The Impact of Context on The Use of Information Systems to Manage Clinical Quality

By

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CERTIFICATE OF APPROVAL

This is to certify that the PhD dissertation of

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THE IMPACT OF CONTEXT ON THE USE OF INFORMATION SYSTEMS TO MANAGE CLINICAL QUALITY

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ABBREVIATIONS

CB-SEM	Covariance-based Structural Equation Modeling
CFA	Confirmatory Factor Analysis
CIS	Clinical Information System
HIT	Health Information Technology
HR	Human Resources
MIPS	Merit-Based Incentive Payment System
PLS-SEM	Partial Least Squares Structural Equation Modeling
PQRS	Physician Quality Reporting System
PT	Physical Therapy
RQI	Rapid Qualitative Inquiry
SEM	Structural Equation Modeling
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
TAUM	Technology Acceptance and Use Model
UTAUT	Unified Theory of Acceptance and Use of Technology

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ABSTRACT

The effective move to value-based care delivery in physical therapy necessitates a shift towards a learning healthcare organization, with clinical managers acting as the primary supporters of providers' navigation of this changing healthcare landscape. This shift also requires efficient, system-wide use of technology. Harnessing the power of clinical and operational data contained within clinical information systems (CIS) offers companies many benefits. Unfortunately, CIS implementation projects in physical therapy have historically been expensive and poorly organized. This hinders organizations from effectively using these systems they spend so much to implement. Worse, with poor implementation and limited institutional control, these systems can simply contribute to provider burnout without any appreciable improvement in care quality. This research sought to understand the information needs of and organizational influences on managers as they utilize information systems to oversee the clinical quality efforts of their organizations.

Utilizing a mixed-methods design including Rapid Qualitative Inquiry for theory development and refinement in addition to Structural Equation Modeling for formal theory testing, we focused on three aims. First, we sought to describe how the varying roles, stakeholder influences, and competing priorities combine into an overarching framework that represents how PT managers seek answers to clinical quality-related questions among their competing priorities (Aim 1). Second, we characterized the organizational facilitators and barriers that influence managers' use of clinical information systems to oversee clinical quality (Aim 2). Finally, we applied what we learned from these first two aims to quantitatively establish the applicability of The Unified Theory of Acceptance and Use of Technology (UTAUT) to PT managers using CIS to oversee quality and explore the impact

of contextual factors on the model's performance (Aim 3). UTAUT served as the unifying theory between the qualitative and quantitative phases of the study.

Our research found that PT managers, in addition to their oversight of clinical quality, have many competing priorities. Providing direct patient care consumed the majority of the managers' time and hindered their focus on administrative duties. Their administrative time was dominated by focus on operational metrics and, "putting out fires" related to human resources and compliance issues. The management of clinical quality was often performed either indirectly via an emphasis on operational metrics or through chart reviews and observing their staff interact with patients. Only when organizations held managers accountable to quality metrics through their interactions with their direct supervisors did they systematically utilize information systems to manage quality metrics.

In both phases of the research, UTAUT factors impacted managers' use of their clinical information systems to oversee clinical quality. Most notably, the perceived usefulness of the CIS appeared to influence managers' intention to use the system in both phases of the research. Additionally, the organization's emphasis on clinical quality and accountability of the managers appeared to influence managers' behavior in the qualitative phase of the study. In the quantitative phase, these organizational facilitators were not statistically significant, but this was likely due to small sample size and response variability. Additionally, habit had a notable confounding impact on the parameter estimates of the other UTAUT factors. When it was removed from the model, the parameter estimates of the other factors all increased. Finally, age had some positive interaction with habit, suggesting organizations might be well served to work deliberately with newer managers to

develop strong system use habits early in their tenures as managers rather than waiting for these habits to develop organically.

This study also established a framework of mixed-methods research for efficiently studying complex sociotechnical environments. This framework can be used both to test established theory as well as develop new theory. Our results also can help physical therapy organizations identify where they can intervene to facilitate managers' efforts to optimize clinical quality. Providing managers protected time and direction for administrative duties, increasing emphasis on managers' accountability to business metrics, matching system content with managers' needs, emphasizing training especially of younger managers, and establishing an executive prioritization of quality metrics will support managers in their efforts to effectively utilize practice information. Additionally, through these efforts organizations can improve their balance between clinical performance and financial goals.

