INTERPROFESSIONAL HEALTHCARE PRACTICES – PROCESSES AND CONTEXT

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ABSTRACT

Interprofessional practice is an integral part of improving the increasingly complex healthcare system. Communication and coordination between professional groups across settings is necessary for effective and efficient chronic disease management, population health, and transitions of care, all of which are important for public health. While the concept of teamwork is not new to healthcare, the specifics of how to carry out team-based care in different organizational contexts are largely unknown. This study explores context, mechanisms, and outcomes of interprofessional practice across a range of settings.

Chapter 1 is a rapid realist review of interprofessional models in the emergency department. It details common contexts for interprofessional practice, such as regulatory changes, management quality improvement initiatives, and professional association guidelines. The study also describes interventions and mechanisms associated with interprofessional practice, including empowering members of the clinical team to share decision making, formalizing communication to reduce uncertainty, and utilizing electronic monitoring to improve efficiency. Finally, it identifies potential outcomes, such as cost, process improvement, and patient health outcomes.

Chapter 2 is a qualitative study of the role of and context for advanced practice providers (APPs) in hospital medicine at two hospitals. This study describes the organizational context for implementing APPs, which include cost pressures and physician shortages. The study also details three different models of APPs in hospital medicine and associated perceived outcomes.

Chapter 3 is a quantitative study of the differences between APP and physician providers of e-visits. The study finds that patients of APPs tend to be younger, single and higher income. It also finds that APPs tend to prescribe more drugs per patient than physicians, which could have cost and quality implications.

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INTRODUCTION

Interprofessional collaborative practice has been identified by the Institute of Medicine (IOM) as a necessary organizational support for the healthcare system.[1] The IOM defines team-based care as "provision of health services to individuals, families, and/or their communities by at least two health providers who work collaboratively with patients and their caregivers to accomplish shared goals within and across settings to achieve coordinated, high-quality care."[2] Similarly, Zwarenstein *et al* in their Cochrane review defined interprofessional collaboration as "the process in which different professional groups work together to positively impact health care."[3] Finally the World Health Organization defines collaborative practice as "multiple health workers from different professional backgrounds provide comprehensive services by working with patients, their families, carers and communities to deliver the highest quality of care across settings."[4] All of these definitions commonly define interprofessional practice as health workers from multiple disciplines or professions working together to improve the quality of care.

The IOM has defined the components of effective healthcare teams as shared goals, clear roles, mutual trust, effective communication, and measurable processes and outcomes.[2] Environmental factors in the healthcare system have necessitated the advancement of these components of interprofessional practice. The growing focus on reducing the cost of care while improving quality involves relying on members of the healthcare team working together to provide services and to ensure quality of care. This is also closely tied to the ongoing shortage or maldistribution of physicians, who have historically been the primary provider of healthcare services. In areas and specialties with a shortage of physicians, practices have also had to increasingly utilize other members of the healthcare team. Consequently, health professions and policymakers have worked to appropriately expand the scope of practice for professionals to best utilize their training within the healthcare teams. Finally the increasing complexity of the healthcare system

necessitates effective and efficient connection and communication between settings and clinicians to best transition patients and families.

In addition, many of the recent healthcare models designed to solve healthcare problems intrinsically rely on effective healthcare teams, such as the Chronic Care Model, the Collaborative Care Model, the Patient Centered Medical Home, and Transitional Care. The evidence of how teamwork is implemented or functions within these models, however, is weak. A Cochrane review of the effects of interprofessional practice on healthcare outcomes only identified five studies with moderate evidence to support interprofessional practice in a small number of healthcare settings.[3] Furthermore, many barriers to effective interprofessional practice have been identified; the IOM made the statement that "making the necessary changes in roles to improve the work of teams is often slowed or stymied by institutional, labor, and financial structures, and by law and custom."[1] These environmental and organizational contextual factors form the premise of this study.

Organizational studies entail the examination of organizational processes, practices and structures and how these influence social relations and socially constructed institutions and vice versa. These studies could involve several levels of analysis from individuals, individual organizations, organizational sets and organizational fields. As the system for healthcare services evolves over time, it is important to consider a systems and organizational approach to understand why and how individuals and organizations do what they do and change. More specifically, we are interested in why provider organizations take up organizational "innovations," such as interprofessional teams, which involve new processes, practices and structure. Our overarching research questions are:

1. What are the mechanisms through which interprofessional practice works within a setting?
2. How does organizational and environmental context affect these mechanisms?

We identified two existing frameworks that have begun to explore these issues to guide our thinking. The first is Greenhalgh *et al*'s study on diffusion of innovation in service organizations.[5] This systematic review aggregated frameworks and studies that have considered the multitude of inputs that affect the

adoption of innovations, such as interprofessional healthcare teams. The second is a framework by Careau *et al* that acts as a tool to determine the level of interprofessional collaboration by the context, objectives, team member interactions, and integration of disciplinary knowledge.[6] Based on these frameworks, we chose three different healthcare settings with different contexts, objectives, and interactions: 1) the emergency department, a complex, unpredictable setting with a high degree of shared decisions, 2) inpatient hospital medicine, a setting that requires a high degree of care coordination but is typically less emergent, and 3) outpatient primary care e-visits, a low complexity environment for basic, non-emergent conditions.

For each paper, we developed research questions specific to the interprofessional care occurring in that setting. We then chose methodologies to best answer the research questions. For the emergency department, there is a vast literature on different models of interprofessional care but a gap in knowledge on organizational and environmental context for these models. We chose to use a rapid realist review methodology to identify already published literature on emergency department interprofessional models and extract data on context, mechanisms, and the interplay between context and mechanisms for the models. In hospital medicine, new models of interprofessional care are emerging, involving advanced practice providers. While there is some evidence on the effectiveness of these models, there is little knowledge on how the interprofessional models work and the organizational context for their formation. Consequently, we chose a qualitative approach to identify mechanisms of interprofessional practice in hospital medicine and contextual factors affecting the implementation and functioning of the mechanisms. Finally, there are many studies on the effectiveness of e-visits for patient outcomes and several studies explaining the organizational formations of e-visit programs. This model involves unidirectional information flow and parallel practice of providers with the use of technology. To understand how the model differs between professional groups, we compared physician and APP lead e-visits quantitatively.

The results of these three papers provide some overarching conclusions. As suggested by Careau *et al*[6], interprofessional practice is not a “one size fits all” strategy. In the study of emergency departments we

find that organizations implemented different interprofessional models depending on a complex interaction of the patient populations and conditions targeted, regulatory changes, guidelines from professional associations, staffing shortages, and specific initiatives from leadership. Similarly the context for the different hospital medicine models included physician shortages, cost and efficiency pressures, and patient satisfaction. The mechanisms of interprofessional practice in the emergency department included leadership involvement in quality improvement, empowering clinicians lower in the institutional hierarchy, standardizing and formalizing communication and information sharing, and providing ongoing feedback to providers on their individual and team performance. Outcomes from different models of interprofessional practice suggested by the studies were process measures, such as communication, referrals, work efficiency, and prescribing; quality measures, such as guideline adherence, patient satisfaction, employee satisfaction; cost indicators, such as length of stay, emergency department visits, and readmissions; and patient outcomes, such as mortality and functioning.

This study describes contextual factors that influence implementation of interprofessional teams. As health systems and policymakers consider implementation and/or incentivization of care models that involve interprofessional practice, these contextual factors are important to consider as moderating factors for success. The study on emergency departments provides a range of choices that could be considered directly for a range of emergency department challenges. Future work in this area could be creating dissemination products that are usable by health system and emergency department leaders. The study also describes different models and mechanisms of interprofessional practice and begins to build hypotheses about how these mechanisms might affect several outcomes of interest. The e-visit study directly shows differences in prescribing outcomes and patient characteristics between two models of care. Future work in this could explore diagnostic concordance and costs between the two models. To build further evidence on interprofessional practice as an effective means of addressing healthcare challenges, future work could also test models of hospital medicine teams to find direct effects on outcomes.

1 PRACTICE MODELS IN THE EMERGENCY DEPARTMENT: A RAPID REALIST REVIEW

1.0 INTRODUCTION

This study uses an approach called a Rapid Realist Review (RRR) to delve into interprofessional models of care in the emergency department (ED). By unpacking what works, for whom and in what contexts, we aim to first describe models of team-based and interprofessional care that have been identified in the literature within the ED setting. We will also identify and characterize the mechanisms within the healthcare system, hospital, department and teams themselves that improve healthcare quality within a particular context. Finally, we will synthesize contextualized strategies for healthcare organizations and policymakers to implement, evaluate and sustain successful ED teams.

The development of effective healthcare teams has been identified as a critical condition for improving the quality of the healthcare system.[1,7,8] A clinical setting where effective team work is particularly relevant is the ED due to the complexity and the emergent nature of patients' conditions. The ED is considered a high risk environment with critically ill and complex patients needing timely and high quality care.[9] Major quality problems experienced in the ED include missed or delayed diagnoses, delays in treatment, medication errors, judgement errors, and poor communication and information flow.[10] Healthcare regulatory bodies worldwide have begun to require reporting of ED quality and efficiency metrics and to impose regulations on ED processes, including timing measures from arrival to evaluation and treatment and treatment of high risk conditions, such as acute myocardial infarction and stroke.[11-14] Optimizing these quality and efficiency measures requires efficient and effective performance of the ED healthcare team.

The ED is a complex healthcare setting that involves multiple healthcare professions working together to provide care for a wide range of patients and conditions. While there are conceptually defined stages of

care within an ED, including triage, diagnosis, treatment and discharge/admission, the work of moving patients through these stages is nonlinear for clinicians. The boundaries between the ED and other settings, such are pre-hospital EMS, trauma, and inpatient units, are porous and the boundaries between professional roles have also become blurred.[15,16] Consequently, interprofessional teamwork in the ED is dynamic with some team members interacting frequently and others being incorporated as patient needs arise. As policymakers work to develop quality measures around ED performance and hospital leadership considers interventions to improve ED processes and quality, it is critical to understand not only how teams operate in the ED and what interventions can be implemented to improve their operations but also the context in which the teams operate.

To date there has been limited work to connect mechanisms of interprofessional teamwork in the ED to outcomes. Previous work has contributed to understanding and establishing strategies to improve ED operations and quality, including the Institute of Medicine's Committee on the Future of Emergency Care in the United States Health System,[16,17] the Robert Wood Johnson Foundation *Urgent Matters* program,[18] the Agency for Healthcare Research and Quality's guide,[19] and the NHS' reforms around emergency care.[14,20] An article by Kilner and Sheppard reviewed the role of teamwork and communication in the ED as related to physiotherapy and concluded that teamwork interventions improved provider satisfaction and may increase access to physiotherapy.[21] Flowerdew et al conducted a scoping review of nontechnical skills related to patient safety in the ED and identified nine skills, which are related but not synonymous to team skills.[22] Outside of the ED, a review by Manser of teamwork and patient safety across all healthcare settings presented connections between provider perceptions of teamwork and teamwork behaviors (quality of collaboration, shared mental models, coordination, communication, and leadership) and patient safety.[23] In a Cochrane systematic review of the effects of interprofessional collaboration, Zwarenstein *et al* found that interprofessional collaborative practice interventions can improve processes and outcomes, however, the results were not generalizable due to the small number and heterogeneity of studies.[3] Furthermore, these interventions included teams with more consistent membership and processes

than one would expect in an ED. More recently, Hewitt, Sim and Harris published a four paper series of a realist synthesis on interprofessional teamwork in health and social care, which delves into the context and mechanisms that make interprofessional teamwork interventions work.[24-27] We are unaware of any work to date that has presented context and mechanisms of interprofessional care interventions that improve quality in the ED.

