanding how the influence of ED work system elements varies across the demand continuum can motivate the design of interventions and system structures that are responsive to the dynamic demands of the ED.

Our study also introduced a novel application and approach to creating configural diagrams. To our knowledge, the present study is the first to use configuration to assess

differences in the same work system and the same process at under different conditions (i.e., under different demands).

7.4.1 Work system configuration under low and high demand

Previous studies have highlighted the role nearly every work system component has in influencing the ED disposition decision-making process (Rutkowski, Scheer, et al., In progress). However, no one study has comprehensively characterized all components of the work system and the influence those elements have on process performance. Using a modified Delphi approach, the present study explored the influence that previously identified elements have on the ED disposition decision-making process under conditions of low and high demand. Our configural diagramming approach provides the subsequent layer of analysis needed to translate descriptive findings into perspective insights that can inform future research or system design by highlighting the elements that most strongly influence the ED disposition decision-making process under both low and high demand (Holden et al., 2013).

We found that ED clinicians perceived most elements (58%) to have the same influence on ED disposition decision-making, regardless of demand. This could indicate that the influence level of these elements may be immune to the dynamic, broader work system context. As such, intervening on elements perceived as consistently, highly influential on the ED disposition decision-making process has the potential to have a meaningful and sustained effect on process performance under varied conditions.

There were two elements rated as highly influential under conditions of low and high demand: patient preference and psychosocial factors. This suggests that these elements may represent areas in which system redesign is likely to be highly effective. With respect to patient

preference for disposition location, previous studies have emphasized the pervasive time pressures and the frequent inability to fully engage patients and care partners in the ED (Adams et al., 2017; Daniels et al., 2018; Dyrstad et al., 2015; Lin et al., 2018; Pope et al., 2017; Rance et al., 2020; Schechtman et al., 2019; Stuck et al., 2017). Thus, developing and implementing efficient but robust mechanisms to elicit patient preference, such as the guidelines developed by Probst and colleagues, has the potential to greatly influence process performance (Probst et al., 2017). Likewise, as research has previously identified a dearth of patient-related information in the ED (Nelson et al., 2013), it follows that developing an information gathering tool or procedure (e.g., in the EHR) to comprehensively capture pertinent psychosocial factors, making that information readily accessible, would meaningfully influence the ED disposition decision-making process under both low and high demands.

7.4.2 Disparate ratings are representative of meaningful differences in ED work system configuration

Although many elements received the same ratings under low and high demand, a subset of work system elements, at least one within each work system component, varied in their rating. The presence of varied rating within each work system component suggests that the ED work system configuration that produces the ED disposition decision-making process under conditions of low and high demand is fundamentally different. Varied perceived elemental influence and overall work system structure indicates that the performance of the ED disposition decision-making process differs under conditions of low and high demand.

Person elements, specifically those related to ED clinician risk tolerance and gestalt, were rated higher under conditions of high demand. The increased reliance on forms of rapid cognitive

processing is common in the ED generally (Calder et al., 2012; Probst et al., 2015; Wright et al., 2018). As such, it is unsurprising that ED clinicians report these elements as highly influential under conditions of high demand when, arguably, the most challenging attributes of the ED (e.g., time pressure, high ED census) are exacerbated, there is a heightened need to prioritize efficiency, and there is the innate tendency to make strategic decisions to reduce demands (Daniels et al., 2018; Nugus et al., 2011; Shanafelt et al., 2002; Turner et al., 2020). Exceptionally high demands and the subsequent effect they have on ED clinician cognition and decision-making behavior has been associated with poor decision quality (Levin et al., 2006; Shanafelt et al., 2002; Soria-Oliver et al., 2017).

Task elements were generally rated as more influential under conditions of high demand, specifically the elements related to number and complexity of patients and time pressure. The pervasive but variable nature of time pressure and the effect of patient census, specifically of high acuity patients, on ED clinicians' perception of overall demands is well-studied (Adams et al., 2017; Daniels et al., 2018; Dyrstad et al., 2015; Lin et al., 2018; Pope et al., 2017; Probst et al., 2015; Rance et al., 2020; Schechtman et al., 2019; Stuck et al., 2017). Time pressure is consistently reported as an inherent characteristic of the ED (Rutkowski, Pulia, et al., In progress; Wears et al., 2010). However, the motivation or source of time pressure seems to vary with demand. Under conditions of low demand, ED clinicians have reported attempting to maximize efficiency to reduce workload and ensure the ED is agile enough to respond to a sudden influx of patients (e.g., a mass-casualty event) (Rutkowski, Pulia, et al., In progress; Shanafelt et al., 2002; Turner et al., 2020). Under conditions of high demand, time pressure seems to be more focused on ethically managing ED census. For instance, in their study exploring ED physician and general medicine physician perspectives on disposition decision-

making, Daniels and colleagues note “an EM physician went on to explain competing demands in the ED: “If the patient is bordering for going home or coming in, those are the patients that I want to spend the least time on, because that is at the expense of patients who are really sick.” (p. 742)

Tools and technology elements, including both the accuracy and accessibility of information, were rated as more influential under conditions of high demand. This could indicate that under high demands, clinicians rely more heavily on tools and technology to support their work. However, previous work has demonstrated that, due to issues of accuracy and accessibility, ED clinicians are often required to make disposition decisions without sufficient information (Nelson et al., 2013; Stiell et al., 2003). Thus, improving the accuracy and accessibility of information available in the ED has the potential to drastically shape the performance of the disposition decision-making process, specifically under high demands.

Two organization elements varied in their ratings between high and low demand. The first was the ability to have comprehensive conversations with patients and/or care partners, which was rated higher under conditions of low demand. Although the disposition decision is not universally conceptualized as a shared decision, barring extenuating circumstances, it would be impossible to make a disposition decision without the input from the patient and/or care partner (Adams et al., 2017; Dyrstad et al., 2015; Probst et al., 2015; Rance et al., 2020; Schechtman et al., 2019). The increased rating of this factor under conditions of low demand could be due to the fact that under low demand, ED clinicians likely have more time to engage in these in-depth conversations and may be attempting to discharge more borderline or “gray-zone” patients (i.e., patients for whom a disposition decision is not immediately obvious), which requires additional coordination (Daniels et al., 2018).

The expectation that patients have a well-developed disposition plan in place at the time of shift change was rated higher under conditions of high demand. This could be because under high demands, ED clinicians may be dispositioning patients more quickly and therefore are likely engaging more ED to hospital handoffs. Ensuring the handoff process is effective and efficient is likely paramount to managing demands and optimizing patient flow (Nugus et al., 2011).

The only physical environment element that varied was the patient's home environment. It was rated as being very or extremely influential under conditions of low demand while only slightly or somewhat influential under conditions of high demands. This could be related to the fact that under conditions of low demand, there is an increased ability to have comprehensive conversations with patients and care partners, an organizational factor that was also rated higher under conditions of low demand. Information about the patient's home environment is likely to surface during a conversation about follow up care plans, for example.

The two external environment factors that varied with demand were best practice guidelines related to disposition decision-making and the potential for negative consequences should a patient bounceback, which was rated higher under conditions of low and high demands respectively. Previous work has noted the general lack of best practice guidelines, specifically for "grey-zone" patients (Emerson et al., 2017; Lin et al., 2018; Probst et al., 2015). However, it is possible that best practice guidelines were rated higher under conditions of low demand as, under these conditions, ED clinicians likely have more bandwidth to search for and assess the limited guidelines that may exist. The potential for negative consequences (e.g., medicolegal repercussions) should a patient bounceback is likely something that is always a consideration for ED clinicians (Siddique et al., 2018). However, under conditions of high demand it may be more

of a consideration given that, although they still do their best to provide the highest quality care, ED clinicians have a lessened ability to have in-depth conversations, conduct every potentially insightful lab test, and search for pertinent information. This may make it more likely that an important piece of information is overlooked or a suboptimal disposition decision is selected.

Disparate influence of work system elements under conditions of low and high demand highlights the variability in the influence of ED work system elements on the disposition decision process. Identifying where this variability occurs within the ED work system gives insight into where additional care should be taken when considering system design. The varied level of perceived elemental influence indicates that any intervention is likely to have variable effect on the ED work system structure and thereby process performance, depending on the level of demand. As such, redesign of these work system elements must be adaptive to the varied influence.

For instance, introducing a forcing function or hard stop within the electronic health record (EHR) that requires the deliberate consideration of the patient's insurance status may be well received under conditions of low demand, where insurance status was perceived as somewhat influential. However, this type of function may be detrimental to disposition decision-making performance under conditions of high demand, where insurance status was perceived to be not influential. Ensuring that proposed system redesigns are compatible with ED clinicians' perception of element influence will be pertinent to effective intervention and longitudinally sustainable use.

7.4.3 Considerations for a modified Delphi approach to configuration

We demonstrated the feasibility of using a modified Delphi approach to produce configural diagrams that represent the same work system for the same process under two conditions. We made strategic study design decisions that led us to achieve favorable outcomes (e.g., 100% response rate on the second survey, short data collection period). As with any study design, there are numerous factors to consider when designing a modified Delphi study.

7.4.3.1 Study design

There are several variables that must be established either a priori or over the course of a modified Delphi study. First, we determined a priori that the study would occur across two rounds of surveys which differs from a tradition Delphi technique which occurs across "n" rounds where "n" is the number of the round where consensus is established (Hsu & Sandford, 2007). Researchers must consider the tradeoffs between a higher proportion of survey elements that achieve consensus and the time-cost and participant fatigue that is likely to occur as the number of rounds increases (Graham, 2010; Hasson et al., 2000; Keeney et al., 2005; McKenna, 1994).

Second, given that there is no agreed-upon standard, when selecting the consensus threshold, it is important to consider the purpose of the study. If the intent of the study is to make an important decision (e.g., update a department policy), a higher threshold may be warranted. If the intent of the study is to make a low-impact decision (e.g., determine tee-shirt color) or assess perceptions, a lower threshold may be appropriate. Our intent with the present study is to assess what *most* ED clinicians think about the elements that most influence their disposition decision-making process. As such, we selected a consensus threshold of 65%. This threshold permitted

some consensus latitude and reduced survey burden while allowing us to draw conclusions about the perceptions of the majority of ED clinicians.

7.4.3.2 Data collection

All factors considered, our data collection and analysis processes were seamless, which is atypical for a Delphi approach. Practically, we completed data collection in less than two months and achieved a 100% response rate on the second survey. Delphi approaches are notoriously "time-consuming and laborious" as a result of the "iterative and sequential" nature of the approach (Hasson et al., 2000; Hsu & Sandford, 2007, p. 5; Keeney et al., 2005). Researchers often under-estimate the amount of time needed to administer the initial survey, obtain and analyze the data (e.g., follow up with non-respondents), and develop and distribute subsequent instruments (i.e., achieve consensus) (Hsu & Sandford, 2007; Keeney et al., 2005). Our failure to encounter such time-related barriers could be a result of a few factors. First, we established the number of rounds a priori, which automatically defined a boundary for the amount of data collection that could occur. This strategy allowed us to scope our data collection period to a timeframe that would be reasonable for participants and research team while still preserving the key characteristics of Delphi approaches (Hsu & Sandford, 2007; Powell, 2003).

Second, we sampled a population accustomed to participating in research. Our study occurred within the ED of an academic medical center with an active commitment to research. As such, many of our participants likely had previous experience participating in research and were aware of the expectations, practices, and norms surrounding survey studies. This may have made them more likely to be compliant.

Third, both surveys were short (~10 minutes), were smartphone compatible, and contained topics that ED clinicians consider daily. The minimal time commitment, ease of use, and familiarity of the topics likely minimized logistic barriers to participation.

Fourth, despite the research team's best effort, we may have been unable to uphold all four key pillars that define the benefits of the Delphi. With respect to feedback, we had no mechanism to ensure that participants reviewed and integrated the feedback provided into their secondary surveys. We also had no mechanism to ensure complete anonymity. Because we aimed to recruit the entire population, participants were likely aware of other colleagues who were participating in the study. Although we have no reason to believe that participants collaborated, it is possible that participants discussed the surveys with one another (Keeney et al., 2005; McKenna, 1994).

Fifth, it should be noted that "the extent to which participants agree with each other does not mean that consensus exists, nor does it mean that the 'correct' answer has been found" (Keeney et al., 2005, p. 210). Participants may have all agreed that, in theory, element A is an extremely influential factor in shaping disposition decision-making. However, this may not align with how ED clinicians engage in the disposition decision-making process in their day-to-day work (Keeney et al., 2005). In other words, there may be a misalignment between ED clinicians' work as imagined (i.e., what ED clinicians ideally do), work as perceived (i.e., what ED clinicians think they do), and work as done (i.e., what ED clinicians actually do) (Leplat, 1989). Future work should consider more just-in-time cognitive approaches (e.g., clinical decision support tools) to assess the elements that acutely shape ED clinicians' disposition decision-making processes.

Sixth, inherently, a Delphi approach conceals dissenting or disparate opinions (Keeney et al., 2005). As part of the consensus building process, participants may have felt inclined to change their responses "because of a possible mistaken belief that the views expressed by the majority of the panel must be right" or "they see that someone else has identified a more relevant issue that they had not thought of" (Keeney et al., 2005, p. 210). As such, although we achieved consensus, our findings may not fully reflect the varied opinions or perspectives of all ED clinicians. Tools like member checking or approaches that honor the variability of individual experiences (e.g., case study, focus groups) could be used to assess the extent to which our findings reflect the full range of ED clinician experiences.

Finally, practically, the default selection in the Qualtrics software was "Not influential" or "1". Defaults are known to influence participants' opinions. Participants did still need to click into each question for the question to be marked "complete". However, the extreme nature of the default selection likely biased participants less than a neutral default (Chimi, 2022).

7.4.3.3 Data analysis

We used a bin approach where each bin represented a set of Likert values (i.e., proportion within a range – unrestricted) (Diamond et al., 2014). The first bin captured the value one which referred to "not influential". The second bin captured the values two and three which referred to "slightly influential" and "somewhat influential" respectively. The third bin captured the values four and five which referred to "very influential" and "extremely influential" respectively. We delineated the bins in this manner as the interpretation of each bin 1, 2 and 3, and 4 and 5 seemed to represent natural braking points (i.e., slightly and somewhat influential seemed similar, very and extremely seemed similar). We elected to bin our data with the intent of minimizing survey

burden (i.e., reducing the number of elements included in the second survey by making consensus easier to establish) and reducing clutter on the configural diagrams (i.e., reducing the number of bubble sizes). However, there are other approaches that could be used to analyze the data (e.g., different binning structures, no binning), each of which would influence how consensus is established and how elements are depicted in the configural diagrams. Researchers should consider which approach supports their objectives.

In light of work systems theory, we assumed that all work system elements within the configural diagram interact (Carayon et al., 2006; Carayon et al., 2014; Holden et al., 2013). However, work systems theory suggests that some interactions may be more influential than others on shaping process performance (Holden & Carayon, 2021; Holden et al., 2013). We tended to explore the work system at the elemental level, rather than the interaction level. However, the interconnectedness of work system elements and how those interactions shape process performance is likely substantial. The present study outlines which elements influence the disposition decision-making process and to what extent. Future work should aim to recruit a mechanism (e.g., epistemic network analysis, co-occurrence analysis) to capture and depict why and how elements interact to provide the most robust description of the work system configurations (Weiler et al., 2022).

Configural diagrams generally include lines that connect interacting work system elements. However, previously published papers using configural diagramming, including the paper from which the method originates, do not provide a description of how to strategically position lines to connect interacting elements given that all elements within a work system interact with one another to some extent (Hay et al., 2020; Holden & Carayon, 2021; Holden et al., 2015; Holden et al., 2013; Werner et al., 2020a). In their 2021 paper, Holden and Carayon

point out that configural "diagrams are not meant to be fully exclusive; they are better suited to show only the most relevant or consequential factors or interactions" (p. 7). Yet, how to determine the most relevant or consequential interactions is still unclear. Thus, to avoid overcomplicating and cluttering our configural diagrams, we did not include lines connecting interacting elements.

With respect to interpretation of the configural diagrams, although we have the ability to influence process performance through targeted intervention motivated by our modified Delphi outputs, there is no guarantee that intervening on a highly influential element will yield exclusively favorable outcomes. Whether favorable outcomes occur due to intervention would depend on the quality of the intervention or redesign and how well it is implemented. The results presented in this study provide us with the anticipated magnitude of influence, not the anticipated outcome of intervention on an influential element.

7.5 Conclusion

Our study extends our understanding of how the ED work system shapes the performance of the disposition decision-making process and also introduces an innovative approach to creating configural diagrams. Practically, our findings have the potential to inform the adaptive and reflexive design of interventions and system structures to support the disposition decision-making. Methodologically, our work expands the work systems analysis toolkit by providing a methodological playbook for configural diagramming, which provides researchers with a mechanism to identify the most influential work systems elements in shaping process performance. The ability to identify these influential elements has the potential to increase the effectiveness and efficiency of work systems research, thereby permitting the translation of

rigorous work system analyses into actional change that will affect patient, care partner, clinician, and organizational outcomes.

7.7 Chapter 7 references

Adams, E., Goyder, C., Heneghan, C., Brand, L., & Ajjawi, R. (2017). Clinical reasoning of junior doctors in emergency medicine: a grounded theory study. Emerg Med J, 34(2), 70-75. https://doi.org/10.1136/emermed-2015-205650

Agency for Healthcare Research and Quality (2011). Disposition of Patient. Retrieved 06/11/22 from https://ushik.ahrq.gov/ViewItemDetails?system=mdr&itemKey=65837000

Aminzadeh, F., & Dalziel, W. B. (2002). Older adults in the emergency department: a systematic review of patterns of use, adverse outcomes, and effectiveness of interventions. Ann Emerg Med, 39(3), 238-247. https://doi.org/10.1067/mem.2002.121523

Bragard, I., Dupuis, G., & Fleet, R. (2015). Quality of work life, burnout, and stress in emergency department physicians: a qualitative review. European Journal of Emergency Medicine, 22(4). https://journals.lww.com/euro-emergencymed/Fulltext/2015/08000/Quality_of_work_life,_burnout,_and_stress_in.1.aspx

Burton, J. H., Young, J., & Bernier, C. A. (2014). The Geriatric ED: Structure, Patient Care, and Considerations for the Emergency Department Geriatric Unit. International Journal of Gerontology, 8(2), 56-59. https://doi.org/10.1016/j.ijge.2014.01.002

Calder, L. A., Arnason, T., Vaillancourt, C., Perry, J. J., Stiell, I. G., & Forster, A. J. (2015). How do emergency physicians make discharge decisions? Emergency Medicine Journal, 32(1), 9-14.

Calder, L. A., Forster, A., Nelson, M., Leclair, J., Perry, J., Vaillancourt, C., Hebert, G., Cwinn, A., Wells, G., & Stiell, I. (2010). Adverse events among patients registered in high-acuity areas of the emergency department: a prospective cohort study. Cjem, 12(5), 421-430. https://doi.org/10.1017/s1481803500012574

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012a). Mapping out the emergency department disposition decision for high-acuity patients. Ann Emerg Med, 60(5), 567-576.e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Capan, M., Pigeon, J., Marco, D., Powell, J., & Groner, K. (2018). We all make choices: A decision analysis framework for disposition decision in the ED. The American journal of emergency medicine, 36(3), 450-454.

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. Quality and Safety in Health Care, 15(suppl 1), i50. https://doi.org/10.1136/qshc.2005.015842

Carayon, P., Wetterneck, T., Rivera-Rodriguez, A. J., Hundt, A., Hoonakker, P., Holden, R. J., & Gurses, A. P. (2014). Human factors systems approach to healthcare quality and patient safety. Appl Ergon, 45(1), 14-25. https://doi.org/10.1016/j.apergo.2013.04.023

Chimi, C. (2022). The Likert Scale: A Proposal for Improvement Using QuasiContinuous Variables.

Coleman, E. A., & Berenson, R. A. (2004). Lost in transition: challenges and opportunities for improving the quality of transitional care. Ann Intern Med, 141(7), 533-536. https://doi.org/10.7326/0003-4819-141-7-200410050-00009

Daniels, L. M., Sorita, A., Kashiwagi, D. T., Okubo, M., Small, E., Polley, E. C., & Sawatsky, A. P. (2018). Characterizing Potentially Preventable Admissions: A Mixed Methods Study of Rates, Associated Factors, Outcomes, and Physician Decision-Making. Journal of general internal medicine,, 33(5), 1525-1497 (Electronic).