CHAPTER ONE. INTRODUCTION AND BACKGROUND

Ubiquitous information technology is allowing businesses to base decisions on compelling data rather than leaders' premonitions. However, in order for healthcare organizations to leverage the power of their information systems in their business and clinical operations, they must facilitate employees' use of these systems and remove barriers to technology adoption. Additionally, while healthcare businesses are often adept at using information systems to make operational decisions, they typically utilize these systems with a far less structured approach in efforts to purposefully measure and improve clinical quality.

This dissertation aimed to define a model of how quality is overseen, how organizations can facilitate and inhibit individuals' use of clinical information system (CIS) for the management of quality, and then utilize an established technology acceptance model to empirically measure the impact of these factors on individuals' intended use of CIS as they oversee clinical quality. The remainder of this chapter outlines the core components involved in the study of CIS use in the management of clinical quality in outpatient physical therapy practices.

Quality Measures and the Role of CIS

Value is defined as a ratio with some measure of patient outcome in the numerator and cost in the denominator.[1] This outcome numerator is often related to the concept of quality, which is inherently difficult to define.[2,3] In healthcare, the term quality is relative to the perspective of the stakeholder and often differing stakeholder perspectives are in conflict with one another.[4] Pervasive quality assurance and improvement approaches often prioritize patient centered care while others focus on standards of care based upon best research

evidence.[5,6] In addition, the payor perspective emphasizes frugal use of resources.[7] With all of these perspectives to consider and no agreement on which quality improvement initiatives should be the foci, it is no wonder efforts to meaningfully improve measures of quality in the US healthcare system have proven difficult and costly.[8]

Improvement in performance on quality of care measures has been difficult for many providers despite organizational, governmental, and payor initiatives to emphasize clinical quality.[9] Using payment incentives or penalties to improve quality measures has yielded limited quantifiable improvements in outcomes measures and serves as a source of stress for providers.[10] Additionally, creating processes for healthcare organizations to avoid such penalties significantly increases the administrative burden on providers and their office staffs.[11]

Provider organizations spend a great deal of time and money trying to achieve incentive payment benchmarks, often to the demise of other quality initiatives in the organization.[12] Much of this expense is borne in the purchase of CIS that have yet to show a systematic positive influence on quality outcomes measures, despite some positive impact on process measures.[13,14] Organizations often struggle to coordinate the various providers and CIS, resulting in missed incentives.[15] Managers are placed in a unique position to address many of these challenges. While the workers are responsible for implementing corporate quality strategy, it is upper and mid-level managers who live at the intersection of strategy development and implementation.[16,17]

The Role of Managers in Clinical Quality

Mid-level managers are tasked with both implementing corporate policy and mission, but also managing the expectations and needs of the frontline workers.[18] Managers who

have concurrent roles as providers, however, can occasionally feel conflict between their values as a professional and the business' policies and directives.[19] If impactful, managers effectively synthesize organizational data and diffuse this information to the frontline providers, which facilitates practice optimization.[20] This influence is especially true in hybrid clinician-managers who see patients clinically as well as manage staff. This is because hybrid managers can directly relate to the clinical staff and help mitigate apparrent misalignments between professional and organizational values.[19,21]

Healthcare managers are pulled in many different directions based upon organizational priorities, various stakeholder perspectives, and competing tasks. Because of all of these competitors for their attention, managers must budget their time and focus on the highest priority tasks. Managers often simultaneously serve competing roles of interpersonal leader, information leader, and decisional leader.[22] The role of the manager as informational leader is particularly relevant as organizations increase their emphasis on data driven approaches to business decisions. Managers must monitor organizational metrics, compare performance to established benchmarks, and then mentor staff to improve performance as needed.