1.0.1 Rapid Realist Review

To achieve our stated goals, we utilize a RRR methodology put forth by Saul *et al*[28] based on Pawson and Tilley's realistic evaluation methods and refined by Pawson, Rycroft-Malone *et al* and Wong *et al.*[29-32] Rather than determining *if* an intervention (I) works, this study aims to describe the context (C) and to unpack complex social and managerial mechanisms (M) that explain *how* a program achieves or does not achieve an outcome (O). This I-C-M-O function is at the core of Pawson's realistic evaluation methodology and addresses the question 'what works, for whom, in what contexts, to what extent, and most importantly how and why?'[28,33] Realist reviews consider evidence from a range of sources, including both qualitative and quantitative data, to answer this question. In contrast to a traditional realist review, a RRR focuses more on types of interventions that policy makers or practitioners can use opposed to developing a broad program theory.[28] As implied by the "rapid," RRRs typically are shorter projects, involving 3-6 months of researcher time versus 1-2 years, and utilize input from experts to reflect on the results instead of the extensive searching that traditional realist reviews utilize to fully develop a program theory.[28] Based on the needs of policymakers and practitioners working in a rapidly changing environment for ED quality measurement, we believe that the intervention-focused, short term strategy is most appropriate.

1.1 METHODS

This RRR was designed to meet the three identified goals and meet the Realist And MEta-narrative Evidence Syntheses: Evolving Standards (RAMESES) publication standards.[31] The first step involved identifying all articles of possible relevance to our topic. Using an iterative process, we began with the

search terms “interprofessional” and “emergency department” and sequentially added related terms that returned meaningful search results. The final search terms were *interprofessional*, *multiprofessional*, *multidisciplin**, *interdisciplin**, *care coordination*, or c*ollaborat**and *emergency room*, *emergency department*, *emergency medicine*, *emergency care*. These terms were used to search the databases CINAHL, Cochrane, PubMed, and Scopus for the years 2004 through 2014. We chose to analyze 10 years of data for relevancy to current day hospital operations. This process identified 3,549 articles (Figure 1-1).

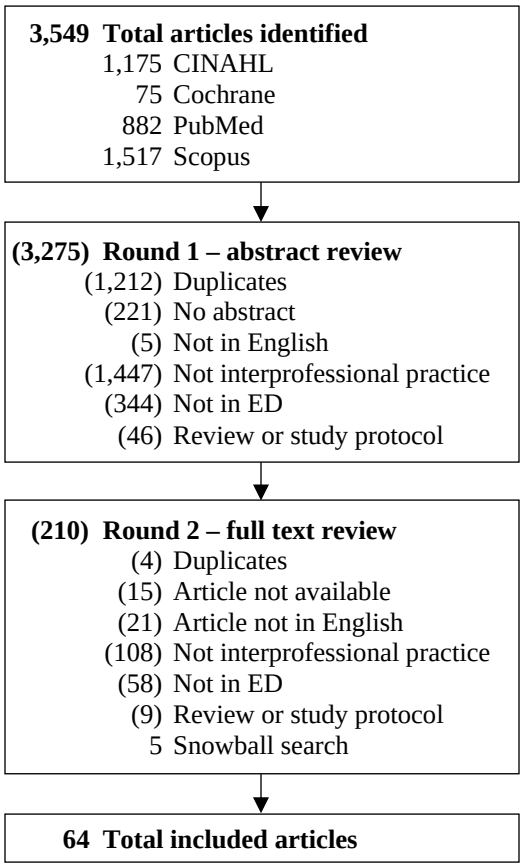

Figure 1-1. Article Search and Disposition Process

Next, using DistillerSR software[34] and an abstract coding protocol, members of the research team reviewed all abstracts for the three inclusion criteria: 1) the article must be a study of interprofessional or multidisciplinary practice, which excludes articles solely about educational programs or simulations, 2) the study must be in the emergency department, and 3) the article cannot be a review, protocol, or editorial. All reviewers were trained on the coding protocol and a pilot review of 25 articles was used to

ensure coding consistency. Each article was reviewed twice, and all conflicts were discussed and resolved. This first round of review excluded 3,275 articles. The first author read the full text of all remaining 274 articles and conducted a snowball search of the references of included articles and relevant review articles to identify any additional articles not identified in the preliminary search. After this process, 64 articles were included for analysis and data extraction; the citations for these articles are included in Appendix 1.

Using an iterative approach, we developed a data extraction tool to capture elements of I-C-M-O and general article characteristics, see Table 1-1. The first author read all 64 authors in depth and documented information from the articles in the data extraction form. Upon completion, the first author synthesized the data in the forms and developed key intervention groups representative of common I-C-M-O configurations within each group (e.g., programs that establish multidisciplinary clinical pathways to improve outcomes for time sensitive conditions). The I-C-M-O data from each group was interpreted and is presented in the results.

Table 1-1. Data Extraction Tool

Data Extraction Category	Description
Strategy/intervention	Clinical or administrative processes, professional roles, information technology, education, or physical space
Context	
Structural	Number of EDs studied, size by annual visits, country, urban/rural, type (freestanding, teaching status, specialty, acuity, public)
Patient population	Patient type targeted for the strategy or intervention
Background issue	Issue identified within the article as the reason for the intervention or study
Regulatory	Regulatory body action affecting ED functioning (e.g., 4-hour turnaround legislation)
Normative	Social expectations affecting ED functioning (e.g., guidelines)
Leadership	Internal leadership actions affecting ED functioning, including QI initiatives
Mechanisms	How the context, intervention or strategy affects team functioning or other outcomes
Outcomes	Measures of team functioning or other outcomes
Article characteristics	Study of intervention or existing practice Study methodology Theoretical framework applied

1.2 RESULTS

The resulting 64 articles represent a heterogeneous group of ED types, locations, research types, etc. In Table 1-2 we show the breakdown by intervention group, country of study, type of study, and methodology. Forty-eight of the included studies focused on one ED, and the remaining articles included multiple EDs, up to 108. The EDs were mainly in teaching hospitals or academic medical centers, but also included community hospitals, freestanding EDs, government hospitals, and specialty hospitals. Seven articles applied an overarching theoretical framework to their study, such as complex adaptive systems, distributed cognition theory, and Merton's theory of value-assimilation. We utilized constructs from these theories as explanatory factors within our interpretation (e.g., we highlight tools and processes necessary for distributed cognition in ED team workflow).

Table 1-2. Included Article Characteristics

Characteristic	Number
Articles	64
Intervention Group	
Patient Subpopulation	30
Pathways	17
Specialized Clinicians	4
Specialized Team	9
General ED Functioning	34
Team Workflow	18
Triage	8
Communication	8
Country of Study	
United States	47
Australia	15
United Kingdom	6
Sweden	5
Other	7
Type of Study	
Study of Intervention	41
Study of Existing Practice	23
Methodology	
Qualitative	33
Quantitative	19
Descriptive	10
Other	2

A divide in the resulting data emerged from a noticeable correlation between patient type, background issue, normative external context, and the interventions employed. As a result, the articles were grouped into two Categories: Patient Subpopulation and General ED Functioning. Thirty-four of the articles focused on a particular patient subpopulation, such as cancer or domestic abuse patients. Of the 34 articles with a particular patient focus, 30 identified a background issue that was specific to that subpopulation, such as achieving a specific door-to-balloon time for STEMI patients. The remaining articles identified background issues that focused on more general aspects of ED functioning, such as communication or teamwork. Within the Patient Subpopulation articles, three interventions types emerged: clinical pathways, specialized individual ED clinicians, and specialized ED teams. Within the General ED Functioning articles, three article foci included: improving team workflow, improving triage processes, and improving communication. We now present the six intervention groups and explain the I-C-M-O components for each, as included in Table 1-3.

Table 1-3. Team-based ED Interventions to Improve Health Care Quality, Synthesized Results

Intervention/strategy	Context	Mechanisms	Outcomes
Add an ED clinician to address specific patient needs • Co-location in ED • Standardized process to utilize new clinician • Training of staff for utilization • Social interaction between clinicians	• Community leaders and government interest in patient subpopulation • Teaching hospitals • Overworked nursing staff unable to address needs • Cultural separation between disciplines	• Complement existing overburdened staff • Improve timely recognition and treatment of patient needs • Raise team awareness of added clinical resource	• Referrals to domestic abuse services • Staff satisfaction • Professional rapport • Timeliness of medication administration
Clinical pathways to address time sensitive, acute patient problems • Authorize initiation of services lower in clinical hierarchy • Formalize communication and care processes • Electronic monitoring of pathway steps • Co-locate and collaborate with necessary services • Noticeable signage or	• Professional association or quality organization guidelines about processes of care and treatment timing • Specialty teaching hospitals and referral hospitals • Multidisciplinary leadership teams formed for implementation • QI efforts included process mapping,	• Improve knowledge, communication and visibility of clinical guidelines and care processes • Prioritize patients with time sensitive problems • Reduce uncertainty and delays in treatment • Empower ED clinicians to efficiently activate pathway upon identification • Enhance collaboration	• Accuracy of treatment • Pathway adherence • Use of evidence-based treatments • Time to treatment • ED length of stay • ED readmissions rates • Hospital admissions rates • Costs • Patient physical functioning • Patient mortality