Diamond, I. R., Grant, R. C., Feldman, B. M., Pencharz, P. B., Ling, S. C., Moore, A. M., & Wales, P. W. (2014). Defining consensus: A systematic review recommends methodologic criteria for reporting of Delphi studies. Journal of Clinical Epidemiology, 67(4), 401-409. https://doi.org/https://doi.org/10.1016/j.jclinepi.2013.12.002

Dyrstad, D. N., Testad, I., & Storm, M. (2015). Older patients' participation in hospital admissions through the emergency department: an interview study of healthcare professionals. BMC Health Services Research, 15(1), 1-9.

Emerson, P., Brooks D Fau - Quasim, T., Quasim T Fau - Puxty, A., Puxty A Fau - Kinsella, J., Kinsella J Fau - Lowe, D. J., & Lowe, D. J. (2017). Factors influencing intensive care admission: a mixed methods study of EM and ICU. European Journal of Emergency Medicine, 24(1), 29-35.

Fernando, S. M., Rochwerg, B., Reardon, P. M., Thavorn, K., Seely, A. J. E., Perry, J. J., Barnaby, D. P., Tanuseputro, P., & Kyeremanteng, K. (2018). Emergency Department disposition decisions and associated mortality and costs in ICU patients with suspected infection. Crit Care, 22(1), 172. https://doi.org/10.1186/s13054-018-2096-8

Gabayan, G. Z., Gould, M. K., Weiss, R. E., Patel, N., Donkor, K. A., Chiu, V. Y., Yiu, S. C., Jones, J. P., Hoffman, J. R., & Sarkisian, C. A. (2016). Poor Outcomes After Emergency Department Discharge of the Elderly: A Case-Control Study. Ann Emerg Med, 68(1), 43-51.e42. https://doi.org/10.1016/j.annemergmed.2016.01.007

Graham, C. (2010). Hearing the voices of general staff: A Delphi study of the contributions of general staff to student outcomes. Journal of Higher Education Policy and Management, 32, 213223. https://doi.org/10.1080/13600801003743315

Habibi, A., Sarafrazi, A., & Izadyar, S. (2014). Delphi Technique Theoretical Framework in Qualitative. Int J Eng Sci, 3, 8-13.

Hasson, F., Keeney, S., & McKenna, H. (2000). Research guidelines for the Delphi Survey Technique. Journal of advanced nursing, 32, 1008-1015. https://doi.org/10.1046/j.1365-2648.2000.t01-1-01567.x

Hay, G., Klonek, F., & Parker, S. (2020). Diagnosing rare diseases: A sociotechnical approach to the design of complex work systems. Applied Ergonomics, 86, 103095. https://doi.org/10.1016/j.apergo.2020.103095

Hay, G. J., Klonek, F. E., & Parker, S. K. (2020). Diagnosing rare diseases: A sociotechnical approach to the design of complex work systems. 86, 103095. https://www.sciencedirect.com/science/article/pii/S0003687020300582

Helmer-Hirschberg, O. (1967). Analysis of the Future: The Delphi Method. RAND Corporation. https://www.rand.org/pubs/papers/P3558.html

Holden, R., & Carayon, P. (2021). SEIPS 101 and seven simple SEIPS tools. BMJ Quality & Safety, 30, bmjqs-2020. https://doi.org/10.1136/bmjqs-2020-012538

Holden, R., Schubert, C., & Mickelson, R. (2015). The patient work system: An analysis of self-care performance barriers among elderly heart failure patients and their informal caregivers. Applied Ergonomics, 47, 133–150. https://doi.org/10.1016/j.apergo.2014.09.009

Holden, R. J., Carayon P Fau - Gurses, A. P., Gurses Ap Fau - Hoonakker, P., Hoonakker P Fau - Hundt, A. S., Hundt As Fau - Ozok, A. A., Ozok Aa Fau - Rivera-Rodriguez, A. J., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. Ergonomics, 56(11), 1669-1686.

Hsu, C.-C., & Sandford, B. (2007). The Delphi Technique: Making Sense Of Consensus. Practical Assessment, Research and Evaluation, 12.

Keeney, S., Hasson, F., & McKenna, H. (2005). Consulting the oracle: Ten lessons from using the Delphi technique in nursing research. Methodological Issues in Nursing Research, 205-212.

Leplat, J. (1989). Error analysis, instrument and object of task analysis. Ergonomics, 32(7), 813-822. https://doi.org/10.1080/00140138908966844

Levin, S., France Dj Fau - Hemphill, R., Hemphill R Fau - Jones, I., Jones I Fau - Chen, K. Y., Chen Ky Fau - Rickard, D., Rickard D Fau - Makowski, R., Makowski R Fau - Aronsky, D., & Aronsky, D. (2006). Tracking workload in the emergency department. Human Factors, 48(3), 526-539. https://doi.org/10.1518/001872006778606903

Lin, M. P., Natsui, S., Sinnette, C., Ball, A., Weissman, J. S., & Schuur, J. D. (2018). Facilitators and Barriers to Reducing Emergency Department Admissions for Chest Pain: A Qualitative Study. Critical Pathways in Cardiology, 17(4), 201-207.

Loughlin, K. G., & Moore, L. F. (1979). Using Delphi to achieve congruent objectives and activities in a pediatrics department. Academic Medicine, 54(2). https://journals.lww.com/academicmedicine/Fulltext/1979/02000/Using_Delphi_to_achieve_congruent_objectives_and.6.aspx

McKenna, H. (1994). The Delphi technique: A worthwhile research approach for nursing? Journal of advanced nursing, 19, 1221-1225. https://doi.org/10.1111/j.1365-2648.1994.tb01207.x

McKenna, H., & Hasson, F. (2002). A study of skill mix issues in midwifery: A multimethod approach. Journal of advanced nursing, 37, 52-61. https://doi.org/10.1046/j.1365-2648.2002.02058.x

MedPAC. (2008). Medicare Payment Advisory Commission (MedPAC) Report to the Congress: Reforming the Delivery System. https://www2.lawrence.edu/fast/finklerm/Miller%20Medpac%20report%202008.pdf

National Research Council. 2011. *Health Care Comes Home: The Human Factors*. Washington, DC: The National Academies Press. https://doi.org/10.17226/13149.

Nelson, D., Washton D Fau - Jeanmonod, R., & Jeanmonod, R. (2013). Communication gaps in nursing home transfers to the ED: impact on turnaround time, disposition, and diagnostic testing. The American Journal of Emergency Medicine, 31(4), 712-716.

Nugus, P., & Braithwaite, J. (2010). The dynamic interaction of quality and efficiency in the emergency department: Squaring the circle?. *Social Science & Medicine*, *70*(4), 511-517.

Nugus, P., Holdgate, A., Fry, M., Forero, R., McCarthy, S., & Braithwaite, J. (2011). Work Pressure and Patient Flow Management in the Emergency Department: Findings From an Ethnographic Study. Academic emergency medicine : official journal of the Society for

Academic Emergency Medicine, 18, 1045-1052. https://doi.org/10.1111/j.1553-2712.2011.01171.x

Pope, I., Burn, H., Ismail, S. A., Harris, T., & McCoy, D. (2017). A qualitative study exploring the factors influencing admission to hospital from the emergency department. BMJ open, 7(8), e011543.

Powell, C. (2003). Methodological Issues In Nursing Research. The Delphi technique: myths and realities. 41.

Probst, M. A., Kanzaria, H. K., Hoffman, J. R., Mower, W. R., Moheimani, R. S., Sun, B. C., & Quigley, D. D. (2015). Emergency Physicians' Perceptions and Decision-making Processes Regarding Patients Presenting with Palpitations. The Journal of emergency medicine, 49(2), 236-243.

Probst, M. A., Kanzaria, H. K., Schoenfeld, E. M., Menchine, M. D., Breslin, M., Walsh, C., Melnick, E. R., & Hess, E. P. (2017). Shared Decisionmaking in the Emergency Department: A Guiding Framework for Clinicians. Ann Emerg Med, 70(5), 688-695. https://doi.org/10.1016/j.annemergmed.2017.03.063

Rance, S. A.-O., Westlake, D. A.-O., Brant, H., Holme, I., Endacott, R., Pinkney, J., & Byng, R. (2020). Admission Decision-Making in Hospital Emergency Departments: The Role of the Accompanying Person. Global qualitative nursing research, 7, 2333393620930024.

Ringer, T., Dougherty, M., McQuown, C., Melady, D., Ouchi, K., Southerland, L., & Hogan, T. (2018). White Paper-Geriatric Emergency Medicine Education: Current State, Challenges, and Recommendations to Enhance the Emergency Care of Older Adults. AEM Education and Training, 2. https://doi.org/10.1002/aet2.10205

Rowe, G., & Wright, G. (1999). The Delphi technique as a forecasting tool: issues and analysis. International Journal of Forecasting, 15(4), 353-375. https://doi.org/https://doi.org/10.1016/S0169-2070(99)00018-7

Rutkowski, R. A., Pulia, M. S., Jaeger, L., Loveless, E., Patterson, B. W., Shah, M. N., Hoonakker, P., Carayon, P., Smith, M., & Werner, N. E. (In progress). A work systems approach to characterizing disposition decision-making under low and high demand

Rutkowski, R. A., Scheer, E., Carlson, C., Parks, R., Pulia, M. S., Patterson, B. W., Shah, M. N., Hoonakker, P., Carayon, P., Smith, M., Christensen, L., & Werner, N. E. (In progress). A scoping review of emergency department disposition decision-making

Schechtman, M., Kocher, K. E., Nypaver, M. M., Ham, J. J., Zochowski, M. K., & Macy, M. L. (2019). Michigan Emergency Department Leader Attitudes Toward and Experiences With Clinical Pathways to Guide Admission Decisions: A Mixed-methods Study. Academic Emergency Medicine, 26(4), 384-393.

Shanafelt, T. D., Bradley Ka Fau - Wipf, J. E., Wipf Je Fau - Back, A. L., & Back, A. L. (2002). Burnout and self-reported patient care in an internal medicine residency program. Ann Intern Med, 136(5), 358-367. https://doi.org/10.7326/0003-4819-136-5-200203050-00008

Siddique, S. M., Lane-Fall, M., McConnell, M. J., Jakhete, N., Crismale, J., Porges, S., Khungar, V., Mehta, S. J., Goldberg, D., Li, Z., Schiano, T., Regan, L., Orloski, C., & Shea, J. A. (2018). Exploring opportunities to prevent cirrhosis admissions in the emergency department: A multicenter multidisciplinary survey. Hepatology communications, 2(3), 237-244.

Skulmoski, G., Hartman, F., & Krahn, J. (2007). The Delphi Method for Graduate Research. JITE, 6, 1-21. https://doi.org/10.28945/199

Soria-Oliver, M., López, J. S., & Torrano, F. (2017). Relations between mental workload and decision-making in an organizational setting. Psicologia: Reflexão e Crítica, 30(1), 7. https://doi.org/10.1186/s41155-017-0061-0

Stiell, A., Forster Aj Fau - Stiell, I. G., Stiell Ig Fau - van Walraven, C., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. Cmaj, 169(10), 1023-1028.

Stuck, A., Crowley, C., Martinez, T., Wittgrove, A., Brennan, J. J., Chan, T. C., & Castillo, E. M. (2017). Perspectives on Home-based Healthcare as an Alternative to Hospital Admission After Emergency Treatment. Western Journal of Emergency Medicine, 18(4), 761.

Turner, A. J., Anselmi, L., Lau, Y.-S., & Sutton, M. (2020). The effects of unexpected changes in demand on the performance of emergency departments [https://doi.org/10.1002/hec.4167]. Health Economics, 29(12), 1744-1763. https://doi.org/https://doi.org/10.1002/hec.4167

Vagias, Wade M. (2006). *Likert-type scale response anchors*. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

Wears, R. L., Woloshynowych M Fau - Brown, R., Brown R Fau - Vincent, C. A., & Vincent, C. A. (2010). Reflective analysis of safety research in the hospital accident & emergency departments. Applied Ergonomics, 41(5), 695-7000.

Werner, N., Ponnala, S., Doutcheva, N., & Holden, R. (2020). Human Factors/Ergonomics Work System Analysis of Patient Work: State of the Science and Future Directions. International Journal for Quality in Health Care, 33. https://doi.org/10.1093/intqhc/mzaa099

Werner, N. E., Rutkowski, R., Graske, A., Finta, M. K., Sellers, C. R., Seshadri, S., & Shah, M. N. (2020a). Exploring SEIPS 2.0 as a model for analyzing care transitions across work systems. Appl Ergon, 88, 103141. https://doi.org/10.1016/j.apergo.2020.103141

Wright, B., Martin, G. P., Ahmed, A., Banerjee, J., Mason, S., & Roland, D. (2018). How the Availability of Observation Status Affects Emergency Physician Decisionmaking. Annals of Emergency Medicine, 72(4), 401-409.

Chapter 8: Discussion

8.1 General discussion

The purpose of this dissertation was to identify the elements that comprise the ED work system structure that interact to produce the disposition decision-making process and characterize the influence of those elements on ED disposition decision-making process performance under conditions of high and low demand. Practically, I aimed to discover which elements most ED clinicians found influential to the ED disposition decision-making process. To do that, I proposed a novel approach to operationalizing configuration – that is the notion that only a subset of all work system elemental interactions is relevant to process performance (Holden et al., 2013). My mixed-methods, staged approach involved the collection and analysis of observation, interview, and survey data to create a robust conceptualization and visualization of work system structures that shape the ED disposition decision-making process.

The outcomes of this dissertation work have both practical and theoretical implications. Practically, my dissertation work defines a set of work system elements that a majority of ED clinicians find influential to the ED disposition decision-making process under low and high demand. With this information, researchers, designers, and leaders can make informed decisions about which questions, interventions, and initiatives are likely to have the greatest influence on the performance of the disposition decision-making process. In other words, the findings from this dissertation provides a list of work system elements that, if redesigned to mitigate barriers or promote facilitators to ED disposition decision-making, would likely have the greatest influence on ED disposition decision-making process performance and related patient, care partner, clinician, and healthcare organizational outcomes. Theoretically, my dissertation work proposes a new approach to perform configural diagramming, a tool used to visualize the configuration of

a work system. My proposed method lays the foundation for future researchers to rigorously perform configural analysis.

My dissertation consisted of three interdependent studies. First, using a work systems framework, I conducted a scoping literature review of the disposition decision-making literature to assess what was known and where gaps remain in our understanding of the elements that influence the ED disposition decision-making process. This review revealed that many aspects of the ED work system have been previously explored, apart from physical environment. However, none of the reviewed studies comprehensively characterized all aspects of the ED work system nor did they explore the effect of variable conditions on the presentation of work system elements, thereby failing to illuminate the full complexity of the ED work system. Thus, these studies lack the ability to connect the influence of ED work system elements to disposition decision-making process performance and related outcomes, a step that will be necessary to facilitate meaningful system redesign or intervention (Carayon et al., 2006).

To begin to fill this gap, I proposed and conducted a two-part exploratory sequential mixed-methods study that aimed to comprehensively identify the factors that shape the ED disposition decision-making process and determine which factors most strongly shape process performance under conditions of low and high demand. To comprehensively identify the factors that shape the performance of the ED disposition decision-making process, I collected rich qualitative data that consisted of contextual inquiry-based observations and critical incident technique (CIT) motivated semi-structured interviews with ED clinicians, patients, and care partners. I analyzed these data using a team-based deductive content analysis guided by the Systems Engineering Initiative for Patient Safety (SEIPS) model.

Results from this study revealed that there were 40 work system elements involved in shaping the ED disposition decision-making process. In comparing the results of my work system analysis to the results of my scoping literature review, we can see notable similarities yet key differences (Table 8.1). The two studies identified many of the same work system elements, with the most notable differences seen under the task element. Differences could be an artifact of variances in study design (e.g., data collection, study sites) or study objectives.

Table 8.1: Comparing and contrasting work system elements identified in my literature review and work system analysis

Work system component	**Work system elements**	**Present in literature review?**	**Present in work system analysis?**
Person	Patient clinical factors	X	X
	Patient psychosocial factors	X	X
	Patient preference	X	X
	Care partner preference	X	X
	ED clinician risk tolerance	X	X
	ED clinician experience, training, and knowledge (including gestalt)	X	X
	ED clinician sense of responsibility & motivations		X
	ED clinician beliefs about patient and/or care partner efficacy	X	X
	Consulting clinician preference	X	X
	Consulting clinician experience, training, and knowledge		X
Task	Task demands		X
	Task ownership		X
	Task sequence	X	X
	Interruptions		X
	Autonomy		X
	Time pressure	X	X
	Multi-tasking		X
Tools and technology	Information accuracy and accessibility	X	X

	Electronic health record	X	X
	Phone	X	X
	ED trackboard		X
Organization	Involvement of patient and/or care partner	X	X
	Disposition culture	X	X
	ED clinician <> EMS CCC		X
	ED clinician <> ED nurse CCC		X
	ED attending <> ED resident/APP CCC		X
	ED clinician <> consulting physician CCC	X	X
	ED clinician <> Hospitalist CCC	X	X
	ED clinician <> PCP CCC	X	X
	ED staffing	X	X
	Clinical momentum		X
	Standard of care	X	X
	Shift change norms		X
	Access to social work	X	X
	Access to physical therapy		X
Physical environment	Patient's home characteristics		X
	ED commotion		X
	Available space		X
External environment	Insurance/reimbursement	X	X
	Medical legal risk	X	X
	Public policy	X	
	Evidence-based practice	X	X

My work system analysis also explored how work system elements manifested within the ED work system under conditions of low and high demand. At least one work system element within each work system component varied in presentation, with the exception of tools and technologies and external environment, which suggests that varied demand have a system-wide influence on the ED work system's configuration. Under conditions of high demand, ED clinicians reported having insufficient cognitive capacity, physical space, and organizational infrastructure to engaged stakeholders and carry out the ED disposition decision-making process

in the way that they would prefer. Under conditions of low demand, ED clinicians reported the opposite.

Although my work system analysis was successful in comprehensively characterizing the work system elements that shape the ED disposition decision-making process under conditions of low and high demand, my findings provided limited insight into the extent to which each of the numerous work system elements influence the performance of the disposition decision-making process. Understanding the level of influence each element has on shaping the performance of the disposition decision-making process is key to prioritizing intervention and redesign efforts. Although it would be ideal to optimize each element and elemental interaction through intervention or redesign, it is often unrealistic to do so. Thus, identifying the elements that most strongly shape process performance and thereby, if acted upon, would likely have the greatest influence on outcomes is a necessary next step.

To refine the list of elements identified in the work systems analysis by influence, I conducted configural analysis by means of a modified Delphi approach that surveyed ED attendings, residents, and physician assistants (PA). The pragmatic goal of this study was to determine which work system elements a majority of ED clinicians found to be most influential on the ED disposition decision-making process under conditions of low and high demand. The modified Delphi approach consisted of two staged surveys interspersed with feedback in an effort to promote consensus-building among participants. Ultimately, within each work system component, at least one work system element varied in perceived influence, which suggests that the variations in ED work system structure meaningfully influence process performance at a system-level.

8.2 Theoretical contributions

This dissertation proposed a novel method to applying configuration through configural diagrams. Configuration is a concept that has been well-described theoretically in the human factors literature (Holden et al., 2013). However, since the publication of SEIPS 2.0 in 2013, only a handful of papers have attempted to use the concept to guide their research (Carman et al., 2021; Hay et al., 2020; Weiler et al., 2022; Werner et al., 2020). Each paper recruited a slightly different approach to operationalizing configuration and/or configural diagramming. However, how these studies specifically assessed the influence each work system element had on process performance remains unclear. Further, the recent SEIPS 101 paper acknowledged the importance and potential utility of configuration, yet offered no practical methodological guidelines (Holden & Carayon, 2021). As such, without clear guidance on how to assess influence, I developed a novel set of methods to conduct a configural analysis.

8.3 Strengths

This dissertation should be considered in light of a number of strengths both in terms of how the study was conducted and the outputs of the study. With respect to how the study was conducted, I took steps to address the following four pillars of trustworthiness: credibility, transferability, dependability, authenticity (Devers, 1999; Guba & Lincoln, 2001).

To establish credibility, I used methodological and data triangulation, and conducted memoing. Data triangulation involves using more than one data collection method (Robson & McCartan, 2016). I used both interview and questionnaire data. Methodological triangulation involves the use of qualitative and quantitative approaches (Robson & McCartan, 2016). My research used a mixed-methods approach and combined qualitative and quantitative data

collection and analysis approaches. Further, during data collection and analysis, we also had prolonged engagement with participants and with the data. In the presentation of our findings, we present quotes from multiple participants.