Healthcare organizations place multiple responsibilities on managers, but unfortunately these managers often are left to prioritize the multiple requirements without the necessary corporate guidence to ensure their efforts align with the organizational priorities.[18] Because of this lack of guidance, managers often sacrifice focus on monitoring clinical quality for other efforts. This has been shown to be especially true for hybrid clinician-managers who often sacrifice admistrative duties to provide additional patient care.[21] These managers are especially susceptible to placing an over emphasis on the low-

value but high-urgency day-to-day tasks, to the detriment of the high-value but low-urgency tasks that can have the greatest impact on organizational health.[23]

Clinical quality is shaped by the entire healthcare system, with the manager in an integral role. It is not simply the responsibility of a single provider.[24-27] While largely unsuccessful, many information systems have been created in an attempt to improve the quality of care.[14,28,29] A significant amount of research has explored the use (and resistance to use) of technology by providers. However, little research has explored information seeking behaviors and information technology use of managers.[30-32]

Sociotechnical Models of CIS Implementation into Practice

Several sociotechnical models have been described to explain the complexity of organizations' interactions with information technology. Specifically, these models help explain how various aspects of an organization can influence the success or failure of information system implementations. In its simplest form, a sociotechnical model involves the interaction of people performing specific tasks while using certain technology, within an organization that has a defined institutional structure. This framework was first described by Leavitt in 1972 and is illustrated in Figure 1.[33]

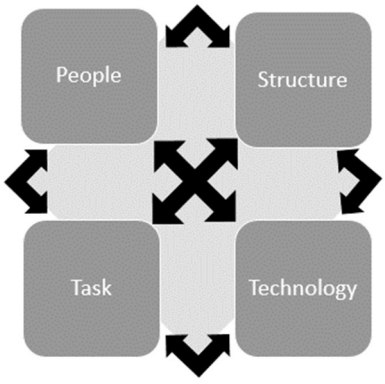

Figure 1: Leavitt's Diamond

Healthcare is a complex system of systems. Attempting to study individuals in isolation, without understanding the complexities of the systems in which they work can lead to research findings with limited or even inaccurate conclusions.[34,35] Multiple sociotechnical models have been proposed in an attempt to study and minimize the risk to patients that can stem from decision errors that can accompany information system implementations.[25,36] An eight factor model was proposed by Sittig and Singh that shows decision errors and process failures seen in hospital implementations fall into at least one of these eight factors.[26,27] They include:

1) Hardware and software infrastructure
2) Clinical content
3) Human-computer interface
4) People
5) Workflow and communication
6) Internal organizational policies, procedures, and culture
7) External rules, regulations, and pressures
8) External measurement and monitoring.

The first three factors in this sociotechnical model are clearly within the domain of informatics. Organizations and vendors place emphasis on system infrastructures, interoperability, and user-centered design when developing applications. While these first three items are essential for well-designed systems, they are not sufficient to account for the organizational behavior factors that influence how individuals and groups act within an organization and ultimately how new systems are adopted.[37] It has long been understood that individuals' behavior is shaped by a complex interaction between their personal

attitudes, the subjective norms of the group in which they function, habit, and many other interconnected factors.[38-40] Thus, the actual use of an information system is only partially driven by the quality of the system itself.[37] If a system is not even used, or used incorrectly, there is no hope for that system to help improve the quality of care.

In the Institute of Medicine's seminal work, *Best Care at a Lower Cost: The Path to Continuously Learning Health Care in America,* the authors outlined a framework that stresses the need to address these multiple domains as a means of developing learning organizations to tackle our healthcare quality dilemma.[24] Anecdotal examples of organizations engaging providers and payors using robust information systems to implement effective value improvement initiatives.[41,42] There are even examples of cross-institutional learning organizations focused on collaborative quality improvement.[43,44] However, as stated above, for organizations to leverage the power of CIS, employees must use these systems. One subcomponent of sociotechnical models is the individual employee's decision to adopt information systems in their work.