Table 1-3 continued

indicators for pathway steps • Education on pathway compliance and clinical competencies for pathway steps • Performance feedback to team members	clinical champions, education, PDCA cycles, audit and feedback	between ED clinicians and with non-ED clinicians • Continuously improve care processes within a local context	
Specialized ED teams for patient subpopulations • Team membership based on clinical needs of patients • Formalize team activation or referral protocol • Formalize team processes • Education of team and ED staff on roles	• Community and teaching hospitals • State funded programs for geriatrics patients • Professional association guidelines about processes of care • Audit and feedback used	• Improves awareness and identification of patients with specific care needs • Increase patient specific, evidence-based care planning and treatment • Enhances functioning of interprofessional teams	• Patient screenings and referrals • Use of evidence-based treatments • Staff satisfaction and morale • Time to treatment • ED length of stay • ED readmissions • Hospital admissions • Patient mortality • Patient safety • Patient satisfaction
Improving ED team communication and information sharing • Integrate and customize ED information system • Information available at the point of care • Collaborative EMR usage • Targeted information sharing • Education on communication	• Teaching hospitals • Regulatory and quality organization guidelines for EMR usage • Hospital leadership identified communication gaps • Barrier identification and process mapping	• Simplify and streamline information transfer • Improve clinical decision making • Develop common understanding of communication • Enhance interaction with patients	• Communication efficiency • Documentation time • Handover accuracy
Improving the ED triage process • Formalize triage process • Patient prioritization and assignment • Immediate evaluation by a team or additional clinicians • Coordination of team communication • Electronic tracking system • Streamline triage documentation • Plan for exception handling • Education, feedback, and maintenance strategies	• Community and teaching hospitals • National 4-hour turnaround rule • Nationally recognized triage programs • Professional association or quality organization guidelines about triage processes • Multidisciplinary leadership teams • Process mapping, education, champions, and audit and feedback	• Improve team communication and functioning • Respond to patient needs • Increase transparency of triage process and exceptions • Builds consensus on process • Expedites triage throughput • Creates accountability for patient flow	• Time to see a provider • Left without being seen rates • ED length of stay • Patient satisfaction

Table 1-3 continued

Improving ED team workflow • Formalize adaptable team structure • Co-locate team • Create team processes by patient types • Establish open and efficient lines of communication • Assign or add coordination roles • Formalize coordination activities • Electronic tracking system • Train clinical staff on teamwork skills • Ongoing feedback and education of staff	• Community, psychiatric and teaching hospitals • National 4-hour turnaround rule • Reimbursement for telehealth • Professional association and quality organization guidelines about teamwork systems based practice • Leadership initiatives to improve teamwork • Lean continuous improvement strategies, process mapping, pilot testing, education, PDCA cycles, audit and feedback	• Increase transparency of roles and processes • Improve information sharing • Empower staff with greater responsibility • Distribute cognitive work • Decrease delays, interruptions and redundancy of efforts • Focus on patient needs and communication • Gain buy-in from members on clinical and team processes	• Volume of patients treated • ED length of stay • Time to treatment or provider • Staff cohesiveness • Staff satisfaction • Provider retention • Interprofessional understanding • Adherence to teamwork behaviors • Situational awareness • Number of interruptions • Patient trust and confidence

1.2.1 Clinical Pathways to Address Time Sensitive, Acute Patient Problems

The first intervention group involves the use of clinical pathways to standardize procedure around time sensitive or acute conditions presenting to the ED. EDs used pathways as an intervention for subpopulations, including adult patients with acute coronary syndrome, cardiac arrest, ST elevated myocardial infarction (STEMI), advanced cancer, trauma with acute pain, peritonitis, pneumonia, sepsis, or stroke and pediatric patients with inborn errors of metabolism, febrile neutropenia, or febrile central line.

Context

The leadership promoted the use of clinical pathways as a solution to prominent quality issues within the ED, including lack of timely identification and therapeutic intervention, problems communicating between clinicians, and non-use of evidence-based treatments. The articles mentioned that professional associations have already issued and endorsed guidelines for multidisciplinary approaches to treating some of the patient groups, such as the American Heart Association (AHA)90 minutes door-to-balloon time for STEMI patients.[35-38] The hospitals using pathway interventions were primarily urban teaching or

academic hospitals with specialty designation (children's, catheterization laboratory referral center, primary stroke center, cancer center). Leadership within these hospitals often formed multidisciplinary teams to represent the clinicians involved in the care of the identified patients and create the pathway or modify national guidelines for their work setting. They also utilized quality improvement (QI) techniques, such as process mapping, clinical champions, education, plan-do-check-act (PDCA) cycles and audit and feedback to implement and continuously improve the pathways.

Interventions

While the development of the pathway itself is a strategy, the ED healthcare professionals utilized multi-component interventions to implement them. A common intervention was allowing a clinician lower in the clinical hierarchy to activate the pathway, such as greeter identification of febrile patients and notification of the triage nurse[39] or ED resident or physician activation of a catheterization laboratory instead of a cardiologist.[35-38] Other formalized communication interventions included engaging outside clinicians, such as renal nurses contacting nephrologists upon assessment of peritonitis.[40] EDs also formalized processes of care, like the deployment of a multidisciplinary emergency heart attack response team for the handover of patients to the catheterization laboratory.[37] Electronic tracking software was also used to flag patients with conditions that require special treatment.[41,42] Some sites also physically co-located necessary pathway services or used visible physical indicators, such as a bright orange Fast Pass to identify chemotherapy patients.[41] Educational interventions were used in many sites to increase pathway compliance and competencies. Finally, feedback was given at the department and individual level based on compliance tracking results.[39,42]

Mechanisms

These interventions were intended to address a variety of barriers and rely on several mechanisms. A cited barrier to using evidence-based interventions was lack of knowledge and visibility.[43-45] Formalized communication, physical cues, education, and feedback all worked to improve knowledge,

communication, and visibility of the clinical pathway steps. Through process mapping and PDCA cycles, creating defined pathway steps, including communication protocols, and training clinicians to follow them, communication barriers were reduced and uncertainty, inefficiency, and delays were decreased.[35,36,46-48] Another mechanism is prioritization of patients with time sensitive problems, which was facilitated by formalized communication, authorizing clinicians to initiate pathways earlier, and electronic monitoring of patients with special needs.[39,46,49,50] Similarly, the barrier of inefficient sign-offs by inaccessible specialists was addressed by empowering clinicians to activate and take pathway steps upon identification of patients with time sensitive needs. In some instances, clinicians did not feel comfortable or had difficulty communicating with other professions and disciplines within or outside of the ED, impeding efficient treatment. Developing communication protocols for the pathway and providing feedback on their use helped to remove these communication barriers and increase collaboration.[37,40,46,47,50] Lastly, utilizing QI strategies and ongoing education and feedback allowed EDs to continue improving pathways and addressing barriers within their local context.

Outcomes

Outcomes from this strategy included process measures, quality indicators, healthcare costs, and patient outcomes. The accuracy of treatments for particular conditions was improved by the implementation of a pathway. Adherence to the pathway protocols and use of standardized evidence-based treatments were also positively impacted. The main quality indictor was the time to treatment for the acute conditions, which was the QI goal of many of the interventions. Healthcare cost and efficiency measures that were targeted included ED length of stay, readmissions to the ED, and admissions to the hospital as well as direct measures of cost. Patient health outcomes measured in several studies included mortality and physical functioning at discharge.

1.2.2 Add an ED Clinician to Address Specialized Patient Needs

A small group of articles studied adding a specialized clinician to the ED team to improve care for specific patient populations, namely domestic abuse,[51] patients requiring time sensitive medication needs,[52] and mental health patients.[53,54]

Context

The environmental context for these interventions was recognition of an unmet care need at the hospital, either by community and local government leaders[51] or by hospital leadership.[53] The existing staff was unable to fulfill the needs of the patients with its current resources and training.

Interventions

Consequently, the EDs introduced new types of clinicians, such as independent domestic violence advocates (IDVAs), mental health triage nurses, or pharmacists. Concurrently, these settings designed a process and educational initiatives to integrate the new role and overcome barriers of collaboration between professional groups. As an example, IDVAs were co-located in the ED with the rest of the clinical team and a standardized form was created to identify patients for referral to this service.[51]

Mechanisms

The interventions worked to improve recognition of patients with specific needs and to increase appropriate referral to resources. They also worked to build awareness of the new clinical skills available and to integrate each role into the work patterns of the ED.

Outcomes

The outcomes were improved patient referrals, staff satisfaction and professional rapport, and treatment of patient populations.

1.2.3 Specialized ED Team for Patient Subpopulations

The use of specialized ED teams is the last identified intervention group within the Patient Subpopulation articles focused on the care of patients with geriatric, cardiac arrest, pediatric, pediatric sexual assault, and behavioral health care needs.

Context

Leadership used these specialized ED teams to address issues for these patients such as their high cost and healthcare utilization, infrequent use of evidence-based treatments, lack of ED personnel expertise, and ED nurses experiencing violence by patients. Unlike the previous interventions, half took place at community hospitals while the others were at teaching hospitals. EDs implemented these interventions within the environmental context of government funding for geriatric care coordination teams in Australia,[55-57] the United Kingdom,[58] and the United States[59] and guideline recommendations by professional associations. Unlike the previous interventions, the only one of the articles involved formal QI processes.

Interventions

Like the pathways, the specialized ED team strategy involved several components. First, teams are designed to respond to particular patient needs. For example, the geriatric care coordination teams typically include a combination of physiotherapists, occupational therapists, social workers, speech language pathologists, nurses, pharmacists, and physicians often with special geriatric training.[55-59] EDs implementing these teams also identified or created methods to determine if the team should be activated and engaged in the care process, such as the Identification of Seniors at Risk (ISAR) to identify patients for consultation used by one of the geriatrics teams.[59] The teams then formalized processes to assess and treat patients, including the Code S process for potentially violent behavioral health patients, which involved a clinical assessment for patient needs and potentially medication, restraint, or seclusion.[60] Most EDs also used some degree of education for team members and other ED members about team roles and

processes. For example, one geriatrics team involved extensive training of the geriatrics nurse leader[59] while another used broader education for ED staff about the role of the care coordination team.[56]

Mechanisms

The main mechanisms identified to address barriers and change behavior were threefold. First, the formalized activation processes and education increased awareness of availability of specialized teams to meet patient subpopulation needs. The assessment tools and detailed processes for the teams also increased the identification of complex patient issues and improved the application of evidence-based treatments. In particular, the eCART intervention particularly had a goal of infusing the team processes with evidence-based protocols to improve adherence.[61] By formalizing processes and team members, the teams were also able to clarify individual roles and modes of communicating and interacting, which enhanced team functioning.

Outcomes

Several studies reported improved rates of patient screenings, evidence-based treatments and referrals to follow-up treatments. Time to treatment was also a measure that was improved by the team interventions. Staff satisfaction and morale increased due to the greater clarity and support felt from the formalized team roles and processes. Measures of healthcare utilization that were affected included ED length of stay, ED readmissions, and hospital admissions. Patient outcomes that improved were mortality as well as safety and satisfaction.

1.2.4 Improving ED Team Workflow

This intervention group includes studies that analyzed team workflow or implemented interventions to improve workflow more broadly. Improving team workflow was considered a strategy to address issues like reducing ED wait times and delays,[62-65] understanding the complexity of ED work within larger systems,[66-68] patient perceptions of ED team performance,[69,70] implementing and maintaining ED teamwork skills, [71-73] interprofessional collaborative activities,[15,74-77] and conflicting team goals.[78]

Context

These interventions and studies mainly took place in teaching hospitals with a small number of community hospitals and psychiatric specialty hospitals. Less than half of the articles documented the environmental or organizational context for the hospitals in which the studies took place. Several articles mentioned a four hour turnaround time regulation as the impetus for the intervention,[62,65,71,78] while others identified guidelines from professional or quality organizations that affect ED teamwork.[66,72] Some EDs had leadership initiatives to implement new teamwork interventions or improve teamwork skills.[62-65,71,72] Formal QI programs were used, including Lean and TeamSTEPPS, as well as process mapping, educational sessions, PDCA cycles, performance improvement coaching, and audit and feedback.