Memoing involves the intentional documentation of ideas, views, and intuitions across all stages of the data collection and analysis process (Robson & McCartan, 2016). Memos contain the output of analysis (Strauss & Corbin, 1990). I memoed across all stages of my work. Memoing allowed me to reflexively document my thoughts, plans, and questions which will guide my future work.

To establish transferability, over the course of data collection, I documented demographic information related to the study setting and participants, so long as it was safe and appropriate to do so. I worked closely with my collaborators to determine the level of detail that is needed to establish transferability without compromising the identity of participants.

To establish dependability, we conducted most data collection and all data analysis in a pair or team setting, with disciplines such as human factors, biomedical engineering and cognitive psychology represented, I documented all research activities and methodological decisions to develop an audit trail, and I provided a rich description of the methods. All data analysis was conducted in pairs (i.e., dual coding) and intermediate interpretations were discussed at weekly team meetings. I documented all research activities and methodological decisions in memos document to establish a retraceable audit trail. Finally, I have and will continue to provide a detailed description of the methods during any presentation or publication of this work.

To establish authenticity, I memoed as described above. I have provided and will continue to provide a rich description of the data analysis and interpretation processes (e.g., how

data were assessed and how conclusions were drawn) in any presentation or publication of this work. In the analysis and reporting of this work, I have integrated examples and quotations from multiple participants to reflect both the range and consistencies among participants' experiences.

With respect to the outputs of the study, my findings provide compelling insight into the significant factors that shape the ED disposition decision-making process. My data collection approaches (i.e., observations, semi-structured interviews, modified Delphi) yielded rich, contextualized data that permitted a robust characterization of the ED work system and its influence on the performance of the ED disposition decision-making process. The data generated from this dissertation not only informed meaningful insights on the ED disposition decision-making process but also have the potential to serve as the basis for future secondary analyses to address related research questions (e.g., clinical decision unit admitting behavior, influence of the COVID-19 pandemic on disposition decision-making). My staged study design allowed me to maximize the data collected at each stage and strategically use one stage to inform another. My results provide a succinct list of work system elements that, if acted upon, are likely to have the greatest influence on ED disposition decision process performance and outcomes. As such, these data and this research will tangibly inform future emergency medicine research and ED system redesign.

8.4 Limitations

The findings from this dissertation should be considered in light of a number of limitations. Limitations of each individual study can be found in previous chapters (Chapters 5, 6, and 7). In this section, I report overarching limitations that span the entire dissertation and propose future work to address such limitations.

First, all data collection took place at the ED of an academic medical center with Level One trauma certification. Due to its academic affiliation, this ED and its employees both conduct and participate in research on a regular basis. This undoubtedly influenced how ED clinician participants thought about the ED disposition decision-making process. As such, it is worth exploring whether ED clinicians at institutions with other characteristics (e.g., critical access, non-academic) have a similar perceptions and experiences as those characterized in this dissertation. This understanding will be necessary as researchers and designers work toward developing interventions and system designs that they intend to be widely implemented to ensure they are sufficiently robust to account for variation among institutions.

Further, the patient population of focus in this dissertation was older adults. Older adults are one of the largest and most vulnerable patient populations who visit the ED, meaning they have the most specialized, demanding or restrictive needs and likely represent the upper bound of patient complexity (Ringer et al., 2018). However, there may be aspects of my findings that are not transferrable to other patient populations. As such, since most ED clinicians practice as generalists, future work may consider exploring whether ED clinicians prioritize the same work system elements for other patient populations. This will ensure that conceptualizations of ED disposition decision-making account for variability that may be present due to unique patient population characteristics.

Second, across all three studies that compose this dissertation, I adhered to the assumption that ED disposition decision-making is a physicians' process (Dyrstad et al., 2015; Lin et al., 2018; Pope et al., 2017). As such, I largely focused my data collection and analysis efforts on capturing the experience of ED physicians and physician assistants. However, there is compelling evidence, both from the above studies and other studies published in the literature, to

suggest that ED nurses and other roles (e.g., social work, case management) have a significant role in informing the ED disposition decision-making process (Calder et al., 2012).

Furthermore, my findings point to the importance of communication, coordination, and collaboration during the ED disposition decision-making process. This suggests that ED disposition decision-making is not an individual, internal process localized to the ED physician (Rutkowski et al., 2020). In fact, communication, coordination, and collaboration are hallmarks of teaming (Salas et al., 2008). In my semi-structured interviews with ED physicians and PAs, some ED clinicians referred to themselves and their colleagues as a "team" while others saw themselves as uniquely distinct from the other roles in the ED. Although the extent to which ED clinicians operate as a team (e.g., verses a group) is debated, some studies have found evidence that teaming occurs during the disposition decision-making process (Probst et al., 2016). Clearly defining the nature of the interactions among the individuals within a system will be necessary to develop tools that support and facilitate communication, coordination, and collaboration.

Third, during the data collection outlined in Chapters 6 and 7, I presented participants with a demand dichotomy. Participants resonated with the description of the ED work system under conditions of high demands. However, many participants found the description of the ED work system under low demands challenging to consider, as most reported that they had not experienced this permutation of the work system recently (due to the pandemic). Although the dichotomy was developed with input from ED clinicians (i.e., the slow concept resonated with some clinicians), it is worth considering whether "low demands" are better conceptualized by a permutation of the ED work system that reflects a "busy but manageable" shift rather than a "slow" shift. Future work could further explore the lived experience of ED clinicians in terms of the demands they experience during this ongoing pandemic period.

8.5 Future work

Previous work noted that "if we are seeking to improve the quality of the ED disposition decision, future efforts should focus on better understanding how we arrive at this decision" using "methods such as systems engineering analysis" (Calder et al., 2012, p 574). To address this gap, I used a work systems approach to characterize the work system that influences the ED disposition decision-making process. My findings offer a new lens through which to view the ED disposition decision-making process and the conditions under which it occurs.

At this juncture, a few studies, the present dissertation included, have aimed to characterize different aspects of ED disposition decision-making (Rutkowski et al., In progress). Although these findings offer valuable insight into how ED disposition decision-making occurs and identify notable barriers to process performance, most of these findings are descriptive and have limited capability of informing actionable, sustainable recommendations. As was done with the innovative approach to the diagnostic process, future work should aim to translate these primarily descriptive findings into a robust framework that clearly situates the dynamic ED work system within the ED disposition decision-making process and links the system and process to outcomes (Balogh et al., 2015). Only with this type of framework will we be able to develop, implement, and evaluate interventions and redesign that are predictable, sustainable, and multifaceted (Balogh et al., 2015).

Methodologically, it is important to consider the overall study design and explore whether alternative or additional forms of data or study design could be useful in future studies. This dissertation can be defined as exploratory sequential design in that I first started with rich qualitative data collection (i.e., contextual inquiry-based conversations and semi-structured

interviews) and transitioned to a quantitative approach (Creswell & Poth, 2016). With contextualized data, I conducted a work systems analysis to identify the elements on which I wanted to survey ED clinicians. I then conducted a modified Delphi survey study, which constituted my quantitative data. This approach allowed me to comprehensively address my research question. However, this study could have benefited from additional quantitative data to determine whether ED clinicians' perception of the ED disposition process is reflected or supported by data collected in the electronic health record (EHR) (e.g., health history, length of stay, ED census).

For example, in the future, ED clinicians could be sampled in real time to assess whether they perceive the demands of their shift to be low or high. Researchers could then pull key EHR metrics (e.g., ED census, length of stay, chief complaint) known to be associated with key performance and disposition outcomes. This would allow researchers to assess whether ED clinicians' experiences of high demand are correlated with measurable EHR metrics. Alternatively, taking the present work a step further, both my dissertation and previous research has identified the pervasive lack of disposition guidelines and supportive technology. As such, future research could combine historic EHR data, subject matter expert recommendations, and ED clinician recommendations and experiences to develop an interactive clinical decision support tool that can be used just-in-time during the ED disposition decision-making process. This approach would allow researchers to leverage both large amounts of historic data and insightful anecdotes to develop a tool that minimizes ED clinician cognitive effort and optimizes outcomes.

8.6 Conclusion

The ED work system configuration that influences the ED disposition decision-making process varies meaningfully with demands. These variations have the potential to limit the efficacy and utility of interventions, policies, and procedures if not considered during design and implementation. To systematically identify these variations, configural diagramming can be used. As this study has successfully demonstrated, configural diagramming can be systematically implemented through a two-staged methodological approach consisting of a work systems analysis of contextualized qualitative data to comprehensively identify the work system elements that compose the system followed by a modified Delphi approach to elicit the influence each element has on process performance. This can then be used to inform the development of configural diagrams to depict the similarities and differences between two or more conditions of the ED work system.

The ability to readily identify similarities and differences between work system structures equips researchers, intervention designers, hospital administrators, and policy makers with the information needed to create solutions that are adaptive and reflexive to the dynamic nature of the ED. Solutions that are adaptive and reflexive are more likely to promote effective, efficient, and safe process performance. Processes that are performed effectively, efficiently, and safely promote optimal patient, care partner, clinician, and hospital organizational outcomes. These optimal outcomes feedback to inform future work system configurations and the performance of processes. In essence, findings from a rigorous configural analysis can inform the development of solutions that lead to positive, sustainable change for critical clinical processes.

8.7 Chapter 8 references

Balogh, E. P., Miller, B. T., & Ball, J. R. (2015). Improving diagnosis in health care.

T. N. A. Press. https://doi.org/10.17226/21794

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576 e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Quality and Safety in Health Care*, *15*(suppl 1), i50. https://doi.org/10.1136/qshc.2005.015842

Carman, E.-M., Fray, M., & Waterson, P. (2021). Facilitators and barriers of care transitions - Comparing the perspectives of hospital and community healthcare staff. *Applied Ergonomics*, *93*, 103339. https://doi.org/https://doi.org/10.1016/j.apergo.2020.103339

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage.

Devers, K. J. (1999). How will we know" good" qualitative research when we see it? Beginning the dialogue in health services research. *Health services research*, *34*(5 Pt 2), 1153.

Dyrstad, D. N., Testad, I., & Storm, M. (2015). Older patients' participation in hospital admissions through the emergency department: an interview study of healthcare professionals. *BMC Health Services Research*, *15*(1), 1-9.

Guba, E. G., & Lincoln, Y. S. (2001). Guidelines and checklist for constructivist (aka fourth generation) evaluation. In.

Hay, G., Klonek, F., & Parker, S. (2020). Diagnosing rare diseases: A sociotechnical approach to the design of complex work systems. *Applied Ergonomics*, *86*, 103095. https://doi.org/10.1016/j.apergo.2020.103095

Holden, R., & Carayon, P. (2021). SEIPS 101 and seven simple SEIPS tools. *BMJ Quality & Safety*, *30*, bmjqs-2020. https://doi.org/10.1136/bmjqs-2020-012538

Holden, R. J., Carayon P Fau - Gurses, A. P., Gurses Ap Fau - Hoonakker, P., Hoonakker P Fau - Hundt, A. S., Hundt As Fau - Ozok, A. A., Ozok Aa Fau - Rivera-Rodriguez, A. J., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*(11), 1669-1686.

Lin, M. P., Natsui, S., Sinnette, C., Ball, A., Weissman, J. S., & Schuur, J. D. (2018). Facilitators and Barriers to Reducing Emergency Department Admissions for Chest Pain: A Qualitative Study. *Critical Pathways in Cardiology*, *17*(4), 201-207.

Pope, I., Burn, H., Ismail, S. A., Harris, T., & McCoy, D. (2017). A qualitative study exploring the factors influencing admission to hospital from the emergency department. *BMJ open*, *7*(8), e011543.

Ringer, T., Dougherty, M., McQuown, C., Melady, D., Ouchi, K., Southerland, L., & Hogan, T. (2018). White Paper-Geriatric Emergency Medicine Education: Current State, Challenges, and Recommendations to Enhance the Emergency Care of Older Adults. *AEM Education and Training*, *2*. https://doi.org/10.1002/aet2.10205

Robson, C., & McCartan, K. (2016). *Real world research*. John Wiley & Sons.

Rutkowski, R. A., Salwei, M., Barton, H., Wust, K., Hoonakker, P., Brenny-Fitzpatrick, M., King, B., Shah, M. N., Pulia, M. S., Patterson, B. W., Dáil, P. V., Smith, M., Carayon, P., & Werner, N. E. (2020). Physician Perceptions of Disposition Decision-making for Older Adults in the Emergency Department: A Preliminary Analysis. *Proceedings of the*

Human Factors and Ergonomics Society Annual Meeting, *34*(1071-1813 (Print)), 648-652.

Salas, E., Wilson, K. A., Murphy, C. E., King, H., & Salisbury, M. (2008). Communicating, Coordinating, and Cooperating When Lives Depend on It: Tips for Teamwork. *The Joint Commission Journal on Quality and Patient Safety*, *34*(6), 333-341. https://doi.org/https://doi.org/10.1016/S1553-7250(08)34042-2

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research*. Sage publications.

Weiler, D. T., Lingg, A. J., Eagan, B. R., Shaffer, D. W., & Werner, N. E. (2022). Quantifying the qualitative: exploring epistemic network analysis as a method to study work system interactions. *Ergonomics*, 1-16. https://doi.org/10.1080/00140139.2022.2051609

Werner, N. E., Rutkowski, R., Graske, A., Finta, M. K., Sellers, C. R., Seshadri, S., & Shah, M. N. (2020). Exploring SEIPS 2.0 as a model for analyzing care transitions across work systems. *Applied Ergonomics*, *88*, 103141.

Appendix A: Review of decision-making literature

To conceptualize and understand disposition decision-making as a cognitive process, I have synthesized key decision-making models and frameworks. Exploring this body of literature is necessary to situate disposition decision-making in the context of the psychological and cognitive theories and principles that underpin the decision. In this section, I review foundational individual and multi-person decision-making frameworks including: Traditional decision-making, Naturalistic decision-making, Transactive memory research, Shared decision-making, and Heuristics.

For clarity and consistency, I have limited my review of multi-person decision-making frameworks to non-team-based models. The term "team" is associated with a very specific definition that often takes the form of "a distinguishable set of two or more people who interact, dynamically, interpedently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited life-span of membership" (Salas et al., 1992) Although our understanding of how individuals operate as part of the disposition decision-making process is relatively limited, there is evidence that disposition decision-making does not occur within a tightly-coupled team as defined by the previous definition (Calder et al., 2012; Rutkowski et al., 2020). As such, it seems more appropriate to explore individual and team-ambiguous models of decision-making.

A1.1 Traditional or classical decision-making models

Classical or traditional decision-making models tend to refer to models that predate more modern approaches to decision-making like naturalistic decision-making and heuristics. These approaches are often more logical or analytical in nature. Examples include Bayesian statistics and regression. These approaches were used for decades and provide the foundation for modern

models of decision-making. However, these approaches have conceptual and applicability challenges.

Foundational decision research focuses primarily on understanding a specific stage of decision-making (i.e., the decision event) (Orasanu & Connolly, 1993). In these models, the individual takes an analytical approach to assess a known and fixed set of options, considers likely outcomes of each choice, and makes the decision that is optimal in light of personal goals or values (Orasanu & Connolly, 1993). Such assessment usually requires the individual to analyze, score, and weigh all potential alternatives to identify the optimal option which can be complex, time-consuming, and laborious (Albar & Jetter, 2009). Given the limited time, information, and cognitive capacity that characterize most decisions, such approaches have been demonstrated to not accurately reflect how individuals make decisions (Simon, 1956).

Although it is useful to have a good understanding of the decision event, limiting the scope of decision-making to just the decision fails to acknowledge that, in most natural settings, the decision is not the ultimate outcome, but rather "decisions are embedded in larger tasks that the decision maker is trying to accomplish" (Orasanu & Connolly, 1993). As such, critical social, environmental, organizational, temporal, historical, etc. factors are not considered when exclusively exploring the decision thereby limiting the validity of the findings (Orasanu & Connolly, 1993). More progressive models of decision-making, like naturalistic decision-making and shared decision-making, were born out of this systemic misalignment between traditional models of decision-making and observed or lived experience (Orasanu & Connolly, 1993).

A1.2 Naturalistic Decision-making

Naturalistic decision-making (NDM) provides a mechanism to describe how individuals make decisions in context (Klein, 2008). Unlike the previous decades of highly-controlled

research that aimed to identify low performance, early NDM researchers aimed to identify the strategies that individuals use to make decisions in light of realistic conditions (e.g., high-pressure, constrained, uncertain) (Klein, 2008). Across fields of study, researchers have found that individuals are not curating and evaluating alternatives (Klein, 2008; Orasanu & Connolly, 1993). Instead, individuals are relying on a synthesis of experience (Klein, 2008). NDM facilitated a shift in understanding of decision-making from a domain-independent general approach to a knowledge-based approach (Klein, 2008).

NDM views decision performance in context as the mutual function of task features and the individual's knowledge and experience relevant to the task (Orasanu & Connolly, 1993). There are eight factors that characterize naturalistic decision-making. The extent to which these factors are relevant to a given decision depend on the setting but at least a subset of these factors will be important to consider when exploring decision-making in naturalistic settings. The factors include ill-structured problems, uncertain dynamic environments, shifting or ill-defined or competing goals, action/feedback loops, time stress, high stakes, multiple actors, and organizational goals and norms (Orasanu & Connolly, 1993). Numerous models have been developed to conceptualize how these factors manifest within and across various decision processes.

A1.2.1 Individual naturalistic decision-making models

In the early 1990s, Lipshitz identified nine models of NDM that emerged around the same time from various literature domains including Noble's model of situation assessment, Klein's model of recognition-primed decisions, Pennington and Hastie's model of explanation-based decisions, Montgomery's dominance search model, Beach and Mitchell's image theory,

Rasmussen's model of cognitive control, Hammond's cognitive continuum theory, Connolly's model of decision cycles, and Lipshitz's model of argument-driven action (Lipshitz, 1993).

Lipshitz's review is not comprehensive of all NDM models that were developed by the 1990s but synthesizes models that were developed to depict "real-world decision-making", represent a new approach to decision-making (i.e., they do not directly stem from "classical decision theory"), and focused on the individual rather than groups or team (Lipshitz, 1993). A commentary on group decision-making models can be found in Section 2.2.2.2. Below I briefly review each of these nine models.

A1.2.1.1 Noble's model of Situation Assessment

This model addresses how the situation prompting the decision is assessed (Lipshitz, 1993). According to the model, this assessment unfolds across the following steps. First, information about the situation is combined and considered alongside additional contextualizing information (e.g., the broader social climate) and knowledge from the decision maker's memory (Lipshitz, 1993). The combination of information and knowledge from these sources results in a tentative interpretation, hereby referred to as a representation, of the situation (Lipshitz, 1993). Each representation is associated with certain expectations. These expectations are continually compared to how the situation is actually unfolding and the representation is retained, refined, or replaced with a new representation that then undergoes the same testing and then is either retained, refined, or replaced (Lipshitz, 1993).

As it pertains to disposition decision-making, the process of continually updating one's representation of situations as they unfold seems to parallel how ED physicians receive and interpret information over the course of the ED visit. ED physicians obtain information from a variety of sources (e.g., the patient, diagnostic tests, other providers) over the course of the ED

visit (Rutkowski et al., 2020). With each piece of new information, the ED provider is likely to either retain, refine, or replace their representation. With respect to application in the field, Nobel's model appears to have relatively limited use in research and instead has been used in the development of software to assess complex situations (Lipshitz, 1993).

In summary, Noble's model of situation assessment may be able to provide some value to understanding disposition decision-making but its limited use in varied research settings may make it difficult to determine the extent of its utility.

A1.2.1.2 Klein's model of Recognition-Primed Decisions

Klein's descriptive model of recognition-primed decision-making explores how proficient decision makers operate effectively under high stress and time pressure (Klein, 2008; Lipshitz, 1993). Through his work studying fireground commanders, Klein found that, unlike the traditional belief that decision-making involves selection among alternatives, proficient decision makers assessed the current situation and selected an appropriate action (Lipshitz, 1993). Recognition-primed decision-making consists of three phases: situation recognition, serial option evaluation, and mental simulation (Lipshitz, 1993).