Models of Acceptance of Information Technology

Models of information technology acceptance have been established outside of, and then tested and extended within, healthcare settings.[38,39,45-49] Most prominently, these include the Theory of Reasoned Action, Theory of Planned Behavior, Diffusion of Innovation, Technology Acceptance Model, and Unified Theory of Acceptance and Use of Technology. Each model posits that human intentional action is strongly influenced by a set of explanatory factors. Further, these factors can interact, creating a complex system of factors that can all play an integrative role in how individuals behave. The various constructs of

these models are all measured through multiple choice surveys and seek to explain system adoption via either self-reported system use or electronic system user logs.

These models trace their origins to the Theories of Reasoned Action and Planned Behavior.[39,40] Both of the models aim to explain variance in an individuals' performance of a target behavior. Additionally, both models show that, in most cases, performance of a target behavior is preceded by the individual's intention to perform the action. Thus, both models best explain variance in a planned behavior versus a spontaneous behavior. Both models use a combination of the individual's attitudes about the target behavior and the subjective norms of the environment in which that individual lives, as antecedents to the behavioral intention to perform a given activity. Extensions of these models have sought to better explain the variance in individuals' performance of target behaviors by adding additional explanatory variables including interaction terms to account for effect modification.

A sub-focus of a sociotechnical view, emphasizing the actions of the individual, one notable extension of the Theory of Reasoned Action is the Technology Acceptance Model (TAM).[47,50,51] TAM is well studied and one of the most widely applied measures of technology acceptance. It has been studied in consumer-based applications, industry, and in healthcare. TAM, shown in figure 2, extended and slightly modified the Theory of Reasoned Action, shown in figure 3. The initial version of TAM removed the subjective norm-based

factor from the Theory of Reasoned Action and replaced it with Perceived Usefulness to explain variance in Behavioral Intention.

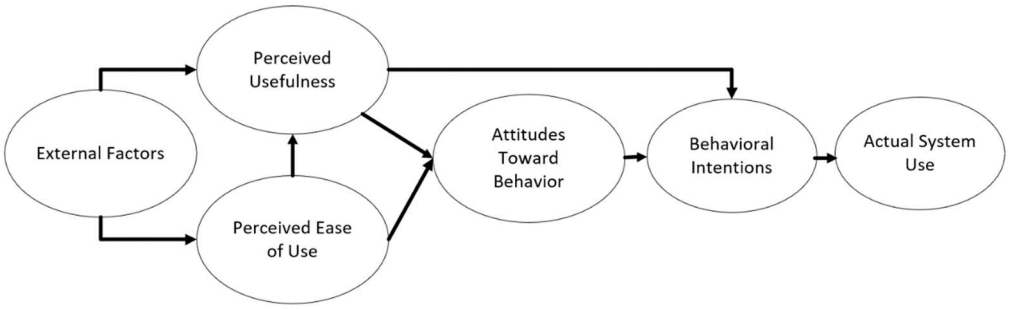

Figure 2: Technology Acceptance Model (Adapted from Davis, 1989)[52]

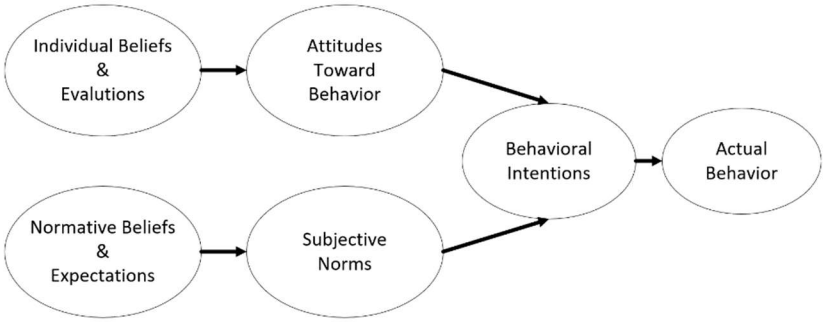

Figure 3: Theory of Reasoned Action (Adapted from Davis 1989)[52]

Additionally, TAM added Perceived Ease of Use, which, combined with Perceived Usefulness explains the individual's attitude about the technology of interest. These two factors served as a basis of the majority of the other models of technology acceptance that followed. TAM was also extended in two subsequent versions in an attempt to explain more of the variance in actual system use.[50,51]