Interventions

These complex teamwork strategies involved many components. One component was formalizing team structures and allowing for adaptable team membership. The most common core team structure was a physician, nurse, and nurse assistant assigned to work together each shift.[63-65,71] Peripheral team members included telehealth consults,[74] inpatient physicians,[15,76] and community resources.[15,76] EDs also rearranged physical space to co-locate the core team and its resources.[64] Team processes were structured by the needs of the patient. For example, in some settings urgent patients were seen by both the physician and nurse simultaneously while less acute patients were seen sequentially.[64,71] Creating open lines of communication through processes and tools was identified as a key component.[62,66,68,69,72,73] One method of improving coordination and communication was the role of a team coordinator or flow manager, which required assigning tasks to an individual(s) or adding a new staff member to the ED. A nurse, physician, or clerk filled this role and was responsible for some or all of: assigning teams, monitoring time and electronic tracking system, reporting delays, prompting physicians to act, managing handovers, calling consults, and managing interdependency with inpatient wards.[62-65,67,68,71,75,78] Another strategy for team coordination and information sharing was team huddles, briefs, rounds, or continuous “check backs” with the team.[65,67,71,72,77] Electronic tracking systems were also used to manage team assignment, patient

flow.[64,67] Training for teamwork skills and ongoing education, monitoring and feedback was a critical element of several interventions.[62,63,66,68,71-73]

Mechanisms

These interventions worked to overcome several barriers to effective teamwork and improve outcomes. Formalizing team work and strategies to support coordination improved transparency of processes and roles or members of the team.[64,65] Consequently, the improved clarity helped to streamline processes, reducing delays, interruptions and redundant efforts.[64] Formalized coordination processes helped to improve information sharing[63,66,67,73,76] and the distribution of cognitive work to the appropriate members of the team, empowering them to participate with greater responsibility.[62,72,76] Effective teamwork also improved communication with patients because patients had greater trust and confidence in teams that worked well together.[69,70] Education and feedback focused on team skills and processes helped to gain buy-in from leadership and team members.[71,72,75]

Outcomes

Observed efficiency improvements included the numbers of patients treated and the turnaround time for patients, as well as time to see a provider or be treated.[62,65,66] Team performance indicators included staff cohesiveness, staff satisfaction, provider retention, and interprofessional understanding of roles.[63,72,74,75] Studies also observed greater adherence to teamwork behavior, greater situational awareness by team members, and decreased numbers of interruptions.[71] Finally patient trust and confidence were positively influenced.[69,70]

1.2.5 Improving the ED Triage Process

The triage process was a focus of several interventions. Leadership viewed triage as a means to address overcrowding in EDs, highlighting the fact that the complexity of ED and interdependencies between the ED and other hospital units also affect overcrowding (e.g., availability of inpatient beds).[79-81]

Context

Two articles noted that guidelines for ED triage did not account for the complexity of operations or align with actual practices.[82,83] These interventions were implemented within the context of 4-hour turnaround regulations in Australia, Dutch national guidelines for triage, and guidelines put forward and implemented by professional organizations and quality organizations. Hospitals formed multidisciplinary leadership teams to implement triage process changes and used QI techniques, including process mapping, clinical champions, educational initiatives, and audit and feedback. The studies were undertaken at both teaching hospitals and community hospitals.

Interventions

While the triage process can theoretically be simplified into a series of steps, the inflow of patients with highly variable needs means continual interruptions and re-prioritizations. EDs have developed multi-faceted interventions to deal with this complexity. A broad component of these interventions includes development and formalization of steps and tools to facilitate advancing through the steps amidst the fluctuating clinical environment.[79-82,84] A critical step to determine the acuity and urgency of the patients is the triage nurse assessment. In some EDs this assessment was conducted concurrently with medical evaluations by a team or a single provider assigned to rapid evaluation, so that bed assignment and orders could be placed faster for high urgency patients.[80,81,84,85] This requires hiring and/or assigning clinician(s) for the rapid evaluation and allocating space to this function, both of which could be resource constraints.[80,83] In another strategy was triage assessment to proactively assign patients to an ED team, reducing the dependence on physicians to "sign up" for a patient.[80] Several EDs used electronic tracking systems to help coordinate communication and patient flow.[79,80,84] Another approach was streamlining triage forms and using color coding and placement in specific locations to indicate prioritization.[82] Finally, EDs used educational sessions and audit and feedback to introduce and maintain the new processes.[81,84]

Mechanisms

Despite the unstructured and heterogeneous nature of ED work, formalization of triage steps and communication tools help to improve the efficiency of the team's work and communication and to increase transparency and monitoring of what should be happening, when, and by whom.[82] Rapid triage teams and patient assignment to teams also allows more efficient coordination of care, discussion of action plans, and upfront voicing of concerns.[85,86] Rapid evaluation is more responsive to patient needs, allowing earlier initiation of care plans for high acuity patients and expedited overall care.[79] Education, evaluation, and feedback are intended to improve skills for teamwork, gain consensus from staff for new processes, and reinforce progress towards goals.[81,83]

Outcomes

The outcomes of these strategies include improvements in length of time to see a provider, overall ED length of stay, reductions in the left without being seen rates, and increased patient satisfaction.

1.2.6 Improving ED Team Communication and Information Sharing

Several strategies focused on how teams communicate in the ED and interventions to improve team communication. Half of the studies were addressing the issue that effective team communication is critical for patient safety and preventing medical errors, while others explored the complexity of ED communication in general, particularly as related to the electronic medical record (EMR).

Context

All of the studies took place in teaching hospitals except one taking place in a rural regional hospital. Few of the articles elaborated on environmental or organizational context for the studies. Stated environmental pressures included regulatory guidelines about EMR usage in EDs[86,87] and hospital leadership initiatives to improve team communication skills,[88] increase EMR usage for information sharing[87] and to fill communication gaps.[89] QI processes involved included a failure mode effects analysis to analyze communication gaps[89] and informal identification of barriers.[88]

Interventions

Two of the hospitals implemented new interventions while the remaining studies were analyzing processes already in place. Consequently, this analysis identified more general strategies than interventions. A common theme was examining how clinicians work in the ED and facilitating communication methods that matched the work. A theme was that ED teams are loosely formed team collaborations where core members belong to multiple teams and bring in periphery members as needed.[90] Other studies explored how multiple team members engage in collaborative information seeking behaviors when communication involves problem solving versus questions with readily available information.[91,92] Another aspect of electronic communication noted was that clinicians rarely look in multiple places in the EMR or at lengthy EMR notes for information and favor verbal communication.[87,89,93] More specifically, nurses expect to utilize the EMR as a mode of information transfer while physicians view it as a tool for information storage and do not look to retrieve information there.[86,93] From these observed behaviors arose strategies for information technology and communication forms more broadly. One strategy was integrating information systems needed for ED operations (triage, tracking, reporting, and lab results) and having all information available at the point of care.[87] Customizing the information system interface to allow information sharing and collaborative information seeking was another strategy.[86,92] Matching modes of communication to the needs of changing ED teams is another strategy, including such methods as face-to-face interactions when team awareness is necessary, overhead pages when team members can decide on urgency, or role-based communication via pager for targeted communication.[90]

Mechanisms

Integrating the EMR and simplifying the design of the interface allows more efficient information sharing and improves decision making at the point of care.[86,87] Beyond the EMR, matching modes of communication with team needs improve the functioning of the team because information can be targeted to the individuals who need it, reducing interruptions, or broadcast to allow team members to choose to be

interrupted.[90] Helping clinicians across the professions to understand how they currently communicate and how they could communicate more effectively helps to develop a common understanding for information technology and communication tools.[93] Effective communication among team members in turn improves communication with patients and patient understanding of their ED experience.[88]

Outcomes

Although few of these observational studies included outcomes, a major outcome that was improved was communication efficiency.

1.3 DISCUSSION

This review provides a multitude of team-based strategies to improve quality, healthcare utilization, and outcomes in the ED. All of the identified interventions are complex, multi-component interventions that are not conducive to randomization without a costly, time-consuming multi-site study. This RRR draws together knowledge from over 60 EDs around the world to increase our understanding of how these interventions work and how they affect outcomes across a variety of organizational and environmental contexts. Rather than controlling for context, we embrace it as an important explanatory factor for quality improvement initiatives. Although none of the interventions are novel, our analysis of them in relation to ED teams sheds new light on their applications.

The data synthesis of the included articles uncovered many I-C-M-O configurations that can influence the effectiveness of a team-based ED intervention. We have shown that policies and guidelines by professional and quality organizations can influence the implementation of interventions. The role of hospital and ED leadership to carry out quality improvement efforts and provide education and feedback for continuous improvement is critical to gaining buy-in and sustaining the interventions. While many of these interventions took place at academic medical centers and teaching hospitals, a broad range of hospitals types was represented, and the interventions have components that can be generalized outside of the academic setting. A common component of many interventions included adaptable teams that

empower members across the interprofessional team to dynamically respond to patient needs. Educating teams on effective communication and formalizing communication processes helped to improve timely recognition of patients, bring in outside resources when needed, improve clinical decision making, and improve information sharing. Tools, such as electronic tracking system, the EMR, documentation templates, and physical signs, improved knowledge of care processes and evidence-based treatments, as well as identification of patient needs and timeliness of care.

These interventions and mechanisms addressed outcomes that are of importance to policymakers and practitioners. Clearly overcrowding and delays are of national concern in many countries. These interventions work to address length of stay and throughput measures. Furthermore, the use of evidence-based approaches to provide high quality care in the ED has been a recent focus of the Centers for Medicare and Medicaid Services and other regulatory bodies. Several of the interventions specifically focus on processes to increase the accuracy and timeliness of evidence-based interventions for acutely ill patients. Finally staff and patient satisfaction are both critical measures for employee efficiency and retention and patient outcomes.

1.3.1 Limitations

This RRR draws as much information from the studies as possible to develop the I-C-M-O function, however, no article fully documents all of these linkages and many omit certain elements entirely. The authors have synthesized the literature across these studies to theorize these connections. We have also limited our review to articles from the past ten years available from a set of databases. While we believe these articles to be clinically relevant for current practice patterns, it is possible that our search did not include all articles. An RRR also does not assess the quality of the research in the included articles. While we have linked commonly observed interventions and mechanisms to observed outcomes, the effects of these interventions are not proven.

1.3.2 Conclusion

We have reviewed extensive literature to uncover interventions and strategies that improve the functioning and outcomes of interprofessional and multidisciplinary ED teams. The RRR also considers the motivations and contexts for these interventions to allow policymakers and practitioners to adapt the interventions to their particular environment. Our results indicate that many of the interventions are commonly known QI strategies that can be contextualized for the urgent nature of the ED and improve ED-specific outcomes.