Situation recognition involves the decision maker recognizing or classifying the situation as typical or unique (Lipshitz, 1993). To do this, the decision maker identifies cues that indicate the situation type and consider causal factors that describe what is happening and what will happen (Lipshitz, 1993). By focusing only on critical information and causal factors, the proficient decision maker reduces information overload, minimizes confusion, and establishes realistic expectations (Lipshitz, 1993). From this assessment, the decision maker sets goals and selects an appropriate action (Lipshitz, 1993).

Serial option evaluation involves the decision maker evaluating action alternatives individually until one is identified that satisfies the current situation (Lipshitz, 1993). Action options are considered from a queue of potential actions that are prioritized according to what is most typical based on identifiable patterns from previous experience (Klein, 2008; Lipshitz, 1993). The prioritization based on typicality allows the decision maker to match the situation to an action quickly and efficiently (Klein, 2008; Lipshitz, 1993). In his work, Klein found that if the decision maker identified an action that they could readily initiate, they would move forward with that action even if it was not optimal (Klein, 2008). The process of identifying the first option that is satisfactory is referred to as satisficing (Klein, 2008).

Mental simulation involves the decision maker evaluating if an action is satisfactory by simulating the actions and potential outcomes, problems, and solutions in their mind (Lipshitz, 1993). Based on this simulation, the decision maker either moves forward with the action, makes modifications, or discards it and proceeds to simulate the next action in the queue (Lipshitz, 1993). During this stage, the decision maker may reassess the situation to identify previously unnoticed aspects of the situation (Lipshitz, 1993). This phase prevents and mitigates mistakes that would likely result from a less rigorous decision-making process (Lipshitz, 1993).

Klein has noted that his recognition-primed decision model is most suitable for proficient decision makers (i.e., those with expertise and experience) who make decisions under time pressure and are not required to optimize or justify the decision, and where the decisions are naturally presented as discrete choices (Klein, 2008). Thus, the model describes how individuals can make rapid and good decisions without comparing options (Klein, 2008). The recognition-primed decision model combines intuition (i.e., System 1 thinking) with analysis (i.e., System 2 thinking). This is critical as exclusively relying on the intuitive approach of pattern matching

could result in flawed options. Likewise, exclusively relying on the analytic approach of considering all options in turn would be too slow to be useful in an acute situation (Klein, 2008). The integration of these two approaches makes the recognition-primed decision model realistic yet comprehensive.

As it pertains to disposition decision-making, although the ED represents a complex and often time-pressured environment, when it comes to disposition decision-making, ED physicians do not necessarily make extremely time-pressured decisions moment by moment for patients with less acute illness or injuries (Stiell et al., 2003; Wears & Leape, 1999; Wears et al., 2010). Further, ED physicians may be required to clearly justify the disposition decision, meaning that satisficing likely is not a part of decision process. In summary, Klein's model of recognition-primed decisions most likely does not completely reflect the disposition decision-making process.

A1.2.1.3 Pennington and Hastie's Explanation-Based Decisions

Pennington and Hastie's story-based model of explanation-based decisions was developed to understand how individual jurors make decisions but has since been expanded to be a more general decision-making model (Lipshitz, 1993). The explanation-based decision model consists of three phases which correspond to the three phases of a trial: processing the evidence, defining the verdict alternatives, and determining the verdict (Lipshitz, 1993).

Processing the evidence consists of the decision maker organizing fragmented, often conflicting information into a coherent story (Lipshitz, 1993). Where there are gaps in the decision maker's story, the decision maker infers actions, mental states, and consequences to increase the coherence of the story (Lipshitz, 1993). The story reveals the underlying episode

schema which consists of initiating events, physical states, psychological states, goals, actions, and consequences which are connected either temporally or causally (Lipshitz, 1993).

Defining verdict alternatives consists of an organizational leader (e.g., a judge) outlining and defining the conditions for a discrete set of potential outcomes (e.g., different verdict options) for the decision maker to consider (Lipshitz, 1993). Finally, determining the verdict consists of the decision maker identifying which outcomes (e.g., verdicts) best align with the story the decision maker constructed from the evidence (Lipshitz, 1993). According to this model, the decision maker will only select an option if it aligns with the story they have previously constructed (Lipshitz, 1993).

Pennington and Hastie noted that the explanation-based decision model is a unique depiction of how decisions are made when individuals must process a large amount of information that is incomplete, fragmented, and presented in a non-temporal sequence (Lipshitz, 1993). They suggest that individuals cope with this suboptimal presentation of information by constructing a causal explanation (i.e., a story) based on the information provided, general knowledge, and inferences (Lipshitz, 1993). This model is most useful for characterizing tasks or domains where stories or storytelling is central (e.g., a legal trial).

As it pertains to disposition decision-making, Pennington and Hastie's story-based model of explanation-based decisions may be useful in more richly understanding disposition decision-making and more clearly situating disposition decision-making into the patient journey. One could argue that the patient journey could be conceptualized as a "story" that unfolds over an extended period of time (Carayon et al., 2020). Thus, a story-based framework may provide sufficient infrastructure to capture micro stories that occur within the macro story (i.e., the patient journey). For example, a story-based approach could be useful in understanding how an

ED physician interprets information provided by the patient and family. ED physicians often ask open-ended questions like “tell me what brought you in today” which gives the patient a chance to tell their “story.” However, patient’s perceptions of the events that preceded their ED visit are often fraught with inconsistencies, are presented in a fragmented manner, and represent only the information the patient is willing and able to communicate. As a result, the ED physician is likely to infer actions, mental states, and outcomes to develop a cohesive story of events.

Further, there are a limited number of disposition locations. For example, usually patients are transferred to an inpatient unit, a clinical decision unit, an outpatient skilled care facility, or home. As such, providers must select a disposition location that best “matches” with the story they have developed over the course of the patient’s ED visit.

Despite its potential benefits, the model has yet to be validated in a healthcare setting. However, this model and story-based models warrant further exploration to determine their suitability for supporting a deeper understanding of disposition decision-making.

A1.2.1.4 Montgomery’s Search for Dominance Structure

The search for dominance structure model captures decisions for which there are several alternatives (Lipshitz, 1993). Montgomery suggested that individuals would search for a dominant alternative which is defined as the alternative that is at least as attractive as competitors on all pertinent attributes and exceeds each on at least one attribute (Lipshitz, 1993). According to this model, the pursuit for a dominant alternative consists of four phases where the decision maker recruits different decision rules (Lipshitz, 1993). The four phases are pre-editing, finding a promising alternative, dominance testing, and dominance structuring.

Pre-editing consists of the decision maker selecting the attribute that will guide the decision-making process (Lipshitz, 1993). These criteria define factors that are important to the

decision maker and will be used to identify obviously unfavorable alternatives (i.e., the conjunctive decision rule) (Lipshitz, 1993). Finding a promising alternative consists of the decision maker selecting an alternative that appears to best align with the attribute defined in the pre-editing phase (i.e., disjunctive decision rule) (Lipshitz, 1993). Dominance testing consists of the decision maker testing the promising alternative against the criteria of dominance. If the criteria align, the alternative is selected. If the criteria do not align, the decision maker moves on to the dominance structure phase (Lipshitz, 1993).

Dominance structure involves the decision maker reinterpreting the standing of the promising alternative relative to the other options to make it a dominant alternative (Lipshitz, 1993). This is done by deemphasizing the chance that a suboptimal attribute of the promising alternative will occur, enhancing the significance of attributes on which the promising alternative is superior through realistic examples, assessing the tradeoffs between the positives of one attribute and negatives of another attribute, and integrating multiple attributes into a composite attribute (Lipshitz, 1993).

In essence, Montgomery conceptualizes decision-making as the process of rationalizing certain decisions and behaviors by quickly identifying a promising alternative and then affirming the dominance of this alternative (Lipshitz, 1993). Montgomery suggests that this approach to decision-making is representative of human's limited capacity for information processing in that focusing on a set of alternatives and evaluating those alternatives by a set of attributes allows individuals to identify the preferred alternative (Lipshitz, 1993). Further, identifying and justifying a dominant alternative affords the decision maker confidence during implementation in light of altering circumstances, ambiguous goals, and competing interests (Lipshitz, 1993). As with the recognition-primed decision model, the search for dominance structure model combines

intuition with deeper analysis thereby allowing decision makers to identify a viable option quickly (Lipshitz, 1993). However, due to the reinterpretation of available information, the search for the dominance structure model may lead to the decision maker distorting reality in favor of justifying a potentially suboptimal but preferred option (Lipshitz, 1993).

As it pertains to disposition decision-making, disposition decision-making involves the selection among a limited number of alternatives based on a set of factors determined by the ED physician and/or the patient (e.g., must be dispositioned to a location where a high-level of support is available). However, the extent to which ED physicians would prospectively justify or rationalize their promising alternative by deemphasizing the chance that a suboptimal attribute of the promising alternative will occur, enhancing the significance of attributes on which the promising alternative is superior, assessing the tradeoffs between the positives of one attribute and negatives of another attribute, and integrating multiple attributes into a composite attribute is unclear. Providers may be asked to justify their decisions in the case of an investigation into a negative outcome. However, it is unclear the extent to which this pending requirement for justification influences practice, specifically disposition decision-making.

In summary, Montgomery's dominance search model may be useful in further understanding how disposition decision-making occurs. However, further investigation is needed to determine the extent to which ED physicians engage in this process of justification and rationalization.

A1.2.1.5 Beach and Mitchell's Image Theory

Image theory was developed from over a decade of work studying real-life decisions across a range of domains (Lipshitz, 1993). The theory consists of four components: images, adoption decisions, progress decisions, and frames. Images refer to the cognitive structures or

schemata that order the decision maker's knowledge and values, and guide decisions (Lipshitz, 1993). Images can be categorized into three types. The first type is the value image which consists of the decision maker's notions about what is "right" and "wrong" and the ideals to which they aim (i.e., their principles) (Lipshitz, 1993). The second is the trajectory image which consists of tangible goals that the decision maker aims to achieve (Lipshitz, 1993). The third is the strategic image which consists of the steps and behaviors needed to achieve the goal (i.e., plans and tactics) and the anticipated outcomes associated with enacting a plan (i.e., forecasts) (Lipshitz, 1993).

Adoption decisions refer to the integration of goals and plans to realize the decision maker's current agenda (Lipshitz, 1993). This process consists of a compatibility test that assesses the extent to which a proposed goal or plan aligns with the decision maker's three images (Lipshitz, 1993). The goal of the compatibility test is to quickly eliminate misaligned goals and plans (Lipshitz, 1993). If more than one proposed goal or plan passes the compatibility test, the decision maker then conducts a profitability test (Lipshitz, 1993). The phrase "profitability test" refers to a range of tests stemming from more intuitive methods (i.e., those that require minimal time and effort) to analytic tests (i.e., those that require a greater time and effort investment), and can either be compensatory (i.e., permitting advantages of an option to balance the disadvantages) or non-compensatory (Lipshitz, 1993). Most decisions are made using a compatibility test, but the decision maker may deem a profitability tests necessary (Lipshitz, 1993). In such cases, the profitability testing process often unfolds across the following four stages:

1. The decision maker is unable to make a decision based on the compatibility test.

2. The decision maker tends to view the compatibility and profitability tests independently. In other words, decision makers often disregard the information they used during compatibility testing as they make a decision based on the findings from the profitability test.
3. As decision complexity increases so does the decision maker's tendency to recruit more intuitive and non-compensatory profitability tests.
4. Decision makers use different profitability tests to make acceptable decisions with limited effort investment (Lipshitz, 1993).

Progress decisions help the decision maker envision and simulate the proposed plan and evaluate whether a plan, if implemented, will achieve its goals (Lipshitz, 1993). Progress decisions occur during compatibility testing. If the decision maker envisions a plan and determines that it is likely to synergize with the trajectory and strategic images, the plan is added to the strategic images (Lipshitz, 1993). If the decision maker determines that the plan is likely to conflict with the existing trajectory and strategic images, the plan may be revised and adopted or replaced by another option (Lipshitz, 1993). Likewise, if the decision maker determines that the plan will address the goals, the decision maker will adopt the plan with no revision (Lipshitz, 1993). If the decision maker determines that the plan is unlikely to address the goals, they will either revise the plan or the goals (Lipshitz, 1993).

A frame refers to the subset of the decision maker's principles, goals, and plans that most influence the decision (Lipshitz, 1993). At a given point in time, the frame represents the accepted norms (Lipshitz, 1993). All other factors being equal, image theory suggests that decision makers have a tendency to accept existing plans and goals over potential alternatives (Lipshitz, 1993).

Relative to the other models explored in this section, image theory most clearly integrates the decision maker's individual values and ideals thereby indicating that decisions are not always pursued to achieve a desired outcome but rather to operationalize individual values and ideals (Lipshitz, 1993).

As it pertains to disposition decision-making, although there may be some aspects of Beach and Mitchell's Image Theory that could be useful in understanding disposition decision-making, there are a number of model components that do not clearly map to disposition decision-making. Specifically, images are developed from an individual's knowledge and values and reflect the individual's principles, goals, and plans. However, identifying an ED physicians' principles may pose a challenge. Most ED providers are likely to share broad goals like optimize patient safety, but principles specific disposition decision-making may be more difficult to elicit. Further, what an ED physician believes about "right" and "wrong" with respect to disposition decision-making may misalign with what the patient and family believe about disposition decision-making. Excluding instances of involuntary hospitalization, the ED physicians' principals may be ultimately overridden by those of patients and care partners.

Further, Image Theory relies on the individual's ability to envision and simulate the proposed plan and evaluate whether a plan, if implemented, will achieve its goals (Lipshitz, 1993). However, it may be difficult for ED physicians to fully consider the implications of dispositioning a patient to one location over another as there is often uncertainty about the type and quality of care a patient will receive in different settings (Werner et al., Under review). In summary, these misalignments likely render Beach and Mitchell's Image Theory less useful for understanding disposition decision-making.

A1.2.1.6 Rasmussen's Cognitive Control of Decision Processes

The cognitive control of decision processes model depicts the decision-making processes of individuals who operate in complex and automated systems (e.g., nuclear power plants) and can help in understanding and reducing the likelihood of "human errors" (Lipshitz, 1993). The model consists of three behavior types: skill-based behavior, rule-based behavior, and knowledge-based behavior.

Skill-based behavior includes expert sensorimotor performance which can occur seamlessly without conscious attention (Lipshitz, 1993). This behavior is controlled by a dynamic mental model that captures the decision maker's movements and environment continually which enables the decision maker to make adjustments to feedback in real time (Lipshitz, 1993). Mental models are a combination of a person's expectations, experiences, and perceptions of a given system (Mathieu et al., 2000; Norman, 1983). Signals (i.e., inputs) serve as the catalyst to action without explicit consideration of the significance of the input or the decision makers' goals (Lipshitz, 1993).

Rule-based behavior refers to behavior that is dictated by rules and knowing how to do something in a way that the decision maker can clearly articulate (Lipshitz, 1993). Signals are processed as indicators for a certain type of situation and subsequent behavior is guided by previous experience or formal training (Lipshitz, 1993). In other words, rule-based behavior involves recognition of signs that then lead to certain behavior (i.e., cue-task association). Both skill-based behavior and rule-based behavior are associated with expert performance in familiar situations (Lipshitz, 1993).

Knowledge-based behavior results in effective action guided by a rich understanding of the situation and clear consideration of objectives and alternatives in novel situations (Lipshitz,

1993). Signals are processed as symbols meaning they are used to construct mental models depicting causal and operational relationships in the environment (Lipshitz, 1993). These models are constructed across varied dimensions of abstraction and decomposition. The abstraction dimension refers to the notion that individuals who operate technological systems sometimes focus on tangible and visible aspects of the system, and at other times they focus on abstract properties such as information flow within a system and the system's general purpose (Lipshitz, 1993). The decomposition dimension refers to the notion that individuals sometimes focus on specific components of the system and at other times focus on larger system components or the system itself (Lipshitz, 1993).

In summary, Rasmusssen's cognitive control of decision processes model gives insight into whether and to what extent individuals operate out of habit, which can then be used to determine how and why accidents occur. Further, identifying the type of behavior an individual is conducting gives insight into the type of decision support systems that would be appropriate and effective. For example, a structural diagram would be useful for identifying a broken component but would not be useful in discerning the component's intended purpose (Lipshitz, 1993).

As it pertains to disposition decision-making, because disposition decision-making is often a lengthy process that consists of numerous tasks, Rasmussen's model may be able to provide insight into how and why ED physicians behave at various points in the ED visit (Medicine, 2008). For example, across an ED visit and throughout the disposition decision-making process, a provider may engage in all three types of behavior. However, this model focuses more on external behavioral cues to decision-making and provides little insight into the person factors that influence the decision. Further, given the behavioral focus of the model, it

may not be comprehensive enough to capture all aspects of the disposition decision-making process.

A1.2.1.7 Hammond's Task Characteristics and Human Cognition

Hammond's work, which aimed to fully explicate and expand upon Brunswik's probabilistic functionalism, is considered an extension of social judgement theory (SJT) (Cooksey, 1996; Lipshitz, 1993). SJT aims to understand human judgement as it occurs in certain ecological contexts (Cooksey, 1996). SJT details the relationship among the task system, the information available on this task system, the perception and integration of this information, and the resulting judgements and decisions (Lipshitz, 1993). Hammond was particularly interested in addressing the following questions: (1) to what extent are decisions made intuitively verses analytically and (2) do decision makers seek patterns or functional relationships to address the situation? (Lipshitz, 1993).

To address the first question, Hammond proposed that the cognitive processes that inform decision-making can be situated on a cognitive continuum ranging from intuitive to analytical. This process continuum is known as the cognitive continuum index (CCI) (Lipshitz, 1993). According to Hammond, determining where a process should be located on this continuum is a function of two factors (Lipshitz, 1993). First, individuals are often more analytical when rapid or "snap" judgements fail and are often more intuitive when detailed analysis fails (Lipshitz, 1993). Second, the nature of tasks influences decision-making (Lipshitz, 1993). The inducement principle suggest that particular task characteristics led to more intuitive behavior while others lead to more analytical behavior. As such, just as cognitive processes can be situated on a continuum, tasks can be situated on a continuum ranging from inducing more or less intuition or analysis. This tasks continuum is known as the task continuum index (TCI) (Lipshitz, 1993).

Hammond's inducement principle describes why individuals waiver between intuitive and analytical cognitive decision-making processes as tasks characteristics change (Lipshitz, 1993). Further, Hammond's correspondence-accuracy principle suggests that decision-making is most effective when there is alignment between the location of the cognitive process on the CCI and the task on the TCI (Lipshitz, 1993). Therefore, changes in the tasks will lead to predictable changes in cognitive processes (Lipshitz, 1993).

The address the second question, Hammond suggests that task characteristics lead to either patterns or functional relations in the situation (Lipshitz, 1993). Pattern seeking is likely to occur if the situation is associated with highly organized information and if the individual must be able to articulate a clear explanation of events or situations (Lipshitz, 1993). Functional relations seeking is likely to occur if the situation is associated with unorganized information and if the individual must be able to provide descriptions or predictions (Lipshitz, 1993).

In summary, Hammond's work suggests that decisions and decision-making are seldom exclusively intuitive or analytic. Rather, decision-making occurs dynamically between intuition and analysis as a result of task characteristics, indicating the importance of exploring the task characteristics.

As it pertains to disposition decision-making, preliminary work has explored the extent to which disposition decisions involve Systems 1 (i.e., intuitive) verses Systems 2 (i.e., analytic) thinking (Cabrera et al., 2015; Sibbald et al., 2017; Wiswell et al., 2013). This work has produced varied findings but overall suggest that there may be elements of Systems 1 and Systems 2 thinking involved in disposition decision-making. Therefore, a decision-making model that integrates the historic utility of intuition verses analysis to an individual as well as the type of cognitive processes that tasks elicit could be useful in understanding how ED physicians

oscillate between intuition and analysis over the course of the disposition decision-making process. However, given that the focus of this model is primarily on the individual decision-maker, it may not be comprehensive enough to capture all aspects of the disposition decision-making process.

A1.2.1.8 Connolly's Decision Cycles

Connolly suggests that decision-making must consist of continual interaction among situation assessment, evaluation of alternatives, and subsequent action as the process of decision-making in context is dynamic (Lipshitz, 1993). The Decision Cycle model consists of three domains (i.e., the actual world, the decision maker's cognitive map, and the decision maker's values, goals, and purposes) and two cycles (i.e., perceptual cycle and decisional cycle). The perceptual cycle involves feedback from action consequences adjusting the decision maker's cognitive map, which motivates future action (Lipshitz, 1993). The decisional cycle involves feedback from action consequences adjusting the decision maker's goals (Lipshitz, 1993).