One of the primary researchers and model architects of the later versions of TAM, Viswanath Venkatesh recognized in the early 2000's that most of the competing models of technology acceptance shared many common themes. For this reason, he and his colleagues proposed a new approach that sought to combine aspects of the competing models into a single unified design, appropriately named the Unified Theory of Acceptance and Use of

Technology (UTAUT).[48,53] This model, shown in figure 4, took those base concepts of Perceived Usefulness and Perceived Ease of Use from TAM (termed Performance and Effort Expectancy respectively in UTAUT) and added back Social Influence from the Theory of Reasoned Action. The survey used to test and refine UTAUT was created by taking the best performing items from the other competing models and combing them into a single survey.[48] UTAUT has since been extended slightly in an attempt to explain more of the variance in technology use behavior.[53]

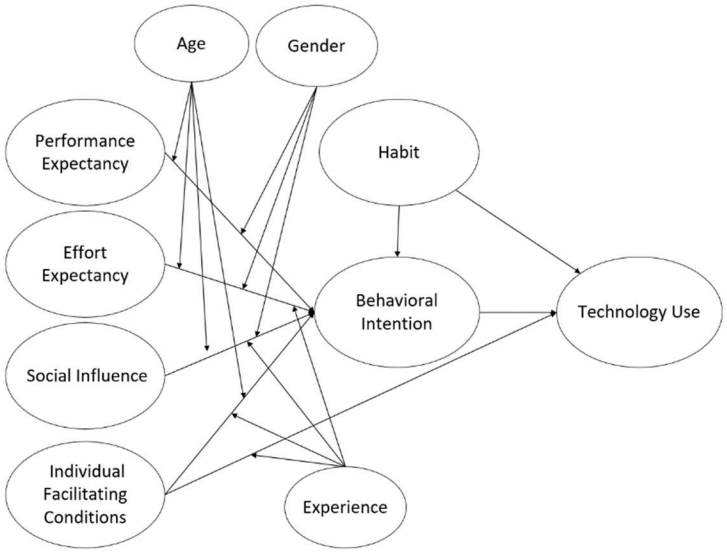

Figure 4: Unified Theory of Acceptance and Use of Technology (Adapted from Venkatesh, 2003)[48]

In addition to the base factors from TAM, UTAUT added a broad class of "Facilitating Conditions" that were proposed to explain an individual's performance of a target behavior even in the absence of the other factors. One such factor is the mandatory use of systems in industry. Even if an employee feels an application is not useful and feels it is difficult to use, the individual will still likely use the system if it is required by his/her employer.[53] TAM, UTAUT, and other models of technology acceptance have been studied

outside of and within healthcare. A comparison between the performances of specifically the TAM and UTAUT models is presented below.

Most of the studies of these models in healthcare have focused on the clinician as a solo actor, functioning apart from the organization within which they work. The role of contextual factors (both the context of the task under study as well as the individual's work environment) have a strong influence on the actions of workers.[54-56] This ties back to the sociotechnical models described above. Individuals and groups of employees function in a complex work ecosystem. Studying the behavior of individuals apart from that ecosystem is likely to yield results with limited utility outside of a very narrowly focused setting.[32,55,57,58] The interplay between individual behavior and the impact of the organizational sociotechnical ecosystem is an emphasis of the manuscripts in chapters three and four. The study of these ecosystems in which human-computer interactions occur has great potential to improve our understanding of the major influencers of employees' daily decision relative to the use of information systems.

Comparing TAM and UTAUT

While a good model should explain a significant amount of the variance in a target outcome variable, this is not the only sign of a good model. Weber developed a framework to evaluate theoretical models in information systems research.[59] This framework suggests that good models should have five characteristics. First, any new model must be important. The new model must seek to explain an interesting phenomenon that has important impact on a particular field of study. Both TAM and UTAUT seek to explain why individuals are motivated (or demotivated) to use a particular technology. Failing to understand these motivations renders efforts on system design less impactful. This is because system design

characteristics are only a small piece of the sociotechnical environment in which humans and information systems operate.