2 ORGANIZATIONAL AND ENVIRONMENTAL CONTEXT FOR INCLUSING ADVANCED PRACTICE PROVIDERS IN UPMC HOSPITALIST MODELS

2.0 INTRODUCTION

Over the past twenty years, the shortage of internal medicine and family medicine physicians, reduced hospitalization rates, caps on resident hours, and payer incentives to improve inpatient costs and care quality, have all contributed to the nationwide increase in hospitalists with over 30,000 currently in practice.[94-99] Nurse practitioners and physician assistants (advanced practice providers or "APPs") have also taken on larger roles in the provision of general medicine inpatient care, changing how hospitalist physicians practice.[100-103] The rapid adoption of new hospitalist models in the United States suggests that the challenges facing hospitals and health systems are instigating change at the organizational and at the health care system level.

While many studies have looked at the direct cost and clinical effects of new hospital medicine models of care, few have studied the context for these models.[18,19] The models and their effect on outcomes can vary greatly with some studies pointing to growing concern about the ability of hospitalists to effectively communicate with and transition to community-based primary care providers.[104-108] This indicates the importance of studying their variability. The provision of inpatient care encompasses an array of interdependent forces with complex historical political, clinical, financial, legal and social contexts that can vary between hospitals and health systems.[109] This study aims to embrace the complexity inherent in healthcare and describe models of hospitalist care utilizing APPs and contextual factors related to implementation of new hospital medicine models.[5,109-111]

UPMC (University of Pittsburgh Medical center) is the second largest integrated healthcare delivery system in the United States. Like many health systems, it utilizes hospitalists in the majority of its 22 hospitals. Four years ago, UPMC formed the Office of Advanced Practice Providers to manage recruitment, training and placement of APPs throughout the health system. One role for APPs that has

been expanded quickly in the past three years is in hospital medicine; however, we have anecdotally observed that APP hospitalists are being utilized differently across the health system. This expansion provides an opportunity to study the variation of the hospital medicine models between the hospitals to better understand the context in which they are being implemented. The study will also contribute to UPMC's quality improvement efforts around hospital medicine and inform the larger health system and hospital medicine community.

2.1 METHODS

We utilized a multiple case study qualitative approach to describe and develop theories about changing models of hospital medicine care across two purposively chosen UPMC hospitals.[111-114] Organizational and environmental context are important factors within the fields of implementation science and organizational studies.[5,115] While certain aspects of context have been studied in great depth, no instrument exists that allow identification or quantification of a range of contextual factors driving change. We utilized qualitative methods to capture the complexity inherent in organizational change and to explore relationships between emerging themes.[112,116] Specifically, we used both field observation and semi-structured interviews to collect data. Field observation allowed us to directly observe the hospital medicine program in action at each hospital and to understand the context for the questions that we asked in the interviews.[116] Subsequent semi-structured interviews allowed us to ask about changes in the program and probe for clinician and management perspectives on the program that may not emerge in day-to-day practice.[116,117]

2.1.1 Sampling

To maximize environmental and organizational variance between cases, we selected two UPMC hospitals by the following variables: (1) use of hospitalist APPs, (2) urban and rural location, (3) hospital type. Hospital 1 is a rural community hospital that has integrated APPs into its hospital medicine practice for five years. Hospital 2 is a suburban tertiary care hospital that has recently integrated APPs into its hospital medicine program in the past year. Within each hospital, we used a purposive heterogeneous sampling

strategy to maximize the number of unique perspectives that we captured about the change in the hospital medicine program.[118] The sample for each hospital included a hospitalist physician, an APP hospitalist, a nurse manager or case manager, and administrative leaders directing the program. We also interviewed three individuals from management at the UPMC system level for the system perspective.

2.1.2 Conceptual framework

To select the topics and questions that we included in the semi-structured interviews, we conducted a brief literature review across several disciplines to find frameworks that include contextual drivers of change. From this review, we chose four defined frameworks that include an array of environmental and organizational constructs.[5,115,119-121] We aggregated all of the explanatory factors that contribute to change in healthcare organizations and constructed questions that address the major constructs, listed next to the interview questions in Table 2-1.

Table 2-1. Interview Guide

Construct	Question
Introductory	1. Please describe your role within hospital medicine at [Facility]
Structure	2. What are the other roles in the hospital medicine program at [Facility]?
Structure	3. What do you think are the most important processes within the hospital medicine program at [Facility]?
Environmental norms	4. How is your hospital medicine program similar to or different than your peer hospitals'?
Structure	5. How has your hospital medicine program changed over the past three years?
Absorptive capacity	6. What do you think are the factors that contributed to these changes?
Culture and climate	7. How have the members of the hospital medicine program responded to these changes?
Patient needs	8. How have the needs of your patients been included or not included in decisions about the hospital medicine program?
Organizational goals	9. Please describe [Facility] or UPMC leadership involvement with the hospital medicine program and its changes?
Resource availability	10. In what ways to you think the changes have affected the hospital medicine program financially?
	11. How is the performance of the hospitalist program being measured?
	12. Do you have any advice about how the hospital medicine program might change in the future?

2.1.3 Data collection

For the field observation, one researcher observed an APP hospitalist at each hospital for nine hours to capture the breadth of their job and interactions throughout a normal day. Prior to observation, we

collaboratively developed an observation template to capture both structural and interaction aspects of the two hospitalist programs. Structural pieces included the time, hospital location, job (e.g., rounding), and tasks completed. The interactions included all interactions that the APP had with other hospital employees and included the title of the person with whom the interaction took place, the content, and any feelings conveyed (e.g., warm tone of voice). Throughout the observation time, the researcher hand wrote field notes into the observation log.

For the semi-structured interviews, one researcher conducted 35-50 minute telephone interviews with all interviewees, totaling 14 individuals, between February and April 2015. All interviews were audio recorded. Before the interview began, the interviewer informed the interviewee of the purpose of the interview, how the results would be used, ensured confidentiality, and obtained consent. The interviews were based on the interview guide in Table 2-1 with probing questions interspersed. The questions were pilot tested with an administrator at UPMC. Interviews with the clinicians and administrative leadership were scheduled and conducted over a three month period. The audio recordings were transcribed to capture verbatim content while excluding extraneous utterances not additive to the meaning of the spoken words. Transcription resulted in 112 pages of single-spaced text.

2.1.4 Data analysis

We aimed to generate major themes from that data that would be useful to a hospital medicine practice-based audience. Consequently, we employed an approach called qualitative description that also seeks to generate themes that are "close to the data" without applying an overarching theory.[122-124] Two researchers not involved with the hospital medicine program reviewed all data and independently developed codes. These researchers then met to compare codes and used an iterative approach to negotiate consensus on a final code list. Next, one researcher used the codebook to systematically code all of the observation and interview data, using Atlas.ti software. We then grouped the data into major thematic categories and subcategories and extracted quotations for descriptive narrative.

This study was approved by the UPMC Health System Quality Improvement Review Board.

2.2 RESULTS

This study uncovered several organizational changes occurring within hospital medicine at the two hospitals – this study will focus on the results relevant to the integration of APPs into hospital medicine. Through the observation and interviews we identified three unique models of how APPs are deployed in hospital medicine, included in Table 2-2, which we termed the "Team Approach," "Divide and Conquer," and "Hybrid." Hospital 1 mainly utilizes the Team Approach where the hospitalist physician and APP round, document, and admit together. Hospital 2 uses one PA hospitalist with the Divide and Conquer model in the observation unit, and he rounds, documents, and admits independently with hospitalist physician contact as needed, mainly through text messages, phone calls, and brief meetings. During the study, this PA was re-deployed to an admitting only role in the emergency department, again with physician contact as needed. In a general medicine unit of Hospital 2, an NP under a Hybrid model works both side-by-side with and independently from the hospitalist physician as volume in their unit changes. Our analysis found environmental and organizational contextual factors that contributed to the differences in these models. We also noted differences in the processes and perceived outcomes of the models. The themes and subthemes are presented in Table 2-3.

Table 2-2. Characteristics of Different APP Hospitalist Models at UPMC

	Hospital 1	**Hospital 2**	
Hospital Medicine Program Daytime Staffing	2 hospitalist physicians with 2 APPs	6 hospitalist physicians with 2 APPs	
Models	Model 1 – Team Approach	Model 2 – Divide and Conquer	Model 3 - Hybrid
Year Implemented	2008	2014	2014
APP Type	Physician assistant	Physician assistant	Nurse practitioner
APP Location	Intensive care and general medicine units	Observation unit or emergency department admissions	General medicine unit
APP Hospitalist Working Style	Side-by-side with hospitalist physician	Independent with intermittent hospitalist physician contact	Both side-by-side with and independent of hospitalist physician
APP Schedule	12 hour days, seven days on-seven days off, staggered with physician	12 hour days, seven days on-seven days off, staggered with physician	8 hour days, weekdays
APP Management	Chief of Hospital Medicine	Hospitalist Physician APP Residency Director	Director of Nursing

Table 2-3. Themes, subthemes and quotes related to APP hospitalist models at UPMC

Themes	Subthemes	Quotes
1. Environmental contextual factors are increasing APP usage in hospital medicine	1.1 APPs can supplement hospitalist physician shortages	**System physician assistant:** "Although we talk about a primary care and physician shortage, there's definitely a distribution issue of what we currently have. There are currently nine jobs on the market for every hospitalist … unless we are able to come up with a new model of care that does use APPs and has less physician responsibility, we're going to have a huge problem in the inpatient environment." **Hospital 1 physician assistant**: "You'd only have a doc for maybe one of two days and then you'd get another one maybe for the whole week and then the next week would be someone different. So yeah it was a little more fragmented … I was kind of the main player." **Hospital 2 nurse practitioner**: "It's really hard for just one person to come up and do all of this, you know, see all the patients, do all the interactions with the staff, do all the interactions with the consultants, you look at everything. I think we're just like the right hand person for the doctor."
	1.2 APPs can improve inpatient efficiency	**System administrator:** "With the new changes in healthcare, we expect patients to have lengths of stay in hours and not days. So it's nice to have more hands on deck to help follow up and this is something that you don't, a physician alone is hard to do." **Hospital 2 administrator:** "I think there's an overarching belief that we need to be as efficient as we can from a cost standpoint and a structure standpoint, and utilizing APPs effectively in the healthcare team is an overarching UPMC goal." **Hospital 2 nurse practitioner:** "And if you do any of the reading and any of the projections, they say that mid-levels are really going to help with costs, keeping costs down."
2. Organizational contextual factors are shaping hospitalist APP usage	2.1 UPMC APP system initiative	**System administrator: "**The APP program itself is new out there [Hospital 2], our two new APPs went out there in June of last year for the residency program and then one of them stayed on and we hired a new one in November so that itself is very new, we just started that last year." **System physician assistant:** "I don't think there's a very good communication between what the end-all be-all plan is for the role of the APP going forward. I think it's been improving ever since the Office of Advanced Practice Providers was created … but as far as is there a coherent message about the ultimate plan, about the role utilization, the growth – of particulars about how we're going to be used, how much we're going to paid, what we're expected to do, number of APPs in practices versus number of attendings, and all of the nuances that go into developing the role, I don't think there has been any communication." **Hospital 2 administrator:** "We were looking at expanding our APP role here at [Hospital2], I sent out a query to find out what they were doing in other parts of the country, to find out how they were utilizing APPs, and I was sort of surprised that a lot of parts of the country are really not utilizing APPs as much as we are." **Hospital 2 physician:** "Initially through the e-mails and [our chief