To more clearly distinguish between acting and thinking, Connolly defines two decision processes: action-last or tree-felling and action-first or hedge-clipping (Lipshitz, 1993). Tree-felling refers to consequential decisions that are made in a single step following a planning period with well-defined goals and are associated with tangible next steps (Lipshitz, 1993). Hedge trimming refers to decisions that are made across a series of steps. Hedge trimming is useful when it is difficult to determine a clear goal and when outcomes of individual actions are minimal (Lipshitz, 1993).

To better understand the interaction among the three domains and the two levels of decision cycles, Connolly suggest using decision paths (Lipshitz, 1993). Decision paths are guided by the clarity of decision maker's values and goals. Individuals with clear goals may

focus on perceptual exploration, which will involve determining what actions best satisfy their goals (Lipshitz, 1993). Individuals with ill-defined goals may focus on evaluative exploration, which will involve more broadly considering the benefit of one action over another (Lipshitz, 1993).

As it pertains to disposition decision-making, the interaction among the actual world, an individual's cognitive map, and an individual's values, goals, and purposes across perpetual cycles and decision cycles may be able to provide insight into the evolution of a disposition decision over the course of an ED visit. Because of the interactions and feedback loops, relative to the other models presented here, Connolly's model of decision cycles may be able to supplement systems models like the Systems Engineering Initiative for Patient Safety (SEIPS) model (Carayon et al., 2006). Integrating Connolly's model of decision cycles with SEIPS, for example, would allow the decision-making process to be embedded within the work system thereby giving a more detailed description of both the decision-making process and the context within which the process occurs. However, on its own, Connolly's model may not be comprehensive enough to capture all aspects of the disposition decision-making process.

A1.2.1.9 Lipshitz's Decision-Making as Argument-Driven Action model

Lipshitz conceptualizes decision-making as argument-driven action and suggests that this could occur through three different modes: consequential choice, matching, and reassessment (Lipshitz, 1993). Lipshitz suggests that these three modes of decision-making differ across six attributes of decision processes: framing, form, uncertainty, logic, handicaps, and therapies. Framing refers to how the decision problem is described (Lipshitz, 1993). Form refers to how an action is determined (Lipshitz, 1993). Uncertainty refers to the questions that must be addressed to act (Lipshitz, 1993). Handicaps refer to the obstacles that effect the ability to make quality

decisions (Lipshitz, 1993). Therapies refer to the mechanisms of improvement that are compatible with the previous five attributes (Lipshitz, 1993).

Consequential choice refers to selecting an option among alternatives in terms of expected outcome (Lipshitz, 1993). Consequential choice problems are often framed as prospective choices (e.g., there are several options available, which has the best outcomes?) (Lipshitz, 1993). The form of the decision process involves comparing alternatives. Uncertainty relates to the likelihood and preferability of the potential outcomes (Lipshitz, 1993). The logic is teleological in that it is purpose-driven as opposed to causally descriptive. The teleological logic reflects the notion that individuals act wisely when they consider the future and plan (Lipshitz, 1993). A key handicap is individual's limited information processing capacity. Therapies to address this handicap include interventions develop using formal models of optimal choice and judgment under uncertain conditions (Lipshitz, 1993).

Matching refers to identifying an action based on its appropriateness to the situation (Lipshitz, 1993). Problems are framed as situational assessment during which questions like "what should be done in this situation?" are asked (Lipshitz, 1993). The form of the decision process involves reliance on personal experience, professional standards, and social norms. Uncertainty refers to unknowns related to the situation or the actions required (Lipshitz, 1993). The logic is deontological in that it relies on the perspective that actions can be classified as good or bad (or right or wrong) based on whether they are consistent with moral duties (Lipshitz, 1993). The deontological logic reflects notion that individuals act wisely when they refer to their experiences or others' experiences (Lipshitz, 1993). Therapies include the use of training and expert or production systems (Lipshitz, 1993).

Reassessing refers to reviewing the appropriateness of an action due to objections of its implementation (Lipshitz, 1993). Problems are framed as oppositions to particular courses of action due to uncertain present or future circumstances (Lipshitz, 1993). A discussion of form is null in that the individual has already committed to a decision (Lipshitz, 1993). The logic is nonjustificational in that it reflects the notion that forethought is not feasible, acting precedes thinking, and the best any individual can hope for is the ability to critically reflect on one's values and assumptions (Lipshitz, 1993). A key handicap is a lack of thorough implementation due to previous decisions or wishful thinking (Lipshitz, 1993). Therapies include methods for promoting critical thinking (Lipshitz, 1993).

In summary, Lipshitz emphasizes that conceptualizing decisions as a selection among alternatives oversimplifies the complex process that most individuals experience. Lipshitz suggests that a more appropriate, generalizable conceptualization is that every action can be justified by a reason. This is generalizable in that action and the reason differ by type of decision process in with an individual engages.

As it pertains to disposition decision-making, Lipshitz's model is much more prescriptive relative to the other models. Although a prescriptive approach is necessary when considering how to address many of the challenges associated with disposition decision-making, a more descriptive approach may be better in light of the relatively limited information available about how disposition decision-making occurs.

A1.2.2 Group naturalistic decision-making models

Orasanu and Salas determined that an NDM approach could be useful in understanding decision-making involving more than one individual (Orasanu & Salas, 1993). They note that many decisions are made my teams or groups and that "even if a single individual bears

responsibility for the decision, many participants contribute to the final product" (Orasanu & Salas, 1993, p. 327). They define team decision-making as the "process of reaching a decision undertaken by interdependent individuals to achieve a common goal" (Orasanu & Salas, 1993, p. 328). They note that team decision-making differs from individual decision-making in that team decision-making involves more than one source of information and that the task perspectives of the involved individuals must be combined to achieve a decision (Orasanu & Salas, 1993). They also suggest that, although individuals appear to have the same goal, team members may have disparate agendas, motive, perceptions, and opinions that must be reconciled (Orasanu & Salas, 1993).

Although many of these comments seem as though they have the potential to apply to disposition decision-making, Orasanu and Salas adhere to a traditional definition of "team". They define a team by the following characteristics: two or more individuals, more than on sources of information, interdependence and coordination among members, adaptive management of internal resources, common valued goals, defined roles and responsibilities, and task relevant knowledge (Orasanu & Salas, 1993). As such, their discussion of team-based NDM lies outside of the scope of this review.

A1.2.3 Advantages and disadvantages to a naturalistic decision-making approach

The aforementioned models represent an exemplary subset of NDM models that depict varying applications of the eight characteristics of NDM described in section 2.2.2. Overall, an NDM approach has the potential to support a richer understanding of disposition decision-making in that NDM aims to fundamentally capture decisions in context. This drive to capture context supports the reality decisions are engrained in larger tasks (or processes) that an individual aims to accomplish (Orasanu & Connolly, 1993). With this recognition, NDM

approaches decision-making, not as an independent occurrence that represents an endpoint, but rather as a dynamic *process* that prompts subsequent action and is deeply connected to the environment within which the individual operates. However, many NDM models have not been validated in healthcare and, as described in section 2.2.2.1, are likely unable to fully describe disposition decision-making.

A1.3 Transactive memory research

A1.3.1 Definition and conceptual underpinning of transactive memory

Transactive memory is the notion that individuals who operate within close proximity experience cognitive interdependence such that their thoughts are closely interconnected (Wegner, 1987). This allows the dyad or group to consider or produce ideas that any one individual would not be able to produce alone (Wegner et al., 1985). As such, exploring transactive memory allows for the "prediction of group and individual behavior through an understanding of the manner in which groups process and structure information" (Wegner, 1987, p. 185). A transactive memory system, then, involves the interaction or "operation of the memory systems of individuals and the processes of communication that occur within the group" (Wegner, 1987, p. 191).

Transactive memory and transactive memory systems are conceptually grounded in understandings of the individual memory system (Wegner, 1987). The individual memory system can be conceptualized through the understanding of three interconnected concepts: internal memory, metamemory, and external memory (Wegner, 1987). Within internal memory, individuals encode information, store information, and retrieve information. Encoding involves the intake and labeling of information (Wegner, 1987). Storage involves the categorizing and

linking of encoded information such that it can be later called upon (Wegner, 1987). Retrieval involves calling upon stored information (Wegner, 1987).

Metamemory captures an individual's assessment of or beliefs about their own memory facilities (Wegner, 1987). In other words, metamemory describes what an individual believes to be true about what they "know" and "do not know". An individual with a comprehensive metamemory will have a realistic grasp of what they know (i.e., no additional information seeking is required) and what they do not know (i.e., additional information seeking is required) (Wegner, 1987). Metamemory allows an individual to assess whether a piece of information or a set of information pieces can be found within one's own memory (Wegner, 1987).

External memory, which also adheres to the encoding, storage, and retrieval processes, describes the out-of-mind record-keeping tendencies most individuals possess (Wegner, 1987). External storage can be both used as a proximal aid (e.g., remembering an upcoming event) and to store large amounts of information that could not be retrieved elsewhere (e.g., from internal storage) (Wegner, 1987). As an example, external memory may involve knowing where to find information as opposed to keeping the information itself in internal memory.

Just as individuals encode, store, and retrieve information, transactive memory networks (e.g., groups) are able to encode, store, and retrieve information in their own way (Wegner, 1987). For example, within a group, encoding and storing may involve designating one individual to remember a certain piece of information. This usually involves discussion of incoming information and a negotiation of where and in what form the information should be stored (Wegner, 1987). As a result, as the name implies, transactive memory cannot be attribute to any one individual or subset of individuals but rather is an emergent property of the group (Wegner, 1987). In summary, Wegner describes transactive memory as being derived "from

individuals to form a group information-processing system that eventually may return to have profound influence upon its individual participants" (Wegner, 1987, p. 191).

The benefits of transactive memory to each involved individual are significant. As a part of a transactive memory network and through the development of a transactive system, an individual's expertise is enriched and expanded (Wegner, 1987). Further, the specialized knowledge that each individual develops as a part of the system is of value to everyone (Wegner, 1987). Individuals not only gain access to one another's domain knowledge but also gain access to the knowledge that is curated through the integration of expertise within the transactive memory (Wegner, 1987).

Beyond the information itself, groups with high functioning transactive memory are able to encode and store relevant information that any one individual would miss (Wegner, 1987). In the same way, an individual's capacity to process information and make decisions is expanded in that others can complete these processes while the individual is preoccupied or unavailable (Wegner, 1987). Groups with operational transactive memories are likely to effectively achieve their goals and satisfy their members (Wegner, 1987). By the nature of their construction, transactive memory systems promote the creation of transactive memory among individuals that would otherwise not operate jointly as part of a group (Wegner, 1987).

Despite the potential benefits, transactive memory has some disadvantages. The distribution of knowledge and expertise among individuals can cause confusion, error, and strain on an individual's information processing capacities (Wegner, 1987). For example, if there is confusion or dispute regarding each individual's domain of expertise, the responsibility for certain types of knowledge may be unclear and lead to relevant information being unencoded and forgotten (Wegner, 1987). Further, just as an individual develops metamemory relating to their

own knowledge, a transactive memory system offers individuals information about what knowledge is available within the group (Wegner, 1987). Although potentially beneficial, this metamemory can result in an overconfidence in one's abilities to access knowledge. This overconfidence can render one's own contribution of information useless and lead to poor decision-making (Wegner, 1987).

When a group disbands, individuals, who were accustomed to operating interdependently to encode, store, and retrieve information, are left with incomplete components for the former transactive system (Wegner, 1987). For example, information about where to locate information is no longer relevant. The codes for information used among group members are often uninterpretable to others. Even pieces of information may lose value and effect an individual's ability to develop an independent individual memory if an individual was only storing them exclusively for the transactive memory (Wegner, 1987).

A1.3.2 Implications of transactive memory in healthcare

Although simplified to three levels consisting of self-diagnosis, physician diagnosis, and medical compliance, Wegner (1987) describes the relevance of transactive memory in health behavior. Beginning with a patient's self-diagnosis, Wegner argues that the assessment of symptoms and the decision to seek treatment is a social process where individuals consult family and friends (Wegner, 1987). An individual develops a hypothesis to describe their symptoms and considers the hypotheses of their friends and family who have varied experiences and knowledge (Wegner, 1987). In light of these interactions and knowledge exchanges, the individual makes the decision to seek care or not often with the consensus of the group.

In the case provider diagnosis, Wegner conceptualizes the physician-patient dialogue as a transactive memory process (1987). The physician is an expert on illness and the patient is the

expert in their symptoms (Wegner, 1987). Both the physician and patient are aware of their own expertise and the expertise of the other and operate jointly to engage in transactive information retrieval (Wegner, 1987). The patient's hypothesis of their illness leads them to report symptoms most aligned with their anticipated diagnosis (Wegner, 1987). For example, if the patient believes they have appendicitis, they are likely to prioritize reporting abdominal pain and deprioritize reporting a stuffy nose. The patient is likely to disclose their hypothesized illness label to the provider (Wegner, 1987). The provider must then decide how much credence to afford this hypothesis (Wegner, 1987).

In the case of prescription and compliance of a physician's recommendation (e.g., medication, diet), Wegner describes the provider initiating the prescription and the patient complying to the recommendation (1987). To prevent accidental or intentional noncompliance, Wegner recommends strengthening the transactive memory system surrounding the patient by integrating care partner (1987). Informing family and friends of the recommended regime can distribute the responsibility of remembering to take a medication, for example. Wegner indicates that informing care partners of the regime is simple but is often overlooked as patients' memories are conceptualized as individual, independent systems and not a part of transactive memory systems.

In summary, transactive memory provides the infrastructure to understand how individuals "think" together and understand how disparate minds operate jointly to complete work. Unlike earlier group think or group mind models, transactive memory integrates the system of interconnection and interdependence that exist among individuals' information communications, emphasizing the social organizational diversity.

A1.3.3 Application of transactive memory to disposition decision-making

Transactive memory may be able to provide insight into whether and how ED physicians engage with others during the disposition decision-making process. Transactive memory provides the infrastructure for identifying the role that each individual serves in the network and could give insight into how interpersonal interactions occur. Transactive memory provides a lens into the information encoding, storage, and retrieval, but little insight into how a decision is made. Questions like "how is retrieved information used during decision-making?" and "how are differences of opinion reconciled?" remain. As such, transactive memory research is likely insufficient for capturing the entire disposition decision-making process but may be able to provide some insight into work system factors (e.g., person, tasks). Used in concert with a decision-making or work systems model, transactive memory research may be useful in understanding disposition decision-making.

A1.4 Shared Decision-Making

A1.4.1 Definition and characteristics of shared decision-making

Proposed as alternative to more paternalistic models of patient care (i.e., the physician makes all of the decisions), shared decision-making (SDM) approaches have emerged in response to the shift toward patient-centered care practices (Frosch & Kaplan, 1999; Godolphin, 2009; Parsons, 2013). According to Charles and colleagues, on the continuum of medical decision-making, SDM falls between paternalistic decision-making (i.e., provider makes the choice) and informed decision-making (i.e., patient makes the choice) (Charles et al., 1999). Godolphin refers to SDM as "the practical reconciliation of respect of persons (autonomy) and the monopoly and power of physicians: the middle ground between 'nanny-knows-best' paternalism and rampant consumerism" (Godolphin, 2009, p. e. 186).

However, given the vast and sometimes disparate literature on SDM, there is no single or shared definition of SDM (Bomhof-Roordink et al., 2019; Makoul & Clayman, 2006; Moumjid et al., 2007). Albeit, many definitions contain similar concepts such as patient values/preferences, options, partnerships, etc. (Bomhof-Roordink et al., 2019; Makoul & Clayman, 2006). One of the most cited definitions of SDM comes from Charles and colleagues (Charles et al., 1997; Makoul & Clayman, 2006; Moumjid et al., 2007). They identified four characteristics that represent the minimum or necessary criteria to characterize an interaction as SDM: 1) involves at least two participants, the provider and patient, 2) both participants take steps to participate in the process of decision-making, 3) both participants share information with one another, and 4) a decision is made and both participants agree to the decision (Charles et al., 1997).

SDM is often associated with treatment decisions (Bomhof-Roordink et al., 2019). However, researchers have begun to explore its utility in other decision types, specifically where equipoise is common, and in a variety of clinical settings (Bomhof-Roordink et al., 2019; Kraus & Marco, 2016; Probst et al., 2017). Because SDM can be used to develop trust between a patient and a provider, it can be an especially powerful tool in the ED where most patients and providers do not have an established relationship yet decisions are cognitively intensive, are often time-sensitive, and require a high degree of communication (Hibbard et al., 1997; Kraus & Marco, 2016).

A1.4.2 Models of shared decision-making

Numerous theoretical and pragmatic or guideline-based models of SDM have emerged. However, many these SDM models contain similar features. As such, I will explore a few of the

most foundational and relevant models in detail and discuss overall trends that I have identified in the literature (Bomhof-Roordink et al., 2019).

A1.4.2.1 Towle and Godolphin (1999) – Informed shared decision-making

Expanding upon the primarily conceptual notion of "informed patient choice", Towle and Godolphin introduced the concept of informed shared decision-making (ISDM) (Towle & Godolphin, 1999). Previous work related to informed patient choice provided a solid conceptual foundation but offered minimal description of the interactive process that must occur for a decision to be made (Entwistle et al., 1998; Towle & Godolphin, 1999). Towle and Godolphin define ISDM as "decisions that are shared by doctor and patient and informed by best evidence, not only about risks and benefits but also patient specific characteristics and values. It occurs in partnership that rests on explicitly acknowledged rights and duties and an expectation of benefit to both" (Towle & Godolphin, 1999, p. 766).

Although similar to the definition of SDM provided in section 2.2.4.1, the definition of ISDM is more robust in terms of how decisions are made, with what information, and with what expected outcome. However, the use of SDM, ISDM, and informed decision-making as synonyms is controversial (Moumjid et al., 2007). That being said, it is important to note that Towle and Godolphin were publishing at the same time as Charles and colleagues, who have been credited with discretely defining many of these terms (Charles et al., 1997, 1999). Thus, the inconsistent use of terms in these earlier models could a relic of different research groups approaching the same problem from different backgrounds, with different ideas, at the same time.

Towle and Godolphin developed a set of eight competencies for providers and seven competencies for patients, which they define as "the knowledge, skills and abilities that represent

the instructional intents of a programme, stated as specific goals" (McAshan, 1979). These competencies were developed from a review of the literature and were validated through semis-structured interviews with family providers, patients, and patient educators (Towle & Godolphin, 1999). The eight competencies for providers include:

1. Develop a partnership with the patient
2. Establish or review the patient's preferences for information (such as amount or format)
3. Establish or review the patient's preferences for role in decision-making (such as risk taking and degree of involvement of self and others) and the existence and nature of any uncertainty about the course of action to take
4. Ascertain and respond to patient's ideas, concerns, and expectations (such as about disease management options)
5. Identify choices (including ideas and information that the patient may have) and evaluate the research evidence in relation to the individual patient
6. Present (or direct patient to) evidence, taking into account competencies 2 and 3, framing effects (how presentation of the information may influence decision-making), etc. Help patient to reflect on and assess the impact of alternative decisions with regard to his or her values and lifestyle
7. Make or negotiate a decision in partnership with the patient and resolve conflict
8. Agree an action plan and complete arrangements for follow up (Godolphin, 2009; Towle & Godolphin, 1999).

The seven competencies for patients include:

1. Define (for oneself) the preferred doctor-patient relationship
2. Find a physician and establish, develop, and adapt a partnership

3. Articulate (for oneself) health problems, feelings, beliefs, and expectations in an objective and systematic manner
4. Communicate with the physician to understand and share relevant information (such as from competency 3) clearly and at the appropriate time in the medical interview
5. Access information
6. Evaluate information
7. Negotiate decisions, give feedback, resolve conflict, agree on an action plan (Towle & Godolphin, 1999).

In summary, Towle and Godolphin's set of competencies for ISDM were developed out of a necessity to operationalize the patient-centered aspect of informed patient choice. The two sets of competencies are designed to function synergistically and provide a clear list of expectations for both patients and providers.