Models must also be novel. UTAUT added contextual factors to TAM which helped to better explain an individual's intention to use certain technology. They should also be parsimonious. The initial TAM version was quite simple. However, this simplicity limited the model's ability to explain variance in the target outcome of system use.[45] While this explanatory power was improved with progress towards the third version of TAM, this came at the expense of model parsimony.[51] This resulted in a framework that was very hard to conceptualize and thus, apply in real life situations. UTAUT sought to maintain the high explanatory power of TAM version three but do so in a simpler model.

Additionally, models should have adequate external generalizability (termed "Level" by Weber). Theories that can be applied only to a very narrow focus are of limited utility in practice. Both UTAUT and TAM have been applied to consumer and industrial applications in cross-sectional and longitudinal studies. Finally, models must be falsifiable. Thus, it is not sufficient to describe an elegant model, but rather this model must be able to be supported or disproven in actual evaluation. While both UTAUT and TAM have been studied extensively, model appropriateness has been assessed by reaching a certain R^2 value for an outcome variable, or sufficient convergent or discriminant validity of indicator variables on a target latent construct.

Both UTAUT and TAM have shown good ability to explain the variance in both individuals' intention to use and actual use of technology. As illustrated in table 2, several studies have shown that UTAUT and TAM perform similarly with respect to the amount of variance explained by each model (R^2 estimates).[48,51-53,60,61] Behavioral intention is often the final

measure of outcome for these analyses since measuring actual system use is generally difficult in less than very controlled technology environments, which then severely limits sample sizes.

	Behavioral Intention	Actual System Use
TAM	0.51 – 0.70	0.12 – 0.62
UTAUT	0.44 – 0.74	0.35 – 0.52

Table 2: Explanatory power (R^2) of TAM and UTAUT relative to behavioral intention and actual system use measures

Importance of Context in Information Systems Research

Both TAM and UTAUT were acceptable models for study in this dissertation research. However, since UTAUT has added contextual factors that were a significant focus of this work, and does so with more simplicity than TAM version three, UTAUT represented a more compelling model for study. Further, Venkatesh created a proposed research agenda for the study of technology acceptance.[54] Venkatesh's proposed agenda emphasizes that future research should focus on contextual factors' influences on target models. As described earlier, the sociotechnical environment in which human behavior is carried out is strongly influenced by a host of contextual factors. This recommendation rests heavily on the work of Hong and colleagues.[56] Their framework suggests one must first begin with a well-grounded theory. Second, the theory must be contextualized by attempting to add additional, previously unexplored factors. This was one of the aims of UTAUT, to extend TAM and this dissertation research sought to further contextualize UTAUT to a specific task and setting.

These models must then be studied in unique environments in order to understand the influence of the novel setting on model performance. Next, environmental specific contextual factors should be added to the model to explore their impact on the performance

of the new survey compared to the base survey. Finally, researchers should both study the direct effects as well as interaction, and/or mediating effects of these contextual factors on the other components of the model. These three recommendations were a major focus of this research. This dissertation aimed to first understand what contextual factors seemed important for study in outpatient PT practices and then add those factors to the UTAUT survey to examine their impact. As an exploratory extension of the primary aims of this work, a final emphasis was focused on the moderating effect of contextual factors on the other constructs in the model.

Specific to UTAUT, Venkatesh outlined two main levels of contextual factors, visualized in Figure 5. Contextual factors can be either individually based or higher-level based. Individual-level contextual factors include user, technology, task, and time attributes and represent interaction with technology for a very specific purpose. Higher-level factors involve environmental, organizational, and location attributes and represent more structural attributes that exist apart from the individual human-computer interactions. Venkatesh argues that individual level factors have been heavily researched as have technology attributes. However, especially organizational attributes have been neglected in technology acceptance research. This dissertation work was focused on the attributes of the organization as well as the specific task of managing clinical quality.