Table 2-3 continued

		hospitalist] who is our coordinator here, the chief hospitalist, we got more information. But we did have a couple of meetings with [system hospital medicine administrator] who has actually presented about this, APPs in our hospitalist group."
	2.2 Physician experience drives APP hospitalist models	**Hospital 1 physician: "**The team that [one PA] is on is usually fill-ins from other hospitals or locums … and so these again are people that aren't comfortable working with PAs, they have less guidance for him, so they're happy turning him loose and letting him do his own thing." **Hospital 1 physician assistant:** "Part of the reason that I think we do what we do [team rounds] is initially with so many people, I found it easier, they found it easier because they didn't know the people here, they didn't know the system well. So I was like 'Let's go see these people together, I'll be right there, you'll be right there if anyone's got questions.'" **Hospital 2 administrator:** "Each doctor had in their mind what they thought [the model] should be … and [the APPs'] responsibilities changed somewhat, and that's part of my dismay, depending upon the physician working." **Hospital 2 nurse practitioner**: "I'm able to do a lot more than some of the doctors are willing to let me do, and I have other doctors that would probably let me do more than I feel comfortable doing."
3. Perception that APP hospitalists improve hospital medicine processes and outcomes	3.1 APPs improve interprofessional communication	**Hospital 1 administrator:** "This is one of the most cohesive groups I've seen from the viewpoint of the APPs and the physicians working in harmony, same minded in their approach, and really feeling the collegiality and the collaboration." **Hospital 1 physician:** "You get more direct responses to nursing questions and clinical questions. So it's just little things that would take so much time if you page somebody, and they don't know the answer, and then you page someone else, and then there's a delay in that person getting back to you … So it decreases confusion, simplifies answers, and it speeds the turnaround time." **Hospital 1 nurse manager**: "[APPs] kind of go in between and I do like that process, they are easier to get ahold of, we have pagers out to them and they will answer us, and they will contact the doctor if they need further information and then relay that back to me instead of me interrupting the doctor all day long." **Hospital 2 physician assistant:** "The nurses I think they love it, maybe a little too much, because I'm always there to answer questions instead of call and find somebody… The specialists are usually very happy because they have somebody they can find if they need to ask me a question or tell us something about their ideas."
	3.2 APPs improve patient experience and satisfaction	**System physician assistant:** "In an inpatient setting specifically the attending physician may not have the amount of time required to adequately explain things to the patient at the bedside about what's going on, how it's going, and what the outcomes are. I would say that across the board, advanced practice providers have been doing that, they have the time available … I think that that definitely improves patient satisfaction and probably to an extent patient outcomes." **Hospital 1 physician:** "We're standing there side by side, she's

Table 2-3 continued

		[PA] got an iPad, we're both in direct, facing the patient and the family, and we take turn fielding questions. So I give my main spiel with the patient, and then sometimes I'll fill in with the spouse or a family member, and if someone has a follow up question, I'll pause, and if she just jumps in and picks up the ball, she'll go on with education and instruction." **Hospital 2 administrator:** "I mean I think that as value based purchasing and all of the, the fact that patient experience is going to play a significant role in how hospitals are compensated moving forward puts the patient at the forefront of every decision that we make, including the hospitalists. So certainly, traditionally APPs have had a little bit more time to communicate details, I mean I've seen programs where APPs work at the time of discharge to spend a significant amount of time making sure that the patients follow up care is appropriately arranged, and they understand their discharge medications." **Hospital 2 nurse practitioner:** "And the other thing I have found over the years is that a patient will talk to me because they don't think they're wasting my valuable time. Where when a doctor comes in they feel like they can't spend a lot of time talking to him because his time is more valuable … A lot of folks, especially the older folks, don't feel that the doctors are approachable or don't have the time to answer the questions like we do." **Hospital 2 nurse practitioner:** "Some of the hospitalists their culture is different and also some of them have a language barrier. You know, they don't understand the quirks in the language. Like somebody said something Monday and the doctor looked for me to explain what the patient meant … Or the doctor will say something and the patient will look at me like 'I don't understand what he said.' So I'll say 'He is saying such-and-such.' I'm sort of like an interpreter in those instances."
	3.3 APPs improve cost, efficiency, and quality	**Hospital 1 administrator:** "It might be, in theory you could say it's a little more expensive to do it in the team, but from a quality standpoint if you're able to keep your length of stay down, if you're able to keep your readmissions down then that's the balancing act that you're looking at for this whole thing." **Hospital 1 physician:** "I'm seriously considering that you would have 50% greater capacity because it's not just doubling it because there's still stuff to do and there's still slowdowns and interruptions and so forth, but I can safely say 50% increase in my productivity by having an extender. And I also think that details are not missed and things are done in a more timely fashion so we could see those 20 people with better quality." **Hospital 2 administrator:** "If operationalized appropriately and efficiently, improving the efficiency of the hospital stay, shortening the hospital stay, coordinating the discharge, decreasing readmissions, I think all of those are opportunities that could be realized."

2.2.1 Environmental Context for APPs in Hospital Medicine

Staff at both hospitals identified scarce hospitalist resources and cost and efficiency environmental pressures as drivers for the implementation of APPs in hospital medicine. Administrators and clinicians viewed the role of APPs as a means of supplementing hospitalist physician resources. At Hospital 1, the rural hospital medicine program faces challenges hiring and retaining physicians and relies on a stable APP staff from the local community and the Team Approach to orient and work with new physicians. The longest tenured PA at the hospital viewed the Team Approach as a pragmatic outcome of her efforts to integrate a stream of new physicians into the program over time, which then evolved into the normal practice at the hospital. At Hospital 2, increases in hospital census and patient complexity were overburdening the hospitalist physicians. They were routinely calling in physicians to work during their time off or paying expensive temporary staff to increase their clinical capacity. APPs were viewed as a means to cover tasks, such as managing observation patients or admitting, to reduce physician workload without adding permanent physician staffing.

At the same time, the health system was feeling pressure to improve quality metrics and efficiency measures, such as length of stay, due to reimbursement changes. This theme was mainly prevalent in Hospital 2. Administrators identified APPs as a means to provide more efficient management of patients, in particular their ability to respond quickly to questions and follow-up on tests is expected to improve the efficiency of discharging patients. Achieving the optimal mix of physicians and APPs was also considered more cost effective from a labor perspective than a physician only model.

2.2.2 Organizational Context for Hospitalist APPs at UPMC

Within the past four years, UPMC has built corporate infrastructure around hospital medicine services and around the training, placement and management of APPs across the health system. One initiative from these two groups was to increase placements of APPs into hospitalist medicine through recruitment and also through an APP hospitalist residency program. We found that UPMC system leadership held informational in-person meetings and webinars with hospital leaders to introduce different models of

APPs in hospital medicine. Administrators at the hospital felt unclear about the best model for their hospital and sought advice from their colleagues in other health systems. Information from hospital leadership was communicated to clinicians through e-mail, meetings, and word-of-mouth. Due to the rapid expansion in APP utilization across the system, clinicians were unclear about the expectations for APPs and improvised at their own locations.

The main determinant of the role of hospitalist APPs is the past experience of the physicians with APPs. At Hospital 1, we observed that the PA with experience in the Team Approach guided new hospitalist physicians to utilize that approach. Experienced hospitalist physicians used to independent rounding, however, were more likely to use Divide and Conquer. At Hospital 2, there was also variability in the APP hospitalist models because of differing physician ideas about their skills and their role.

2.2.3 Perceived Processes and Outcomes of APP Hospitalist Models

Hospital staff expressed multiple changes in processes and outcomes related to APP hospitalists. One process that was affected by APP hospitalists is interprofessional communication. At Hospital 1 the cohesiveness of the Team Approach was perceived to improve the timeliness and accuracy of responses to nursing and other clinicians. At Hospital 2, the constant presence of APPs in observation and general medicine units was also perceived to improve communication with nursing and specialists. The clinicians indicated that involving APPs in hospital medicine enhances interactions with patients. With the Team Approach, APPs were purported to improve the richness of the patient-physician interaction by removing distractions and providing additional education to family and caregivers. APPs dedicated to a unit in the Divide and Conquer approach were also able to spend more time with patients and for questions and deeper explanations. The APPs also felt that they improved patients' confidence in asking questions and helped to overcome cultural barriers with foreign physicians. Finally, including APPs in hospital medicine is perceived to improve cost, efficiency and quality. Specific outcomes include increased hospitalist physician capacity at a lower labor cost, decreased medical errors, improved discharges processes, and reductions in length of stay and readmissions.

2.3 DISCUSSION

This study highlights UPMC's widespread integration of the APP hospitalist role. We found variation in the contextual factors that drove implementation of the APP hospitalist models and resulting variability in the structure and perceived outcomes of the models. The identified environmental contextual factors contributing to the implementation of these models are hospitalist physician shortages and pressures to increase inpatient healthcare efficiency. The physician shortage in the rural hospital resulted in a "bottom-up" formation of the Team Approach to overcome operational difficulties with physician turnover. At the suburban hospital, a "top-down" organizational initiative to improve efficiency introduced the APP hospitalist role into the program. Leadership at that hospital implemented the Divide and Conquer and the Hybrid models based on their perceived needs within hospital medicine and their knowledge of APP skills. While previous studies have identified environmental factors that lead to use of APP hospitalists,[125] this is the first study to begin unpacking the context of why and how these APPs are used.

Both hospitals perceived that the APP hospitalist models were improving interprofessional communication, patient experience, and efficiency but through different mechanisms. Effective communication has been proven time and again as a critical component of high quality teamwork in healthcare.[126] The Team Approach model improves communication by having two individuals fully knowledgeable of the patient and the care plan, increasing the likelihood that other clinicians will be able to reach one of them for questions. The Divide and Conquer approach allows the APP to be dedicated to particular unit or set of patients, and the increased presence makes him more available for questions from other clinicians. Related to the communication improvements, the models were also perceived to improve patient satisfaction because with the Team Approach, having two individuals for the examination reduced interruptions and allowed greater focus on the patient and more thorough answers to questions. The Divide and Conquer approach again increases availability of the APP for patient questions and follow-up. Finally, one benefit the Team Approach offers that was not matched in the Divide and Conquer approach was the reduced errors through constant double checking of each other's work.