Expanding on this work, in 2000, Elwyn and colleagues conducted focus groups with general practitioners to assess existing protocols for patient involvement in decision-making, including Towle and Godolphin's set of competencies and other works (Elwyn et al., 2000). Elwyn and colleagues developed a set of eight competencies that mirror and expand upon Towle and Godolphin's work. The eight provider competencies are as follows:

1. Implicit or explicit involvement of patients in decision-making process
2. Explore ideas, fears, and expectations of the problem and possible treatments
3. Portrayal of equipoise and options
4. Identify preferred format and provide tailor-made information
5. Checking process: understanding of information and reactions (e.g., ideas, fears, and expectations of possible options)

6. Checking process: acceptance of process and decision-making role preference
7. Make, discuss, or defer decisions involving patients to the extent they desire to be involved
8. Arrange follow-up (Elwyn et al., 2000)

The key differences between these two sets of eight provider competencies is that in Elwyn and colleagues' set, the portrayal of alternatives occurs before determining whether the patient wants to be involved in the decision-making process while in Towel and Godolphin's set the steps are reversed (Elwyn et al., 2000). Elwyn and colleagues' (2000) note that this key difference is critical as, in some cases where the decision is difficult, the patient may withdraw from the decision-making process after alternatives are shared. Further, they note that the patient's preferences will adapt based on the perceived skill of the provider, the patient's own personality, and other sociodemographic variables (Elwyn et al., 2000).

A1.4.2.2 Charles and colleagues (1999) – Models of treatment decision-making

Charles and colleagues described and organized three categories of treatment decision-making: paternalistic, shared, and informed (Charles et al., 1999). Charles and colleagues situated these three categories of treatment decision-making along a continuum and described the following analytical stages for each: information exchange, deliberation, and decision on treatment to implement (Charles et al., 1999). For the purposes of the present analysis, I will focus on their description of SDM.

Information exchange relates to the type and amount of information shared between the patient and provider and the directionality of the information. For an exchange to qualify as SDM, according to Charles and colleagues' definition (Charles et al., 1997), the provider should share information related to the decision including treatment alternatives, the advantages and

disadvantages of each alternative, and potential outcomes for each alternative (Charles et al., 1999). The patient must share information on any relevant issues such as values, preferences, life-style, etc. This bidirectional exchange of information ensures that the provider and patient explore alternatives in light of the patient's situation and circumstances (Charles et al., 1999).

Deliberation relates to "the process of expressing and discussing treatment preferences" (Charles et al., 1999, p. 656). In SDM, deliberation occurs during the interaction between the patient and provider (Charles et al., 1999). Some argue that the exchange of information is sufficient (Charles et al., 1999). However, Charles and colleagues argue that the exchange of information provides the inputs for deliberation. For a successful deliberation, both the provider and the patient must believe that there are multiple alternatives (Charles et al., 1999). Usually, patients are required to choose between two sets of alternatives. The first set of alternatives features two different treatments (Charles et al., 1999). The second set of alternatives features a treatment and doing nothing (Charles et al., 1999). The interaction between the provider and the patient could be explicit or implicit. Further, the patient may choose to involve others in the deliberation process (e.g., care partner), which can make the interaction more complicated but may be necessary if the decision influences others (e.g., the patient making the decision to receive care at home) (Charles et al., 1999).

The decision to implement a treatment relates to choosing a treatment (Charles et al., 1999). Through deliberation, the patient and the provider have built consensus and are invested in the final decision (Charles et al., 1999). With a shared understanding, the patient and the provider decide what treatment to pursue (Charles et al., 1999).

In summary, this framework contextualizes SDM within other forms medical decision-making and outlines the analytical stages and minimum requirements at each stage for SDM to

occur. Although this model focuses specifically on treatment, it is possible to see how these concepts could be applied to other clinical decisions, like disposition decision-making. However, this model focuses specifically on the interaction and information exchange between the ED physician and the patient and does not consider other factors that may influence the decision.

A1.4.2.3 Whitney (2003) – Levels of certainty and importance

Whitney developed an empirical model rooted conceptually in the notion that patients relinquish decision-making control to providers when a problem has one correct solution but want to be involved when there are multiple options, and that two of the most important characteristics of medical decisions are effect on the patient and the degree to which those decisions have medical consensus (Braddock III et al., 1999; Deber & Baumann, 1992; Deber et al., 1996; Whitney, 2003). Whitney conceptualizes shared medical decisions as occurring between patients and providers in light of two characteristics: importance and certainty (Whitney, 2003).

Importance refers to the seriousness of a decision considering its potential effect on a patient's health and well-being, and potential moral, financial, social, legal and aesthetic outcomes (Whitney, 2003). Importance is determined by medical facts and personal values (Whitney, 2003). The importance of a decision may differ for patients and providers (Whitney, 2003). Importance can be mapped on a continuous scale including the following levels of importance: major, important, routine, and minor (Whitney, 2003). When importance is major, Whitney argues that providers should educate their patients so as to help them understand information available and make a decision (Whitney, 2003).

Certainty refers to "the degree to which a decision-analytic approach using good-quality data would demonstrate that there is a single preferred intervention" (Whitney, 2003, p. 276).

Without evidence, certainty could be assessed using expert opinion. When two providers disagree about the course of action, the patient should be informed and offered another opinion (Whitney, 2003). Certainty can be mapped on a scale including high certainty, intermediate certainty, and low certainty (Whitney, 2003). When there is low certainty, the patient's decision should be given priority (Whitney, 2003).

All medical decisions can be placed on a Cartesian plane, where the horizontal axis depicts certainty from low to high and the vertical axis depicts importance from low to high (Whitney, 2003). The placement of each decision on the plane will vary by patient and circumstance. The plane can be separated into four zones: patient priority, provider priority, potential conflict, and shared priority (Whitney, 2003). Patient priority encompasses decisions of high importance and low certainty (i.e., the upper left corner of the second quadrant) (Whitney, 2003). An example of this type of decision is choosing between a mastectomy and lumpectomy with radiation for localized breast cancer (Whitney, 2003). Provider priority encompasses decisions of high certainty and low importance (i.e., the lower right corner of the fourth quadrant) (Whitney, 2003). An example of this type of decision would be a provider ordering a secondary X-ray to expose a fracture from another angle (Whitney, 2003).

Potential conflict refers to decisions of major importance and high certainty (i.e., the upper right corner of the first quadrant) (Whitney, 2003). Because the decision is important, the patient should feel empowered to decide against the provider's advice (Whitney, 2003). Likewise, because there is a high degree of certainty and likely only one medically sound option, the provider may strongly encourage the patient to act according to their recommendation (Whitney, 2003). Whitney notes that in these situations, the patient usually accepts the provider's recommendation. However, one can envision circumstances where conflicts may arise. For

example, pregnant woman who is diagnosed with an aggressive cancer may be strongly recommended surgery and chemotherapy, which could terminate her pregnancy. The woman may decide to forego treatment in favor of completing her pregnancy (Whitney, 2003).

Shared priority encompasses decisions characterized by all other combinations of uncertainty and importance (Whitney, 2003). These decisions are negotiated between the provider and patient, and how the decision is made will depend the decision (Whitney, 2003). Some decisions will require an information-rich conversation (e.g., the decision to try to revascularize a leg verses amputate) while others will only require a concise conversation (e.g., running a blood panel) (Whitney, 2003).

In summary, this model provides a mechanism to assess the interaction between importance and uncertainty in a decision. The characterization of decisions across these two variables gives insight into whose perspective should primarily guide decision-making and how decisions should be made. In that regard, the model also suggests that there are some types of decisions that are not well-suited for SDM. Further, Whitney recognizes that patients and providers do not act independently. For example, patients may consider input from care partners and providers from colleagues. Further, "outside factors" may influence the decision (e.g., insurance policies). Whitney notes that "these influences do not lessen the validity of the preferences of the patient and the provider" (Whitney, 2003, p. 276). However, within the model, Whitney provides no mechanism to capture the existence or influence of these factors.

A1.4.2.4 Makoul and Clayman (2006) – An integrated model of shared decision-making

Through a comprehensive and critical search of the literature, Makoul and Clayman propose a model of SDM that is conceptually sound and useful in both research and clinical practice (Makoul & Clayman, 2006). The model delineates essential elements, ideal elements,

and general qualities of SDM. Essential elements are necessary for SDM to occur (e.g., define/explain problem, present options, patient values, preferences) (Makoul & Clayman, 2006). Ideal elements are not necessary but are likely to enhance the decision-making experience (e.g., unbiased information, definition of roles, mutual agreement) (Makoul & Clayman, 2006). General qualities refer to characteristics that broadly describe SDM (e.g., information exchange, involves 2+ people, partnership) (Makoul & Clayman, 2006). Makoul and Clayman note that discussion of essential or ideal elements can be initiated by either the provider or the patient, thereby not forcing the responsibility onto a single participant.

To compliment the list of essential elements, ideal elements, and general characteristics, Makoul and Clayman developed a scale that depicts that degree of sharing that occurs during the discussion of elements. The scale ranges from "doctor alone" to "patient alone", with "shared equally" in the center. They note that whichever participant facilitates the discussion, "the degree of sharing increases as input from the other party increases" (Makoul & Clayman, 2006, p. 307). Based on the elements and the scale, Makoul and Clayman suggest that it is possible for SDM to occur if the provider assumes decision-making responsibility, provided the patient willingly relinquished the shared responsibility and that the essential elements are present.

In summary, Makoul and Clayman synthesized and reconciled a vast body of literature to develop a comprehensive, yet applicable definition of SDM. Although the elements of SDM may be difficult to identify in practice (e.g., what does true discussion of patient values look like?), the description of key elements and the delineation between elements that are essential and ideal is critical to understanding the range of SDM definitions and characteristics presented in the literature.

A1.4.2.5 Elwyn and colleagues (2012) – A shared decision-making model (three-talk model)

The model developed by Elwyn and colleagues in 2012 identifies three steps of SDM including: choice talk, option talk, and decision talk. Choice talk relates to the stage of ensuring that the patient knows that there are reasonable alternatives available (Elwyn et al., 2012). Option talk relates to sharing information about alternatives. Decision talk relates to supporting the work of assessing alternatives in light of preferences and determining which is best (Elwyn et al., 2012). Within each of these steps, the provider supports deliberation. Deliberation refers to assessing advantages and disadvantages of the alternatives, considering the implications of each alternative, and envisioning possible outcomes, both practical and emotional (Elwyn et al., 2012). Both option talk and decision talk can be bolstered by decision support interventions. Decision support interventions provide informational "inputs" to the SDM process. Over the course of SDM, a patient's preferences will transform from initial to informed (Elwyn et al., 2012).

Thee three steps are presented linearly but may not occur exclusively in a linear pattern. Further, Elwyn and colleagues note that this model could be operationalized in a variety of ways. For example, choice talk could occur through an email, a letter, a phone call, or an in-person meeting if the decision type permits. For each step, Elwyn and colleagues provide a set of sub-steps that detail specific types of questions and topics of discussion that are necessary to complete each step.

In summary, this intentionally simplified model provides a summary of the key steps of SDM and can be easily adapted to fit the circumstance. This model builds upon previous work in that it integrates the ethical underpinnings of SDM and describes the steps and skills required to successfully engage in SDM.

However, this model has received criticism. Some found the terms uninterpretable (e.g., the distinction between choice talk and option talk is unclear) (Elwyn et al., 2017). Others noted the absence of a distinct mention of risk communication or goal setting, both of which are perceived to be critical aspects of SDM (van de Pol et al., 2016). Others felt like the model did not emphasize the exploration of patient preferences or context sufficiently (Elwyn et al., 2017). Still, others felt like the model did not capture the goal of SDM to promote a patient's "autonomous capacity", emphasize the emotional and relational aspects of care, or prioritize the patient's need to be supported during decision-making (Elwyn et al., 2017).

In response to these critiques, Elwyn and colleagues revised the 2012 model. The revised model, named the three-talk model of SDM, reconfigures and renames many of the same features of the original model (Elwyn et al., 2017). Choice talk was renamed to team talk (Elwyn et al., 2017). The three stages of talk were transformed from a linear progression to a cyclical progression (Elwyn et al., 2017). The goal of the redesigned model was to serve as a visual guide for clinicians in their practice (Elwyn et al., 2017). Thus, this model is unlikely to be useful in comprehensively describe how the context within which disposition decision-making occurs.

A1.4.2.6 Probst and colleagues (2017) – A guiding framework for shared decision-making in the ED

Probst and colleagues provide a pragmatic framework that describes how to determine if SDM is appropriate and how to engage in an SDM conversation in the ED (Probst et al., 2017). To determine whether SDM is appropriate, Probst and colleagues identify three factors that a provider must consider. First, a decision must be associated with clinical uncertainty or equipoise (Probst et al., 2017). Clinical equipoise refers to a situation where one alternative is not obviously "better" than another and the provider has no preference to one option over another (Elwyn et al., 2000; Elwyn et al., 2009). For example, Probst and colleagues provide an example

of equipoise as it manifests in disposition decision-making for a patient with possible acute coronary syndrome (ACS) with an unremarkable ED evaluation:

> "Both disposition decisions [that is, admission or discharge] could be deemed medically reasonable, and yet could have vastly different repercussions for the patient. If the patient is admitted, they will incur costs and experience the inconvenience of hospitalization, the possibility of iatrogenic injury or false-positive findings. On the other hand, if the patient is discharged, s/he risks recurrence of pain and the low likelihood of a missed ACS. The patient may prefer to avoid the disruption associated with hospitalization and undergo provocative cardiac testing as an outpatient, even if this is associated with a small medical risk. Conversely, the patient may feel unsafe going home and prefer to expedite the evaluation by being admitted" (Probst et al., 2017, p. 3)

Second, unlike other forms of decision-making where the locus of control resides with the provider, SDM can only function when both the provider and the patient are able to meaningfully contribute (Probst et al., 2017). This means that the patient must be willing and able to participate in decision-making. Specifically, the patient or a proxy must have the cognitive capacity, skills, and self-efficacy to make decisions related to their care (Probst et al., 2017). Third, SDM requires a dedicated segment of time (Probst et al., 2017). Thus, factors related to the patient's acuity or the ED environment may prevent this from occurring. For example, if a patient's acuity is too great, engaging in SDM may put the patient's wellbeing at risk (Probst et al., 2017). Further, ED providers are often responsible for managing multiple patients at once and are required to be aware of the state of the ED overall (Probst et al., 2017). As such, an ED provider may not be able to engage in SDM if doing so would sacrifice the care and safety of other patients or disrupt the overall flow of the ED (Probst et al., 2017).

Once it has been determined that SDM is appropriate, there are four steps that must occur to engage in SDM. First, the ED provider must make clear that a clinical decision must be made and that there are alternatives to select among (Probst et al., 2017). The ED provider should outline what they are going to discuss and the purpose of the discussion. Second, the ED provider should share information related to alternatives, the potential advantages and disadvantages of each alternative, and the potential outcomes for each alternative (Probst et al., 2017). Once alternatives have been presented, the conversation could be guided by the patient's follow-up questions. Probst and colleagues urge providers to share this information in segments and use plain language so as not to overwhelm the patient. They further note that decision aids can be useful in communicating alternatives at this stage.

Third, the ED provider should elicit and explore the patient's values, preferences, and specific circumstances (Probst et al., 2017). Probst and colleagues suggest asking questions that lead to a conversation about the patient's thoughts, priorities, and any social factors that may influence a patient's preferences or ability to achieve favorable outcomes with an alternative (e.g., do you live alone?). Fourth, the ED provider and the patient should decide together on the best alternative given the patient's values, preferences, and specific circumstances (Probst et al., 2017). The ultimate decision could be based on the ED provider's suggestion, as many patients are inclined to trust providers' knowledge and judgement but would ideally be based on the patient's assessment. If a patient urges the provider to share their opinion (e.g., what would you do if you were in my situation?), providers should aim to offer suggestions in based on the extent to which the options align with the patient's values (e.g., if you are nervous about going home because you live alone, it might make sense to stay at the hospital) (Probst et al., 2017).

In summary, this framework provides a practical set of questions or factors to consider where determining whether and how to engage in disposition decision-making in the ED. This framework draws from and presents foundational patient-centered and ethical factors in a way that is logical and applicable to the ED. However, given that this model serves more as a framework for clinicians, it is unlikely to provide comprehensive insight into the context within which disposition decision-making occurs.

A1.4.3 Themes of shared decision-making

A1.4.3.1 Advantageous themes

With respect to conceptual components of SDM, of the models presented here and others in the literature, the majority share the same two foundational principles:

1. Ensure that the patient understands the alternatives and the advantages and disadvantages of those alternatives
2. Ensure that the patient's goals and preferences guide decision-making (Bomhof-Roordink et al., 2019; Makoul & Clayman, 2006; Moumjid et al., 2007; Quality, 2020)

All of the models presented here and other in the literature note the necessity of the involvement of two or more individuals (Bomhof-Roordink et al., 2019). All of the models presented here, even those specific to the ED, depict SDM as a staged set of steps or processes that unfold overtime. The models presented here ranged in terms of how SDM should be initiated. Whether explicit or implicit, some of the models rely on the provider to assess the appropriateness of SDM and facilitate SDM, if appropriate (Probst et al., 2017; Whitney, 2003). Others are either ambiguous in terms of who should initiate or distribute that responsibility between the patient and the provider (Charles et al., 1999; Elwyn et al., 2017; Elwyn et al., 2000; Elwyn et al., 2012; Makoul & Clayman, 2006; Towle & Godolphin, 1999).

A1.4.3.2 Disadvantageous themes and gaps

Most research on SDM argues if the responsibility for SDM resides with the provider, more paternalistic tendencies will manifest in the provider-patient relationship (Towle & Godolphin, 1999). Yet, many SDM models are oriented toward provider-initiated discussions and tasks (Elwyn et al., 2000). Such approaches treat the patient more as an information source and a final check as opposed to a partner in decision-making (Charles et al., 1997; Emanuel & Emanuel, 1992). However, the collaboration that occurs in SDM is important as most patients do not have a sense of their preferences a priori and develop their preferences on an as-need basis as decision-making in healthcare situations unfold (Hibbard et al., 1997).

With respect to applicability, Wirtz and colleagues point out that clinical decision-making models, including SDM, have two key limitations (Wirtz et al., 2006). First, models fail to describe how providers and patients develop or discover the scope of alternatives. There are likely to be numerous factors that influence the set of options patients and providers consider (e.g., what is considered medically acceptable, payer, organizational constraints) (Whitney, 2003; Wirtz et al., 2006). Second, models fail to provide a description of how deliberation and joint decision-making should occur (Wirtz et al., 2006). Without a rich description of how this process occurs, deliberation and decision-making may be seen as a transactional or technical task as opposed to a complex and iterative process (Walker & Carayon, 2009).

A1.4.4 Application of shared decision-making to disposition decision-making

SDM models provide insight into the types of discussions that are needed to arrive at a clinical decision. As Probst and colleagues highlight in their example shown in section 2.2.4.2, SDM could be appropriate for disposition decision-making (Probst et al., 2017). Pragmatically, SDM is a concept that most providers and healthcare researchers understand or are at least aware

of. SDM is rooted in healthcare quality improvement and patient safety, and many would agree that SDM should be the "default" in most healthcare decisions (Godolphin, 2009; Probst et al., 2017; Weston, 2001). However, current SDM models offer limited insight into the cognitive decision-making process and capture only some of the context needed to fully understand how disposition decision-making occurs (Wirtz et al., 2006). This is critical as "the rapidly paced and often chaotic ED environment is a unique clinical setting that offers many contextual challenges [to SDM]" (Hess et al., 2015). Further, few physicians use SDM in practice and report numerous challenges to implementing SDM in the ED (Godolphin, 2009; Hess et al., 2015; Probst et al., 2015). Thus, SDM may be better suited for conceptualizing the future of disposition decision-making in the ED as opposed to capturing how disposition decision-making occurs at present.

A1.5 Heuristics

A1.5.1 Definition and conceptual underpinning of heuristics

Conceptualized as one of the three approaches (i.e., logic, statistics/probability, heuristics) the human mind uses to make decisions, the concept of heuristics emerged across a variety of fields including physics, biology, economics, computer science, psychology, and others throughout the 20th century (Gigerenzer & Gaissmaier, 2011). There are numerous definitions of a heuristic (Gigerenzer & Gaissmaier, 2011). A comprehensive definition that draws from others' definitions of heuristics comes from Gigerenzer and Gaissmaier (2011): "a heuristic is a strategy that ignores part of the information, with the goal of making decisions more quickly, frugally, and/or accurately than more complex methods" (p. 454). More simply, heuristics are "simple decision algorithms that can work well in appropriate environments" (Todd & Gigerenzer, 2007) and are described as fast and frugal (Gigerenzer, 2008). Historically, heuristics have been associated with Systems 1 thinking, which is often considered to be error-

prone. However, Gigerenzer and Gaissmaier argue that such an association does not actually exist (Gigerenzer & Gaissmaier, 2011).