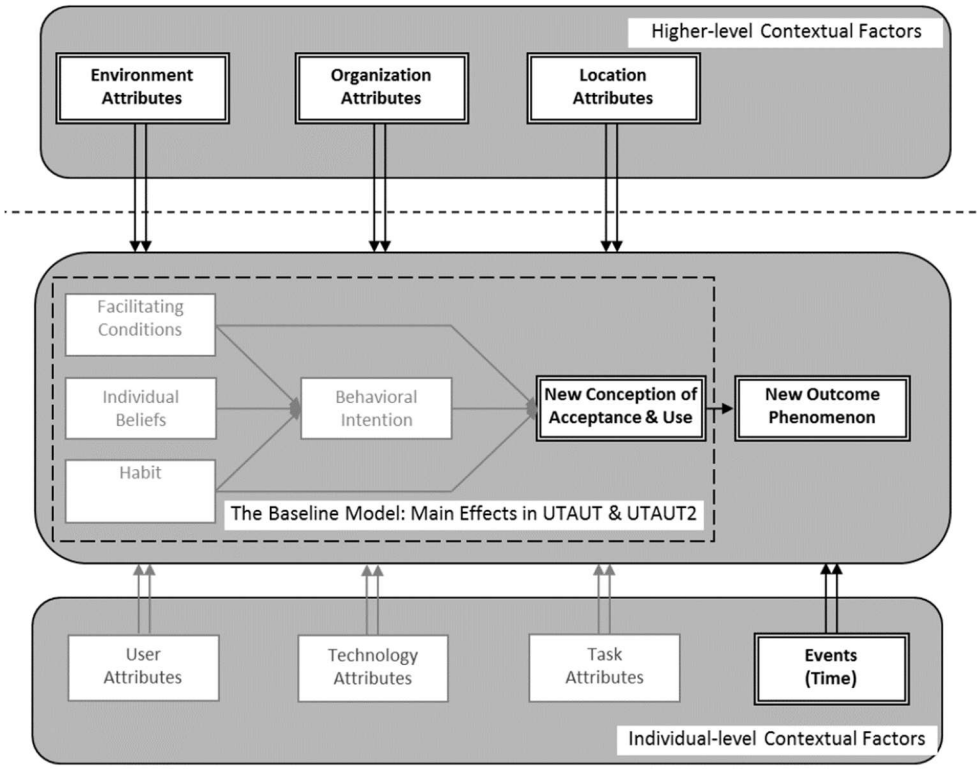

Figure 5: Contextual influence on UTAUT model (Excerpted from Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead by Venkatesh V, Thong J, and Xu X, © May, 2016. Used with permission from Association for Information Systems, Atlanta, GA; 404-413-7445; www.aisnet.org. All rights reserved)[54]

UTAUT in Healthcare

Several studies have explored information system adoption in healthcare, utilizing UTAUT.[62-67] Outcomes constructs for these studies included actual system use in three studies, individuals' intention to use their system in one study, and overall global assessment/satisfaction with a system in one final study. The information systems used in these studies included clinical decision support systems (pharmacokinetics assistance application), electronic health records, speech recognition software, a mobile electronic medical record application, a picture archiving and communication system, and various rehabilitation-based technologies. In these studies UTAUT explained between 28 – 57% of the variation in the individuals' intention to use their respective information systems.

Additionally, behavioral intention explains between 43 – 57% of the variance in actual system use.

One of these studies showed that in a modified UTAUT model, Facilitating Conditions had a very significant effect on Behavioral Intention that was greater than the effect of Effort Expectancy.[63] Another of these studies showed that the coefficient for Facilitating Conditions on Behavioral Intention was actually greater than Performance or Effort Expectancy.[66] However, another of these studies found that Facilitating Conditions did not significantly improve the system use variance explanation more than Behavioral Intention could alone.[64]

None of these studies explored the influence of Facilitating Conditions on Behavioral Intention as either moderating or mediating variables. The initial UTAUT model did not view Facilitating Conditions as a direct effect predictor of Behavioral Intention, but rather acting only on actual system use.[48] However, the subsequent versions of UTAUT (shown in figure 5 above) suggest Facilitating Conditions can have a direct impact on Behavioral Intention as well as potentially a mediating or moderating effect.[53,54] Additionally, all of these studies used only the base questions from the UTAUT survey and did not attempt to identify specific potential facilitating conditions for the unique setting in which their research was performed.