APPs are being utilized across the healthcare system and are a growing component of the healthcare workforce.[127,128] While APPs have been in existence as a profession longer than hospitalists, the roles and tasks that APPs take on are little understood.[129] Previous studies have suggested that APPs in hospital medicine may reduce costs,[102,103] but there is little information on how the APPs were utilized. This study begins to build hypotheses about different models for APP hospitalists and metrics that those models can improve in hospital medicine. Furthermore, we provide a description of UPMC's process of building organizational infrastructure and implementing APPs in hospital medicine as a strategic initiative. One notable early barrier to this strategy is the lack of understanding about APP roles and expectations at the hospital level. Implementation strategies such as ongoing education or clinical champions could work to overcome this barrier.

2.3.1 Limitations

A limitation of the current study is the small size of the sample observed and interviewed. We have anecdotally heard of a multitude of different APP hospitalist models across UPMC and nationwide. Building on the present study with additional sites would reduce the bias of the small sample. The study also relies on the perceptions of administrators and clinicians about how the APP hospitalist model will affect clinical and financial outcomes. This study is intended to be hypothesis generating and draw out the organizational rationale for these changes versus suggesting that the rationale has been empirically proven. Future quantitative analysis that compares patient and financial outcomes across hospital medicine models could provide further insight about the relative performance of the different hospital medicine models.

2.3.2 Conclusion

In conclusion, we provide insight into different APP hospitalist models used at UPMC. We analyzed contextual factors, such as physician shortages and cost pressures that hospitals commonly face, and suggest that these models might help to meet those challenges. Based on the perceptions of the clinical staff, it is also suggested that incorporating APPs into the hospital medicine team could improve team

communication, patient satisfaction, and quality of care. These findings are relevant for hospital leadership considering implementing APP hospitalists in their facilities.

3 COMPARING ADVANCED PRACTICE PROVIDERS AND PHYSICIANS AS PROVIDERS OF EVISITS

3.0 INTRODUCTION

The number of providers using telephone, e-mail and videoconference technology (eVisits) to deliver primary and chronic care services is rapidly increasing. The confluence of technological advances, provider acceptance, patient demand and reimbursement changes have driven a projected 400 percent increase in eVisits in just the past two years.[131] eVisits are defined as structured electronic communication with a clinician to gather information on patient history and symptoms, develop a diagnosis and potentially prescribe therapeutic management. Early eVisit studies have shown improved communications, chronic disease management and access to care,[132] as well as indications of lower costs;[133] however, quality and patient safety issues are still of concern. [134-136] While eVisits may fit better into busy lifestyles and decrease the reliance on physician office visits, questions persist around whether practitioners are adequately trained to diagnose patients electronically or provide continuity of care with a standalone model.[135]

Significant variation exists between eVisit programs, and these differences are important for understanding the cost, quality, and health outcome implications of these programs. Based on the published literature, this variability is mainly attributable to health system decisions about the types of patients accepted, the mode of the eVisit (e-mail, phone, videoconference), cost, decision support algorithms, and the types of practitioners providing services. [137-141]As the use of eVisits has exploded, the number of health systems staffing these services with advanced practice providers (APPs) is also increasing. APPs were defined as a group in 1998 by Cooper *et al* with "traditional" APPs including nurse practitioners, certified nurse-midwives, and physician assistants.[142,143] This group is broadly defined as licensed, independent providers that are not physicians.[144,145] Since the 1990s "advanced practice

provider" has emerged as a commonly used descriptor for this group, although the grouping itself is contentious among the individual professions.[145,146] For this study, we will focus on nurse practitioners and physician assistants as the APPs involved with eVisits.

Scope of practice expansions in many states and reimbursement of APPs by government and private payors are making the deployment of APPs in primary care more attractive to health systems and practice groups.[147] Although previous studies have compared patient characteristics and health outcomes between APPs and physicians in traditional primary care settings,[148-150] to our knowledge no prior study has compared APPs and physicians in the context of eVisits. To fill this gap, we will analyze variability in patient characteristics, conditions treated, and prescribing between types of eVisit providers, physicians and APPs, providing services to two UPMC AnywhereCare eVisit programs: Continuity and Convenience.

3.1 METHODS

3.1.1 Program Description

UPMC's original eVisit program, Continuity, utilizes internal and family medicine clinic-based physicians to deliver eVisit services. An earlier version of this program has been introduced in previous publications by Albert *et al* and Mehrotra *et al* .[139,141,151] Continuity is available for all primary care practices in the UPMC system, but patients must have an established UPMC primary care physician to access it. The new eVisit service, Convenience, introduced in November of 2013 is available to any person aged three years and older residing in the Commonwealth of Pennsylvania, see Table 3-1. It primarily utilizes UPMC's Emergency Resource Management Inc. (ERMI) APPs and urgent care physicians to provide services during the daytime (6am to 9pm) and emergency medicine (EM) physicians at nighttime (9pm to 6am).

Prior to the launch of UPMC AnywhereCare, eVisits were only available by signing into an existing MyUPMC patient portal via HealthTrak, an application of Epic Systems MyChart (Verona, WI). Now existing patients can sign in via their MyUPMC account or a new patient can create an account online

through the AnywhereCare website. For both Continuity and Convenience, patients initiate an eVisit through an online questionnaire.[152] Patients are directed to seek emergency care for life threatening conditions, including chest pain, trouble breathing, or weakness on one side of the body, and an office visit for follow-up to a recent surgery or procedure. Next, patients are asked to select one or more of 38 symptoms or "none of the above," grouped as general, head, body, chest, stomach, ear, skin, urinary, vaginal and other. After this selection, an algorithm of closed-ended and open-ended questions about the symptoms gather information for diagnosis and to identify conditions appropriate for treatment by the eVisit program or to triage patients to other settings. The algorithm has been coded to include conditions that can be accurately diagnosed and have highly efficacious treatment via electronic care. After the symptoms algorithm, patients are asked to verify (for existing patients) or enter (for new patients) contact information, pharmacy of choice, other current health issues, medications, and allergies.

Table 3-1. Comparison of UPMC eVisit Programs Summary Characteristics

	UPMC AnywhereCare, Continuity	**UPMC AnywhereCare, Convenience**
Providers	Physicians	Nurse practitioners, physician assistants, physicians
Conditions	38 conditions	38 conditions
Patients	UPMC primary care patients	Residents of Pennsylvania
Mode	Secure messaging	Secure messaging and videoconference
Launched	2008	2013
Price (without insurance)	$38	$38

The next phase is communication preferences where existing patients can choose whether they would like their request to be sent to a team or care providers (Convenience) or one of their primary care physicians (Continuity). New patients are only allowed to access the team of care providers, defined on the website as Pennsylvania based and licensed providers, including Certified Registered Nurse Practitioners, Physician Assistants, and certain physicians.[152] The website indicates that the Convenience service provide a response in up to 30 minutes and allows video consults while the Continuity service has a one business day response time and no video consult available. For established UPMC patients, this presents a choice between an eVisit with their physician and a timelier eVisit with an APP or EM physician.

Existing patients utilizing Convenience and new patients are then asked whether they prefer to communicate via a video consult or secure message. Patients are notified of secure messages and video consults via personal e-mail, but the messages and video consults are only delivered through the secure MyUPMC patient portal. Finally, patients make a payment, as applicable, and submit their eVisit request.

Incoming eVisits for the Convenience program prompt a notification via pager to the clinicians on call. While Continuity provides a response from the physician within 24 hours, usually during daytime hours, Convenience provides a response within 30 minutes at all times. All eVisit clinicians provide services using an application within Epic Systems software. Once an eVisit is accepted by a provider, the provider can see the results of the patient's questionnaire and an evidence-based Smart Set, based on the symptoms, that includes diagnosis, a progress note, follow-up orders and patient instructions. If the patient is a UPMC Health Plan patient, the provider is also able to review his or her electronic medical record. eVisit providers can communicate with patients through the myUPMC patient portal and place electronic orders for tests and prescriptions.

3.1.2 Data

We analyzed all eVisits and eVisit providers for both the Continuity and Convenience programs between November 4, 2013 and August 4, 2014, utilizing data from UPMC's outpatient electronic medical record and patient portal system, Epic Systems MyChart. During this time there were 2,184 unique eVisit records, representing 1,831 individual people. The Convenience service is available to all residents of Pennsylvania, however, users are primarily from the UPMC catchment area in Western Pennsylvania. There are 115 unique clinicians providing eVisits across the two services, made up of 83 primary care physicians, 17 EM physicians, and 15 primary care APPs. This study was approved by the UPMC Health System Quality Improvement Review Board.

3.1.3 Outcomes

To compare eVisits by different types of providers and across the two services, we considered several outcomes measures. First, we determined the volume of eVisits and calculated a mean, high and low

number of visits per provider. Then we found the percentage of visits initiated during daytime hours, considered 6am to 9pm. We calculated the response time in hours by subtracting the time the message was received from the time to which the message was replied. Next, we classified the top four conditions with the following ICD-9 codes, as used in previous literature:

- Sinusitis 461.0-3, 461.8-9, 473.0-3, 473.8-9[141,153-156]
- Upper respiratory infection (URI) 465.9[153,156,157]
- Urinary tract infection (UTI) 595.0, 595.9, 599.0, 788.1, 788.41, 788.63[141,158,159]
- Bronchitis 490, 466.0[156]

Finally, we considered the number of medications prescribed by the provider types as a whole and by the top four conditions.

3.1.4 Covariates

The key independent variables for this analysis are the provider type and service type. Other covariates that we observed directly in the data are patient characteristics, including age, gender, marital status, and race. We estimated patient income using the mean income by zip code of residence from the 2008-2012 American Community Survey 5-Year Estimates. We assigned a measure of urbanicity by applying the 2006 National Center for Health Statistics' Urban-Rural Classification Scheme for Counties to each patient's county of residence.

3.1.5 Statistical Tests

We limited our sample to include only completed eVisits. We created cross frequency tables by provider type and service type to analyze differences in terms of number of eVisits, percentage of daytime eVisits, response time in hours, patient characteristics, types of eVisits by condition, and number of prescriptions. We then conducted multivariate analyses and used the t-test to compare age, income, and urbanicity and chi-square test to compare other patient characteristics and conditions among the provider and service types. Finally, we conducted the Kolmogorov-Smirnov goodness-of-fit test for the prescription data to

determine if it is normally distributed. To estimate the effect of provider and service types on number of prescriptions, we utilized an ordinary least square linear regression for all diagnoses together and then for each of the top four diagnoses and other diagnoses separately while controlling for patient characteristics. The data analysis for this paper was generated using SAS software, Version 9.3 of the SAS System for Windows.