Historically, the application of heuristics has been seen as an informal approach to decision-making. However, Gigerenzer and Gaissmaier argue that heuristics can and should be formalized through the definition of three "building blocks":

1. Search rules specify in what direction the search extends in the search space
2. Stopped rules specify when the search is stopped
3. Decision rules specify how the final decision is reached (Gigerenzer & Todd, 1999 as cited in Gigerenzer & Gaissmaier, 2011)

The "core capacities [of heuristics] include recognition memory, frequency monitoring, object tracking, and the ability to imitate" (Gigerenzer and Gaissmaier, 2011, p. 456), which allow heuristics to be efficient (i.e., fast) and require little input (i.e., frugal). Just as an individual decides what statistical approach to use (e.g., regression vs. Bayesian statistics), individuals decide which heuristic to use. Gigerenzer and Gaissmaier (2011) identify four selection principles that describe how individuals decide which heuristic to use. First, heuristics and the associated core capacities are innate, to some extent, as a result of evolution (Gigerenzer & Gaissmaier, 2011). Second, an individual's education or learning influences their selection behavior (Gigerenzer & Gaissmaier, 2011). Third, social processes serve as a means for individuals to select and learn heuristics (e.g., imitation, teaching) (Gigerenzer & Gaissmaier, 2011). Fourth, the content and infrastructure of an individual's memory influences which heuristics can be used (Gigerenzer & Gaissmaier, 2011).

There are two primary explanations for why individuals use heuristics: the accuracy-effort tradeoff and the ecological rationality of heuristics (Gigerenzer & Gaissmaier, 2011). The

accuracy-effort tradeoff refers to the notion that to avoid effortful and time-consuming information searching and processing, humans rely on heuristics recognizing that there may be some loss in accuracy (Gigerenzer & Gaissmaier, 2011). Further, there are two interpretations of tradeoffs: rational tradeoffs and cognitive limitations (Gigerenzer & Gaissmaier, 2011). Rational tradeoffs refer to the notion that not all decisions are sufficiently important to require deep consideration and therefore individuals engage in fast and frugal cognition instead (Gigerenzer & Gaissmaier, 2011). Thus, the time-saved out-weighs the potential of higher accuracy that could be gained with a more time-intensive cognitive process (Gigerenzer & Gaissmaier, 2011). Cognitive limitations refer to the capacity limitations that hinder individuals from operating rationally and instead require them to rely on heuristics (Gigerenzer & Gaissmaier, 2011).

Ecological rationality refers to extent to which heuristics that are well-suited for the structure of the environment (Gigerenzer & Gaissmaier, 2011). The exploration of ecological rationality answers the following two questions: "how does cognition exploit environmental structures, and how does it deal with error?" (Gigerenzer and Gaissmaier, 2011, p. 457). To address the first question, it is important to first understand how "environmental structure" is defined. Environmental structure describes how well the decision processes align with the environments within which they occur (i.e., the mind-world interactions) (Todd & Gigerenzer, 2007; Todd & Gigerenzer, 2012).

Although there are numerous heuristics and numerous ways to categorize heuristics, Gigerenzer and Gaissmaier identify four categories of heuristics: recognition-based decision-making, one-reason decision-making, tradeoff heuristics, and social heuristics (Gigerenzer & Gaissmaier, 2011).

A1.5.2 Heuristic models

A1.5.2.1 Recognition-based decision-making

The concept of recognition-based decision-making draws from the recognition memory literature suggesting that the similarity or familiarity of information (i.e., recognition) is available sooner than relational information (i.e., recollection) during information processing (Gigerenzer & Gaissmaier, 2011; Ratcliff & McKoon, 1989). In recognition-based decision-making, heuristics base "judgements on recognition information only" and disregard all other cues (Gigerenzer & Gaissmaier, 2011, p. 460). Examples of heuristics that fall under this category of heuristic are the recognition heuristic and fluency heuristic.

Recognition heuristic: The purpose of the recognition heuristic is "make inferences about a criterion that is not directly accessible to the decision maker, based on recognition retrieved from memory" (Gigerenzer and Gaissmaier, 2011, p. 460). When there are two alternatives for a given choice, the recognition heuristic states that "if one of two objects is recognized and the other is not, then infer that the recognized object has higher value with respect to the criterion" (Goldstein & Gigerenzer, 2002, p.76). This heuristic suitable for "environments in which recognition is correlated with the criterion being predicted" (Goldstein and Gigerenzer, 2002, p. 78).

The strength of the association between the criterion, the mediator (i.e., objects in the environment that reflect or serve as a surrogate for the criterion and are accessible), and recognition memory is determined by three factors: ecological correlation, surrogate correlation, and recognition validity (Goldstein & Gigerenzer, 2002). Ecological correlation refers to the correlation between the criterion and the mediator (Goldstein & Gigerenzer, 2002). Surrogate correlation refers to the correlation between the mediator and recognition memory (Goldstein &

Gigerenzer, 2002). Recognition validity refers to the "proportion of times a recognized object has a higher criterion value than an unrecognized object in a reference class" (Goldstein & Gigerenzer, 2002, p. 78). Through the realization of the recognition heuristic, it is possible to observe the less-is-more-effect where "those who know more exhibit lower inferential accuracy than those who know less" (Goldstein & Gigerenzer, 2002, p. 79).

Fluency heuristic: The fluency heuristic states that "if both alternatives are recognized but one is recognized faster, then infer that this alternative has the higher value with respect to the criterion" (Gigerenzer & Gaissmaier, 2011, p. 462). This heuristic applies when alternatives are given (e.g., a two-alternative choice) and when alternatives are not given (e.g., when a decision-making must make provide a choice from their memory) (Gigerenzer & Gaissmaier, 2011). The latter refers to a variable of the fluency heuristic called the "take-the-first" heuristic. Specifically, the take-the-first heuristic states that "in familiar yet ill-defined tasks, choose one of the initial options generated once a goal (and a strategy) has been defined, rather than exhaustively generating all possible options and subsequently processing them deliberatively" (Johnson & Raab, 2003, p. 218). Johnson and Raab argue that the options generated by an individual are informed by simple strategies and the environment triggers an associative memory network, thus yielding viable options (Johnson & Raab, 2003). Klein's recognition-primed decision-making model, described in section 2.2.2.1, is conceptually similar to the take-the-first heuristic (Gigerenzer & Gaissmaier, 2011).

A1.5.2.2 One-reason decision-making

Unlike recognition-based heuristics, this category of heuristics relies on recall. In one-reason decision-making, as the name suggests, heuristics base "judgements on one good reason only" and disregard all other cues (Gigerenzer & Gaissmaier, 2011, p. 463). This category of

heuristics was initially developed to capture preferences but has been expanded to capture decisions (Gigerenzer & Gaissmaier, 2011). This category of model, sometimes referred to as models of bounded rationality, originate from Simon's work on bounded rationality, most famously, the concept of satisficing (Gigerenzer & Goldstein, 1996). Bounded rationality suggests that humans are unable to "feasibly consider…perfect[ly] rational decisions in practice [due] to the finite computational resources available for making them" (Albar & Jetter, 2009, p. 581). Examples of heuristics that fall under this category of heuristic are one-clever-cue heuristic and take-the-best.

One-clever-cue: This heuristic refers to a decision that is made based on a single, but influential cue (Gigerenzer & Gaissmaier, 2011). For example, in nature, when selecting a mate, peahens assess a few potential peacocks who are displaying their feathers and select the peacock with the most colorful feathers (Gigerenzer & Gaissmaier, 2011; Petrie & Halliday, 1994).

Take-the-best: This heuristic can be summarized as "take the best, ignore the rest" (Gigerenzer & Goldstein, 1996, p. 653) and describes how individuals determine which alternative has a larger value on a criterion (Gigerenzer & Gaissmaier, 2011). This value assessment is based on a binary cue value retrieved from an individual's memory (Gigerenzer & Gaissmaier, 2011). This heuristic can be applied using fast-and-frugal trees, which are simple decision aids that allow decision-makers to quickly make decisions based on a set of pre-determined, sequential criteria (Gigerenzer & Gaissmaier, 2011).

A1.5.2.3 Tradeoff heuristics

Unlike recognition and one-reason decision-making where non-dominant cues are disregarded (i.e., some cues are inherently weighted), tradeoff heuristics consider all cues as equally dominant (i.e., weighing all cues equally) (Gigerenzer & Gaissmaier, 2011). Tradeoffs

refer to "a class of heuristics that weights all cues or alternatives equally and thus makes tradeoffs" (Gigerenzer & Gaissmaier, 2011, p. 469). Examples of heuristics that fall under this category of heuristic are tallying and 1/N rule. Tallying involves summing the number of cues in favor of one alternative versus another. This heuristic can be applied using mapping models. Also known as the equality heuristic (Messick, 1993), the 1/N rule "allocates resources [(i.e., time, finances)] equally to each N alternative" (Gigerenzer & Gaissmaier, 2011, p. 470).

A1.5.2.4 Social heuristics

Social heuristics refer to heuristics that draw from social information (Gigerenzer & Gaissmaier, 2011). Examples of heuristics that fall under this category include imitation heuristics (e.g., imitate the majority, imitate the successful), tit-for-tat, and the default heuristic (Gigerenzer, 2008). The imitate the majority heuristic refers to mimicking the actions of the majority of one's peer group (Boyd & Richerson, 2005; Gigerenzer, 2008). The imitate the successful heuristic refers to mimicking the behavior of the most successful individual (Boyd & Richerson, 2005; Gigerenzer, 2008). The tit-for-tat heuristic refers to initial cooperation followed by mimicking one's partner's last action (Axelrod, 2012; Gigerenzer, 2008). The default heuristic refers to accepting the provided option (Johnson & Goldstein, 2003).

A1.5.3 Implications of heuristics for disposition decision-making

In summary, heuristics represent a deviation from the traditional prioritization of "optimal" decisions in favor of reflecting the reality of timely and satisfactory decision-making (Albar & Jetter, 2009; Simon, 1956). Although the practice of satisficing may reflect how some clinical decisions are made, it is important to consider that, in the case of disposition decision-making, physicians and patients are likely seeking the optimal choice as opposed to an alternative that could work. As described earlier, dispositioning patients to the location that best

supports their needs is critical to maintaining high quality care and promoting patient safety (Calder et al., 2010; Calder et al., 2012; Chamberlain & Pollack, 1998). At the same time, the ED represents a face-paced and often information-scare environment, which could make heuristics an appropriate fit as they are less time-consuming, require less informational input, and generally perform just as well or better than statistical or logical models (Gigerenzer, 2008; Gigerenzer & Gaissmaier, 2011; Gigerenzer & Goldstein, 1996).

Furthermore, because heuristics require few informational inputs and are mechanistic in how they produce decisions, they are transparent and easy to assess (Goldstein & Gigerenzer, 2002), which could be useful in tracing a provider's decision-making process. However, heuristics range in accuracy depending on their ecological rationality (Gigerenzer & Gaissmaier, 2011), which could be problematic for decisions that occur in dynamic environments, like the ED, with decisions that have critical implications for patient survival and health, like disposition decisions (Davis & Jacques, 2008).

In practice, a relatively small portion of studies related to the use of heuristics in medical decision-making focus on provider or patient-and-provider decision-making, with most focusing on patient decision-making (Blumenthal-Barby & Krieger, 2015). In addition, most studies have used hypothetical examples or vignettes. A such, there is limited research exploring whether and how heuristics are used in clinical practice (Blumenthal-Barby & Krieger, 2015).

A1.6 Decision-making model summary

Overall, no single model provides sufficient detail nor mechanistic functionality to capture how the disposition decision-making process unfolds over time interacting with and occurring within a macro context and oriented toward specific outcomes.

A1.7 References

Albar, F. M., & Jetter, A. J. (2009). Heuristics in decision making. PICMET'09-2009 Portland International Conference On Management Of Engineering & Technology,

Axelrod, R. (2012). Launching “the evolution of cooperation”. *Journal of theoretical biology*, *299*, 21-24.

Blumenthal-Barby, J. S., & Krieger, H. (2015). Cognitive biases and heuristics in medical decision making: a critical review using a systematic search strategy. *Medical Decision Making*, *35*(4), 539-557.

Bomhof-Roordink, H., Gärtner, F. R., Stiggelbout, A. M., & Pieterse, A. H. (2019). Key components of shared decision making models: a systematic review. *BMJ open*, *9*(12), e031763.

Boyd, R., & Richerson, P. J. (2005). *The origin and evolution of cultures*. Oxford University Press.

Braddock III, C. H., Edwards, K. A., Hasenberg, N. M., Laidley, T. L., & Levinson, W. (1999). Informed decision making in outpatient practice: time to get back to basics. *Jama*, *282*(24), 2313-2320.

Cabrera, D., Thomas, J. F., Wiswell, J. L., Walston, J. M., Anderson, J. R., Hess, E. P., & Bellolio, M. F. (2015). Accuracy of 'My Gut Feeling:' Comparing System 1 to System 2 Decision-Making for Acuity Prediction, Disposition and Diagnosis in an Academic Emergency Department. *West J Emerg Med*, *16*(5), 653-657. https://doi.org/10.5811/westjem.2015.5.25301

Calder, L. A., Forster, A. J., Stiell, I. G., Carr, L. K., Perry, J. J., Vaillancourt, C., & Brehaut, J. (2012). Mapping out the emergency department disposition decision for high-acuity patients. *Ann Emerg Med*, *60*(5), 567-576.e564. https://doi.org/10.1016/j.annemergmed.2012.04.013

Carayon, P., Schoofs Hundt, A., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Flatley Brennan, P. (2006). Work system design for patient safety: the SEIPS model. *Qual Saf Health Care*, *15 Suppl 1*, i50-58. https://doi.org/10.1136/qshc.2005.015842

Carayon, P., Wooldridge, A., Hoonakker, P., Hundt, A. S., & Kelly, M. M. (2020). SEIPS 3.0: Human-centered design of the patient journey for patient safety. *Appl Ergon*, *84*, 103033. https://doi.org/10.1016/j.apergo.2019.103033

Charles, C., Gafni, A., & Whelan, T. (1997). Shared decision-making in the medical encounter: what does it mean?(or it takes at least two to tango). *Social science & medicine*, *44*(5), 681-692.

Charles, C., Gafni, A., & Whelan, T. (1999). Decision-making in the physician–patient encounter: revisiting the shared treatment decision-making model. *Social science & medicine*, *49*(5), 651-661.

Cooksey, R. W. (1996). The methodology of social judgement theory. *Thinking & Reasoning*, *2*(2-3), 141-174.

Davis, L., & Jacques, P. F. (2008). Heuristics in the emergency room. *The Journal of Physician Assistant Education*, *19*(2), 52-54.

Deber, R. B., & Baumann, A. O. (1992). Clinical reasoning in medicine and nursing: Decision making versus problem solving. *Teaching and Learning in Medicine: An International Journal*, *4*(3), 140-146.

Deber, R. B., Kraetschmer, N., & Irvine, J. (1996). What role do patients wish to play in treatment decision making? *Archives of internal medicine*, *156*(13), 1414-1420.

Elwyn, G., Durand, M. A., Song, J., Aarts, J., Barr, P. J., Berger, Z., Cochran, N., Frosch, D., Galasiński, D., & Gulbrandsen, P. (2017). A three-talk model for shared decision making: multistage consultation process. *bmj*, *359*.

Elwyn, G., Edwards, A., Kinnersley, P., & Grol, R. (2000). Shared decision making and the concept of equipoise: the competences of involving patients in healthcare choices. *Br J Gen Pract*, *50*(460), 892-899.

Elwyn, G., Frosch, D., & Rollnick, S. (2009). Dual equipoise shared decision making: definitions for decision and behaviour support interventions. *Implementation Science*, *4*(1), 1-8.

Elwyn, G., Frosch, D., Thomson, R., Joseph-Williams, N., Lloyd, A., Kinnersley, P., Cording, E., Tomson, D., Dodd, C., Rollnick, S., Edwards, A., & Barry, M. (2012). Shared decision making: a model for clinical practice. *J Gen Intern Med*, *27*(10), 1361-1367. https://doi.org/10.1007/s11606-012-2077-6

Emanuel, E. J., & Emanuel, L. L. (1992). Four models of the physician-patient relationship. *Jama*, *267*(16), 2221-2226.

Entwistle, V. A., Sheldon, T. A., Sowden, A., & Watt, I. S. (1998). Evidence-informed patient choice: practical issues of involving patients in decisions about health care technologies. *International journal of technology assessment in health care*, *14*(2), 212-225.

Frosch, D. L., & Kaplan, R. M. (1999). Shared decision making in clinical medicine: past research and future directions. *American journal of preventive medicine*, *17*(4), 285-294.

Gigerenzer, G. (2008). Why heuristics work. *Perspectives on psychological science*, *3*(1), 20-29.

Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision making. *Annual review of psychology*, *62*, 451-482.

Gigerenzer, G., & Goldstein, D. G. (1996). Reasoning the fast and frugal way: models of bounded rationality. *Psychological review*, *103*(4), 650.

Godolphin, W. (2009). Shared decision-making. *Healthc Q*, *12*(12 Spec No Patient), e186-e190.

Goldstein, D. G., & Gigerenzer, G. (2002). Models of ecological rationality: the recognition heuristic. *Psychological review*, *109*(1), 75.

Hess, E. P., Grudzen, C. R., Thomson, R., Raja, A. S., & Carpenter, C. R. (2015). Shared decision-making in the emergency department: respecting patient autonomy when seconds count. *Academic Emergency Medicine*, *22*(7), 856-864.

Hibbard, J. H., Slovic, P., & Jewett, J. J. (1997). Informing consumer decisions in health care: implications from decision-making research. *The Milbank Quarterly*, *75*(3), 395-414.

Johnson, E. J., & Goldstein, D. (2003). Do defaults save lives? In: American Association for the Advancement of Science.

Johnson, J. G., & Raab, M. (2003). Take the first: Option-generation and resulting choices. *Organizational behavior and human decision processes*, *91*(2), 215-229.

Klein, G. (2008). Naturalistic decision making. *Human factors*, *50*(3), 456-460.

Kraus, C. K., & Marco, C. A. (2016). Shared decision making in the ED: ethical considerations. *The American journal of emergency medicine*, *34*(8), 1668-1672.

Lipshitz, R. (1993). Converging themes in the study of decision making in realistic settings. *Decision making in action: Models and methods*, 103-137.

Makoul, G., & Clayman, M. L. (2006). An integrative model of shared decision making in medical encounters. *Patient education and counseling*, *60*(3), 301-312.

Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of applied psychology*, *85*(2), 273.

McAshan, H. H. (1979). *Competency-based education and behavioral objectives*. Educational Technology.

Medicine, S. f. A. E. (2008). *Disposition of the Emergency Department Patient*. https://www.saem.org/cdem/education/online-education/m3-curriculum/disposition/disposition-of-the-emergency-department-patient

Messick, D. M. (1993). Equality as a decision heuristic. *Psychological perspectives on justice: Theory and applications*, 11-31.

Moumjid, N., Gafni, A., Bremond, A., & Carrere, M.-O. (2007). Shared decision making in the medical encounter: are we all talking about the same thing? *Medical Decision Making*, *27*(5), 539-546.

Norman, D. A. (1983). Some observations on mental models. *Mental models*, *7*(112), 7-14.

Orasanu, J., & Connolly, T. (1993). The reinvention of decision making. *Decision making in action: Models and methods*, *1*, 3-20.

Orasanu, J., & Salas, E. (1993). Team decision making in complex environments.

Parsons, T. (2013). *The social system*. Routledge.

Petrie, M., & Halliday, T. (1994). Experimental and natural changes in the peacock's (Pavo cristatus) train can affect mating success. *Behavioral Ecology and Sociobiology*, *35*(3), 213-217.

Probst, M. A., Kanzaria, H. K., Hoffman, J. R., Mower, W. R., Moheimani, R. S., Sun, B. C., & Quigley, D. D. (2015). Emergency Physicians' Perceptions and Decision-making Processes Regarding Patients Presenting with Palpitations. *J Emerg Med*, *49*(2), 236-243.e232. https://doi.org/10.1016/j.jemermed.2015.02.013

Probst, M. A., Kanzaria, H. K., Schoenfeld, E. M., Menchine, M. D., Breslin, M., Walsh, C., Melnick, E. R., & Hess, E. P. (2017). Shared Decisionmaking in the Emergency Department: A Guiding Framework for Clinicians. *Ann Emerg Med*, *70*(5), 688-695. https://doi.org/10.1016/j.annemergmed.2017.03.063

Quality, A. f. H. R. a. (2020). *Strategy 6I: Shared Decisionmaking. Content*. https://www.ahrq.gov/cahps/quality-improvement/improvement-guide/6-strategies-for-improving/communication/strategy6i-shared-decisionmaking.html

Ratcliff, R., & McKoon, G. (1989). Similarity information versus relational information: Differences in the time course of retrieval. *Cognitive Psychology*, *21*(2), 139-155.

Rutkowski, R. A., Salwei, M., Barton, H., Wust, K., Hoonakker, P., Brenny-Fitzpatrick, M., King, B., Shah, M. N., Pulia, M. S., & Patterson, B. W. (2020). Physician Perceptions of Disposition Decision-making for Older Adults in the Emergency Department: A Preliminary Analysis. Proceedings of the Human Factors and Ergonomics Society Annual Meeting,

Salas, E., Dickinson, T. L., Converse, S. A., & Tannenbaum, S. I. (1992). Toward an understanding of team performance and training.

Sibbald, M., Sherbino, J., Preyra, I., Coffin-Simpson, T., Norman, G., & Monteiro, S. (2017). Eyeballing: the use of visual appearance to diagnose 'sick'. *Med Educ*, *51*(11), 1138-1145. https://doi.org/10.1111/medu.13396

Simon, H. A. (1956). Rational choice and the structure of the environment. *Psychological review*, *63*(2), 129.

Stiell, A., Forster, A. J., Stiell, I. G., & van Walraven, C. (2003). Prevalence of information gaps in the emergency department and the effect on patient outcomes. *Cmaj*, *169*(10), 1023-1028.

Todd, P. M., & Gigerenzer, G. (2007). Environments that make us smart: Ecological rationality. *Current directions in psychological science*, *16*(3), 167-171.

Todd, P. M., & Gigerenzer, G. E. (2012). *Ecological rationality: Intelligence in the world*. Oxford University Press.

Towle, A., & Godolphin, W. (1999). Framework for teaching and learning informed shared decision making. *Bmj*, *319*(7212), 766-771. https://doi.org/10.1136/bmj.319.7212.766

van de Pol, M. H., Fluit, C. R., Lagro, J., Slaats, Y. H., Rikkert, M. G. O., & Lagro-Janssen, A. L. (2016). Expert and patient consensus on a dynamic model for shared decision-making in frail older patients. *Patient education and counseling*, *99*(6), 1069-1077.

Walker, J. M., & Carayon, P. (2009). From tasks to processes: the case for changing health information technology to improve health care. *Health Aff (Millwood)*, *28*(2), 467-477. https://doi.org/10.1377/hlthaff.28.2.467

Wears, R., & Leape, L. L. (1999). Human error in emergency medicine. In *Ann Emerg Med* (Vol. 34, pp. 370-372). https://doi.org/10.1016/s0196-0644(99)70133-2

Wears, R. L., Woloshynowych, M., Brown, R., & Vincent, C. A. (2010). Reflective analysis of safety research in the hospital accident & emergency departments. *Human Factors and Ergonomics in Patient Safety*, *41*(5), 695-700. https://www.sciencedirect.com/science/article/pii/S0003687009001665

Wegner, D. M. (1987). Transactive memory: A contemporary analysis of the group mind. In *Theories of group behavior* (pp. 185-208). Springer.

Wegner, D. M., Giuliano, T., & Hertel, P. T. (1985). Cognitive interdependence in close relationships. In *Compatible and incompatible relationships* (pp. 253-276). Springer.

Werner, N. E., Rutkowski, R. A., Krause, S., Barton, H., Wust, K., Hoonakker, P., King, B., Shah, M. N., Pulia, M., Brenny-Fitzpatrick, M., Smith, M., & Carayon, P. (Under review). **Disparate perspectives: Exploring healthcare professionals' mental models of older adults' transitions of care between the Emergency Department and Skilled Nursing Facility**.

Weston, W. W. (2001). Informed and shared decision-making: the crux of patient-centred care. *Cmaj*, *165*(4), 438-439.

Whitney, S. N. (2003). A new model of medical decisions: exploring the limits of shared decision making. *Medical Decision Making*, *23*(4), 275-280.

Wirtz, V., Cribb, A., & Barber, N. (2006). Patient-doctor decision-making about treatment within the consultation--a critical analysis of models. *Soc Sci Med*, *62*(1), 116-124. https://doi.org/10.1016/j.socscimed.2005.05.017

Wiswell, J., Tsao, K., Bellolio, M. F., Hess, E. P., & Cabrera, D. (2013). "Sick" or "not-sick": accuracy of System 1 diagnostic reasoning for the prediction of disposition and acuity in patients presenting to an academic ED. *Am J Emerg Med*, *31*(10), 1448-1452. https://doi.org/10.1016/j.ajem.2013.07.018

Appendix B: PubMed Search Strategy

("Emergency Service, Hospital"[mesh] OR "Emergency Medical Services"[mesh] OR "Emergency Medicine"[mesh] OR (emergenc*[tiab] AND (service*[tiab] OR unit*[tiab] OR department*[tiab] OR room[tiab] OR rooms[tiab] OR ward[tiab] OR wards[tiab] OR medicine[tiab] OR medical[tiab]))) AND ((decision*[tiab] OR "Decision-Making"[mesh]) AND ("Patient Admission"[mesh] OR "Patient Discharge"[mesh] OR "Patient Transfer"[mesh] OR admit[tiab] OR admits[tiab] OR admission*[tiab] OR discharg*[tiab] OR transfer*[tiab] OR disposition*[tiab])).

Appendix C: Likert scale of level of influence

1 – Not at all influential

2 – Slight influential

3 – Somewhat influential

4 – Very influential

5 – Extremely influential

Appendix C reference

Vagias, Wade M. (2006). *Likert-type scale response anchors*. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

Appendix D: Delphi Survey 1

Delphi Survey 1

Start of Block: Default Question Block

We would like you to complete this survey evaluating the factors that influence your disposition decision-making for older adults (older than 65 years) during two types of shifts: 1) chaotic and overwhelming and 2) manageable.

In the survey we will ask for your job title, your gender, and your age. This data is confidential and will only be used to conduct analyses at the group level (e.g., resident physicians vs. attending physicians).

The survey will take approximately 10 minutes to fill out. This is the first of two surveys you will receive. The second survey will be sent to your email in approximately two weeks.

Thank you for your participation!

Page Break

What is your job title?

- ○ Intern physician (PGY-1) (1)
- ○ 2nd year resident physician (PGY-2) (2)
- ○ 3rd year resident physician (PGY-3) (3)
- ○ Fellow (4)
- ○ Attending physician (5)
- ○ Advanced practice provider (e.g., PA) (6)
- ○ Other - please specify (7) _____

How many total years have you worked in this role, both at UW and other institutions?

_____

What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender (3)
- ○ Prefer not to say (4)

What is your age?

_____

Please estimate the percentage of your patient load that is aged 65 years old or older

	0 10 20 30 40 50 60 70 80 90 100
% of your patient load that is aged 65+ ()	

Page Break

Consider a shift that is particularly chaotic and overwhelming. You are managing multiple complex and high acuity patients. The emergency department (ED) is under-staffed. You don't have the time or resources to manage your patients in the way you'd like. You feel immense time pressure to get your patients out of the ED as the waiting room is full and wait times are long.

Please provide a rating (1 = not influential; 5 = extremely influential) for each factor on the extent to which it influences your disposition decision-making process for older adults in the ED during a **chaotic and overwhelming** shift.

	Not influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
	1	2	3	4	5

Best practice guidelines related to disposition decision-making ()	
Extent to which patient's insurance will cover subsequent care costs ()	
Potential for malpractice repercussions ()	
Potential for negative consequences if your patient were discharged and bounced back to the ED ()	
Patient's physical home environment (e.g., stairs to get into house, bathroom only on second floor) ()	
ED crowding (e.g., use of hallway beds, boarding, number of patients in waiting room) ()	
ED staffing (e.g., number of nurses) ()	
Amount and accuracy of patient information available to you (e.g., baseline status, living situation) ()	
Information available in the electronic health record (e.g., medical history, medications) ()	
The number and complexity of the patients to whom you're providing care ()	
The extent to which you feel time pressure to quickly disposition patients (e.g., to see waiting room patients, manage ED patient flow, minimize length of stay) ()	
Ease of enacting disposition alternatives (e.g., amount of follow-up care coordination required to discharge, number of phone calls required to admit) ()	
Ability to delegate tasks to another ED clinician (e.g., ED nurse calling patient's family and reporting back) ()	
Ability to get handoff from EMS yourself or by way of another ED clinician ()	
Ability to contact care partner not physically in the ED (e.g., by phone) ()	
Ability to have comprehensive conversations with patient and/or care partner ()	
Ability to have comprehensive conversations with other ED clinicians ()	
Recommendation from consulting clinicians (e.g., ortho, neuro) ()	

Recommendation from hospitalist ()	
Access to physical therapy in the ED ()	
Access to social work in the ED ()	
Ability to either call or send an inbasket message to patient's primary care physician ()	
Diagnostic or disposition momentum (e.g., inclination to do what has been done before for the patient) ()	
Extent to which there are departmental incentives to discharge "grey-zone" patients ()	
Expectation that patients have a well-developed disposition plan in place at the time of shift change ()	
Your "gut" reaction/instinct for a patient's disposition ()	
Your personal comfort discharging a patient with a high risk of adverse outcomes ()	
Your previous experience with similar patients or training in an area that is specifically relevant to your present patient ()	
Patient cognitive status ()	
Patient disposition preference or agreeability with your disposition recommendation ()	
Patient psychosocial factors (e.g., access to transportation, living situation, ability to fulfill own future care needs) ()	
Care partner disposition preference ()	

Do you have any comments about disposition decision-making for older adult patients during a **chaotic and overwhelming shift**?

_____

Page Break

Consider a shift that is manageable. You are taking care of a comfortable number of patients and very few are high acuity. You feel confident in your plans for each of your patients. You feel like you have all of the time and resources you need to manage your patients in the way you'd like. You feel very little time pressure to get patients out of the ED as the waiting room is nearly empty and wait times are short.

Please provide a rating (1 = not influential; 5 = extremely influential) for each factor on the extent to which it influences your disposition decision-making process for older adults in the ED during a **manageable** shift.

Not influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
1	2	3	4	5

Best practice guidelines related to disposition decision-making ()	
Extent to which patient's insurance will cover subsequent care costs ()	
Potential for malpractice repercussions ()	
Potential for negative consequences if your patient were discharged and bounced back to the ED ()	
Patient's physical home environment (e.g., stairs to get into house, bathroom only on second floor) ()	
ED crowding (e.g., use of hallway beds, boarding, number of patients in waiting room) ()	
ED staffing (e.g., number of nurses) ()	
Amount and accuracy of patient information available to you (e.g., baseline status, living situation) ()	
Information available in the electronic health record (e.g., medical history, medications) ()	
The number and complexity of the patients to whom you're providing care ()	
The extent to which you feel time pressure to quickly disposition patients (e.g., to see waiting room patients, manage ED patient flow, minimize length of stay) ()	
Ease of enacting disposition alternatives (e.g., amount of follow-up care coordination required to discharge, number of phone calls required to admit) ()	
Ability to delegate tasks to another ED clinician (e.g., ED nurse calling patient's family and reporting back) ()	
Ability to get handoff from EMS yourself or by way of another ED clinician ()	
Ability to contact care partner not physically in the ED (e.g., by phone) ()	
Ability to have comprehensive conversations with patient and/or care partner ()	
Ability to have comprehensive conversations with other ED clinicians ()	
Recommendation from consulting clinicians (e.g., ortho, neuro) ()	

Recommendation from hospitalist ()	
Access to physical therapy in the ED ()	
Access to social work in the ED ()	
Ability to either call or send an inbasket message to patient's primary care physician ()	
Diagnostic or disposition momentum (e.g., inclination to do what has been done before for the patient) ()	
Extent to which there are departmental incentives to discharge "grey-zone" patients ()	
Expectation that patients have a well-developed disposition plan in place at the time of shift change ()	
Your "gut" reaction/instinct for a patient's disposition ()	
Your personal comfort discharging a patient with a high risk of adverse outcomes ()	
Your previous experience with similar patients or training in an area that is specifically relevant to your present patient ()	
Patient cognitive status ()	
Patient disposition preference or agreeability with your disposition recommendation ()	
Patient psychosocial factors (e.g., access to transportation, living situation, ability to fulfill own future care needs) ()	
Care partner disposition preference ()	

Do you have any comments about disposition decision-making for older adult patients during a **manageable** shift?

_____

End of Block: Default Question Block

Start of Block: Follow Up Info

Please enter the first letter of your last name the last four digits of your phone number. For example, if someone's telephone number is 608-678-1234 and last name is Johnson, they would enter 1234J. This will serve as your unique, anonymous identifier to link your responses from the first and second survey.

_____

Please enter your UW-Health email address. We will send the second survey link to this email.

_____

Upon completion of this survey, you will be sent a $30 Amazon e-gift card. Please provide the email address to which you would like your e-gift card sent.

_____

End of Block: Follow Up Info

Appendix E: Second Delphi survey

Delphi Survey 2

Start of Block: Default Question Block

Thank you so much for your participation in the first Patient Safety Learning Lab survey exploring the factors that most influence your disposition decision-making process for older adults in the ED. We had a total of 33 participants complete the first survey.

In analyzing the results from the first survey, we found that you and your fellow ED clinicians agreed on the influence of the following factors on the disposition decision-making process during a **chaotic and overwhelming shift**:
- ED crowding
- Patient psychosocial factors

We found that you and your fellow ED clinicians agreed on the influence of the following factors on the disposition decision-making process during a **manageable shift**:
- Patient's home environment
- The extent to which you feel time pressure to quickly disposition patients

There were a total of 30 factors for a chaotic and overwhelming shift and 30 factors for a manageable shift on which you and your fellow ED clinicians had disparate perspectives on their influence on the disposition decision-making process.

In this second survey, we would ask that you:
1) Briefly review your responses as well as the aggregate responses from the first survey (sent to you via email)
2) Re-rate the factors on which you and your fellow ED clinicians had dissimilar ratings. You may choose to change your rating from the first round or keep it the same.

The survey will take approximately 10 minutes to fill out.

Thank you for your participation!

Page Break

Page Break

Consider a shift that is particularly chaotic and overwhelming. You are managing multiple complex and high acuity patients. The emergency department (ED) is under-staffed. You don't have the time or resources to manage your patients in the way you'd like. You feel immense time pressure to get your patients out of the ED as the waiting room is full and wait times are long.

Please provide a rating (1 = not influential; 5 = extremely influential) for each factor on the extent to which it influences your disposition decision-making process for older adults in the ED during a **chaotic and overwhelming** shift.

Not influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
1	2	3	4	5

Best practice guidelines related to disposition decision-making ()	
Extent to which patient's insurance will cover subsequent care costs ()	
Potential for malpractice repercussions ()	
Potential for negative consequences if your patient were discharged and bounced back to the ED ()	
Patient's physical home environment (e.g., stairs to get into house, bathroom only on second floor) ()	
ED staffing (e.g., number of nurses) ()	
Amount and accuracy of patient information available to you (e.g., baseline status, living situation) ()	
Information available in the electronic health record (e.g., medical history, medications) ()	
The number and complexity of the patients to whom you're providing care ()	
The extent to which you feel time pressure to quickly disposition patients (e.g., to see waiting room patients, manage ED patient flow, minimize length of stay) ()	
Ease of enacting disposition alternatives (e.g., amount of follow-up care coordination required to discharge, number of phone calls required to admit) ()	
Ability to delegate tasks to another ED clinician (e.g., ED nurse calling patient's family and reporting back) ()	
Ability to get handoff from EMS yourself or by way of another ED clinician ()	
Ability to contact care partner not physically in the ED (e.g., by phone) ()	
Ability to have comprehensive conversations with patient and/or care partner ()	
Ability to have comprehensive conversations with other ED clinicians ()	
Recommendation from consulting clinicians (e.g., ortho, neuro) ()	
Recommendation from hospitalist ()	

Access to physical therapy in the ED ()	
Access to social work in the ED ()	
Ability to either call or send an inbasket message to patient's primary care physician ()	
Diagnostic or disposition momentum (e.g., inclination to do what has been done before for the patient) ()	
Extent to which there are departmental incentives to discharge "grey-zone" patients ()	
Expectation that patients have a well-developed disposition plan in place at the time of shift change ()	
Your "gut" reaction/instinct for a patient's disposition ()	
Your personal comfort discharging a patient with a high risk of adverse outcomes ()	
Your previous experience with similar patients or training in an area that is specifically relevant to your present patient ()	
Patient cognitive status ()	
Patient disposition preference or agreeability with your disposition recommendation ()	
Care partner disposition preference ()	

Do you have any comments about disposition decision-making for older adult patients during a **chaotic and overwhelming shift**?

_____

Page Break

Consider a shift that is manageable. You are taking care of a comfortable number of patients and very few are high acuity. You feel confident in your plans for each of your patients. You feel like you have all of the time and resources you need to manage your patients in the way you'd like. You feel very little time pressure to get patients out of the ED as the waiting room is nearly empty and wait times are short.

Please provide a rating (1 = not influential; 5 = extremely influential) for each factor on the extent to which it influences your disposition decision-making process for older adults in the ED during a **manageable** shift.

Not influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
1	2	3	4	5

Best practice guidelines related to disposition decision-making ()	
Extent to which patient's insurance will cover subsequent care costs ()	
Potential for malpractice repercussions ()	
Potential for negative consequences if your patient were discharged and bounced back to the ED ()	
ED crowding (e.g., use of hallway beds, boarding, number of patients in waiting room) ()	
ED staffing (e.g., number of nurses) ()	
Amount and accuracy of patient information available to you (e.g., baseline status, living situation) ()	
Information available in the electronic health record (e.g., medical history, medications) ()	
The number and complexity of the patients to whom you're providing care ()	
Ease of enacting disposition alternatives (e.g., amount of follow-up care coordination required to discharge, number of phone calls required to admit) ()	
Ability to delegate tasks to another ED clinician (e.g., ED nurse calling patient's family and reporting back) ()	
Ability to get handoff from EMS yourself or by way of another ED clinician ()	
Ability to contact care partner not physically in the ED (e.g., by phone) ()	
Ability to have comprehensive conversations with patient and/or care partner ()	
Ability to have comprehensive conversations with other ED clinicians ()	
Recommendation from consulting clinicians (e.g., ortho, neuro) ()	
Recommendation from hospitalist ()	
Access to physical therapy in the ED ()	
Access to social work in the ED ()	

Ability to either call or send an inbasket message to patient's primary care physician ()	
Diagnostic or disposition momentum (e.g., inclination to do what has been done before for the patient) ()	
Extent to which there are departmental incentives to discharge "grey-zone" patients ()	
Expectation that patients have a well-developed disposition plan in place at the time of shift change ()	
Your "gut" reaction/instinct for a patient's disposition ()	
Your personal comfort discharging a patient with a high risk of adverse outcomes ()	
Your previous experience with similar patients or training in an area that is specifically relevant to your present patient ()	
Patient cognitive status ()	
Patient disposition preference or agreeability with your disposition recommendation ()	
Patient psychosocial factors (e.g., access to transportation, living situation, ability to fulfill own future care needs) ()	
Care partner disposition preference ()	

Do you have any comments about disposition decision-making for older adult patients during a **manageable** shift?

_____

End of Block: Default Question Block

Start of Block: Follow Up Info

Please enter the first letter of your last name the last four digits of your phone number. For example, if someone's telephone number is 608-678-1234 and last name is Johnson, they would enter 1234J. This will serve as your unique, anonymous identifier to link your responses from the first and second survey.

_____

Upon completion of this survey, you will be sent a $70 Amazon e-gift card. Please provide the email address to which you would like your e-gift card sent.

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End of Block: Follow Up Info

Appendix F: Example Delphi calculations

Below is an example of the calculations done for each element surveyed. These values relate to the element “best practice guidelines related to disposition decision-making”.

Summary statistic	Element summary
# of 1s	1
# of 2s	10
# of 3s	12
# of 4s	4
# of 5s	6
# of non-responses	0
% of 1s	3.03
% of 2s	30.30
% of 3s	36.36
% of 4s	12.12
% of 5s	18.18
Relative % of 1s	3.03
Relative % of 2s and 3s	66.67
Relative % of 4s and 5s	30.3
Mode	3