3.2 RESULTS

Of the 2,184 eVisits, 259 (11.9%) were Continuity, 1,532 (70.1%) were Convenience and 393 (18.0%) were incomplete visits. Continuity had 41 (15.8%) incomplete visits and Convenience had 352 (23.0%) incomplete visits – these are excluded from the following analysis. As shown in Table 3-2, the majority of the AnywhereCare eVisits were provided by APPs, but these visits were concentrated in a smaller amount of providers than the Continuity service. Two APPs, both physician assistants, provided 1,100 of the 1,791 total completed visits. Visits for Continuity services were initiated 91.9% during the day while Convenience visits were initiated 93.0% during the day. We also observe that in accordance with policy, the Convenience APPs and urgent care physicians provide virtually all daytime eVisits while the EM physicians provide all of the Convenience night eVisits. For the Continuity service, the physicians respond to both day and night visits. The policy for Continuity services indicates that a physician will answer within 24 hours, and on average services are provided within 12 hours, which is consistent with the prior study of the UPMC eVisit program.[139] For Convenience eVisits, providers are expected to respond within 30 minutes, and services are provided on average within 20 to 30 minutes.

Table 3-2. Comparison of Provider eVisits Between UPMC AnwhereCare Continuity and Convenience Services

Variables	Continuity	Convenience				Total
	Physicians	APPs	Physicians	EM Physicians	All	
Total eVisits	300	1,487	208	189	1,884	2,184
Incomplete eVisits	41	188	80	84	352	393
Completed eVisits*	259	1,299	128	105	1,532	1,791
Providers	72	15	11	17	43	115
eVisits per provider						
Mean	3.6	86.6	7.5	9.5	35.6	15.6
High	24	600	47	47	600	600
Low	1	1	1	1	1	1
Daytime hour visits, %	91.9	99.9	100.0	0.0	93.1	92.9
Response time, hours	12.2	0.3	0.3	0.5	0.3	2.1

*Completed eVisits are the basis of all subsequent analyses
Notes: APPs = advanced practice providers, EM = emergency medicine

The comparison of patient characteristics showed similar results to previous studies,[139,141] but as shown in Table 3-3, the differences by provider and service type indicate that some patient groups may have different eVisit preferences. Although the average age range was similar to previous studies,[139,141] we found that Continuity patients were older on average than the Convenience patients, and the t-test comparison indicates that the difference was statistically significant across the four provider types and the two services. We also found that patients of both Continuity and Convenience services are more likely to be female than male and more likely white than other races. Chi-square comparisons between the provider types found that gender and race were not or were marginally significant, while the comparison between service types found that race was significantly different between the Continuity and Convenience services. Patients utilizing eVisit services were more likely to be married than any other marital status, and patients of the Continuity services have a statistically significant higher likelihood of being married than patients of the Convenience service. We found that the average income for patients was between $75,000 and $85,000 and the mean urban-rural classification was between large central metro and large fringe metro. The t-test comparisons of urbanicity indicated no difference between provider and service types but that income was significantly higher for patients of the Convenience service than the Continuity service. Next, we considered the primary diagnosis of patients presenting to different types of providers.

The top four most common conditions for both programs include sinusitis, upper respiratory infection, urinary tract infection, and bronchitis with the fifth being cough for Continuity and pharyngitis for Convenience. In Table 3-3, however, the chi-square comparisons between provider and service types indicate that the types of top conditions are significantly different. Sinusitis is a higher percentage of the Continuity service while URIs are more common in the daytime Convenience service and UTIs are more common in the nighttime Convenience service.

Table 3-3. Comparison of Patient Characteristics and Diagnosed Conditions Between UPMC AnwhereCare Continuity and Convenience Services by Provider Type and Service Type

	Continuity	Convenience				P Value by Provider Type*	P Value by Service Type**
Variables	**Physicians**	**APPs**	**Physicians**	**EM Physicians**	**All**		
Age, mean	47.4	42.5	39.2	39.0	42.0	<0.0001	<0.0001
Female,%	72.2	75.4	71.1	77.1	75.2	0.4848	0.3048
Race, %							
White	82.2	82.5	84.4	87.6	83.0	0.0981	0.0423
Black	5.4	2.3	3.9	3.8	2.6		
Other	0.0	0.6	0.8	1.0	0.7		
Missing	12.4	14.6	10.9	7.6	13.8		
Marital status, %							
Married	62.6	52.0	50.8	56.2	52.2	0.0197	0.0218
Single	22.0	26.5	30.5	32.4	27.2		
Other	6.1	8.2	9.3	1.8	7.9		
Missing	9.3	13.3	9.4	9.6	12.7		
Zip Code Level Mean Income, $	75,406	82,584	85,485	81,003	82,719	0.0944	0.0165
Urbanicity* **	1.74	1.68	1.61	1.71	1.68	0.7458	0.4236
Conditions, %							
Sinusitis	42.1	33.1	25.0	28.6	32.1	<0.0001	0.0093
Upper respiratory infection	12.0	17.6	30.5	10.5	18.2		
Urinary tract infection	7.0	8.5	10.1	16.2	9.1		
Bronchitis	4.6	6.1	4.7	7.6	6.1		
Other	34.4	34.8	29.7	37.1	34.5		

Notes: APPs = advanced practice providers, EM = emergency medicine
*P value of t-test or chi-squared test of differences among the four provider types (Continuity physicians, Convenience APPs, Convenience physicians, and Convenience EM physicians)
** P value of t-test or chi-squared test of differences between the two services (Continuity and Convenience)
***Urbanicity measure was calculated by applying the 2006 National Center for Health Statistics' Urban-Rural Classification Scheme for Counties to each patient's county of residence. The classification ranges from a score of 1, indicating a large central metro, to a 6, indicating a noncore county not within a micropolitan area.

The number of prescriptions written for eVisit patients ranged from zero to five with a mean of 1.27. The Kolmogorov-Smirnov goodness-of-fit test was significant, indicating that the prescriptions were normally distributed. The ordinary least squares linear regression indicates that the provider, service and the diagnosis type are significantly associated with the number of prescriptions, but the other patient characteristics were not significant. In Table 3-4 we present the regression model results by condition type, and we observe that the Convenience APPs and EM physicians prescribe more than the average number of prescriptions while the Continuity physicians and Convenience urgent care physicians prescribe less. When we analyzed prescriptions per patient by the condition types, we found that the provider type was significantly different for sinusitis and URIs and marginally significant for bronchitis while service type was significantly different for sinusitis and marginally significant for bronchitis.

Table 3-4. Comparison of Number of Prescriptions Per Patient Visit Between UPMC AnwhereCare Continuity and Convenience Services by Condition

Prescriptions per Patient	Continuity	Convenience				P Value by Provider Type*	P Value by Service Type**
	Physicians	APPs	Physicians	EM Physicians	All		
All	1.20	1.48	0.99	1.43	1.42	<.0001	<.0001
Sinusitis	1.28	1.68	1.06	1.23	1.64	<.0001	<.0001
Upper respiratory infection	1.11	1.32	0.50	1.51	1.13	0.0001	0.9131
Urinary tract infection	1.00	1.17	0.77	1.04	1.10	0.3651	0.6264
Bronchitis	1.63	1.97	1.59	2.43	1.97	0.0667	0.0936
Other	0.77	0.93	0.82	1.10	0.93	0.3078	0.3917

*P value test of differences among the four provider types (Continuity physicians, Convenience APPs, Convenience physicians, and Convenience EM physicians)
** P value test of differences between the two services (Continuity and Convenience)
Notes: APPs = advanced practice providers, EM = emergency medicine. With a normally distributed outcome, we conducted an ordinary least square linear regression to estimate the effect of provider and service type on number of prescriptions. We adjusted for covariates including age, gender, race, marital status, income, and urbanicity. None of the covariates are statistically significant and therefore not reported here.

3.3 DISCUSSION

This observational study is the first to compare different provider and service types for eVisits and provide evidence about patient characteristics and outcome differences between these groups. These observations raise several questions about provider training, continuity of care, patient responsiveness,

and quality. We observe that the APPs provide a larger volume of eVisits on average than the physician providers. This finding is likely due to the fact that a small group of the APPs are dedicated to providing eVisits versus the physicians who provide eVisits in addition to traditional patient visits. One of the quality concerns for eVisits in the literature is the proficiency of practitioners providing care in an electronic venue.[135] Training, monitoring quality, and providing feedback to a small dedicated staff of clinicians seems a more efficient strategy than managing a disperse set of clinicians who provide eVisits on an infrequent basis. On the other hand, the Convenience providers have no knowledge of the patient beyond the information in the questionnaire and for some patients the electronic health record. For existing patients this could decrease continuity of care,[160] but for new patients, it may actually create a new linkage into the delivery system when the patient record is created.

We also observe that the response time for the Convenience program is significantly shorter than the response time for the Continuity program. As noted, the UPMC policy for these programs differs, but this indicates that dedicated staffing for eVisits allows a much more timely response, which is more responsive to patient needs.[137,160] Demographically, the Convenience program exhibited similar characteristics to the Continuity program and past studies of eVisits.[139,141] The majority of patients are middle-aged, white and female. Younger, single, higher income patients are more likely to use the Convenience service than the Continuity service, suggesting that continuity of care may be less important to these patients than convenience. It could also indicate willingness for younger individuals to utilize an innovative care channel.

Finally, from the clinical perspective, we observe that the APPs and EM physicians tended to prescribe more medications than the primary care and urgent care physicians. Another concern about eVisits, as a convenience care venue, is that it encourages drug-seeking behavior and overprescribing, particularly of antibiotics.[160] While we did not analyze the types of medications prescribed in this study, a previous study of eVisits has already established that antibiotic prescribing for UTIs and sinusitis was significantly higher for eVisits than physician office visits, indicating a potential for conservative overprescribing of

antibiotics.[151] The higher number of prescriptions by APPs and EM physicians could indicate that overprescribing is an issue within these groups. On the other hand, we have heard anecdotally that the number of messaging interactions between APPs and patients is higher than physicians and patients. Together with the prescribing, this could indicate that staff dedicated to the eVisit service may be uncovering and treating a larger variety of symptoms that would be otherwise unaddressed.

3.3.1 Limitations

This analysis is subject to several limitations. We are comparing clinical indicators, such as response time and number of prescriptions, across multiple patient types that could have different clinical needs. We are also relying on diagnosis codes to compare patient conditions types versus presenting symptoms. We are also not accounting for differences between individual providers, such as years of clinical experience or experience with eVisits.

3.3.2 Conclusion

As eVisits continue to grow as a health services delivery channel and expand in scope of service offerings, it will be important to study differences between providers and programs. As health systems or health plans consider the development of an eVisit program, a key question is the staffing. Should clinicians be dedicated to eVisits exclusively or should eVisits be an addition to their existing duties? Should the clinicians be physicians or APPs or both? These questions can have implications for the type, continuity, quality and timeliness of care provided; financial performance of the program; and customer and employee satisfaction. Future work could focus on patient decision making to use eVisits versus other less cost effective settings and the effect of eVisit program design on these decisions. There is also a lack of literature about clinician education and training for providing eVisit services and whether clinicians are being trained to deliver these services in undergraduate, graduate and residency programs. Finally, several of the existing programs involve automated protocols and care pathways to guide clinical decision making. Understanding the acceptance and effectiveness of these protocols could inform decision making in other settings and how information technology enhances quality in virtual settings.

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