Physical Therapy as a Use Case

The field of physical therapy (PT) offers a valuable avenue of study because of the organic way the profession has adopted technology and quality measures, somewhat removed from the outside mandates that have driven adoptions in other areas of healthcare. The profession of PT has slowly adopted electronic medical and health records over the past

twenty years.[68] Because PT was excluded from Meaningful Use incentives, adoption has been more organic and also more varied than in medicine. PT organizations have adopted technology for a myriad of reasons since they have not been pushed to adopt specific technologies or processes by the incentives received by government programs. For this reason, PT offers a rich environment to study how and why organizations implement and use information technology for daily operations, with limited influence from artificial and externally mandated use requirements.

Additionally, PT was not included in the majority of the Centers for Medicare and Medicaid Services' Physician Quality Reporting System (PQRS) measures the past few years nor in the initiation of the health information technology (HIT) components of the newer Merit-based Incentive Payment System (MIPS) program of the past year. For this reason, like with the uptake of technology, PTs' embrace of quality improvement initiatives and monitoring of quality measures has been inconsistent and varies widely across organizations.[69] PTs were partially drawn into MIPS in 2019 and some payors are beginning to engage in risk-based contracts that incentivize PTs based on achieving quality benchmarks. However, these types of reimbursement in PT are still very rare.

Many PT organizations have invested in quality-based CIS to help them manage clinical quality. Several dedicated systems have been developed to collect and then analyze information regarding patient reported outcomes. These include Focus on Therapeutic Outcomes (FOTO), Rehab Outcomes Measurement System (ROMS), Web-Outcomes, CareConnections, and most recently the Physical Therapy Outcomes Registry among others.[70] Despite investment in these systems, therapists' actual use of information regarding patient reported outcomes have increased somewhat in the past 15 years, but use of these

systems is still generally low.[71] The biggest reported barriers to use of these systems are a perceived lack of time and a distrust of the information, including the potential for self-reporting bias in the data.[72]

Additionally, PT care generally does not conform to evidence based guidelines even in organizations that recommend using guideline adherent care.[73,74] This is despite published research that guideline adherent care generally results in better outcomes and lower direct and down-stream costs.[73,75-77] Because of this lack of adherence to best-practice standards, there is large variability in PT care throughout the profession.[78] It is hoped that as PTs gain skill in utilizing CIS to augment their decision making and these systems are refined to better meet the needs of PTs that care delivery and outcomes could be improved.[79]

Because PTs are at a transition phase in both technology use and focus on quality improvement and quality measurement, now is an opportune time to explore what factors influence organizations' use of technology to manage quality. Additionally, since PT was drawn into MIPS in 2019 and will be more fully in 2020, PT organizations will be seeking ways of improving the use of their CIS to manage quality to help ensure they can receive the incentive payments, and avoid penalties, involved in the program.

Managers in PT have been understudied and they serve a hybrid role, simultaneously caring directly for patients and often managing facilities on the side.[80] As cited earlier, this hybrid role of clinician-manager has been shown to distract managers from their administrative duties.[21] Primarily due to a lack of payor mandate, physical therapists in the US lag behind other areas of healthcare in engaging with quality indicators.[81] However, physical therapy organizations are beginning to implement quality improvement systems

with inconsistent results and now is the time to learn from our current state and set a course for improvements in the near future.[70]

Technology Acceptance in PT

No studies have specifically explored the acceptance of technology in physical therapy. A well done study by Schaper explored technology acceptance in occupational therapy, a related but notably different field.[82,83] Three studies combined occupational therapists, speech language pathologists, and PTs together.[66,84,85] There are no studies related to technology acceptance in PT managers. Further, these cited studies explored the use of technology in general in therapy and not specifically information technology. This lack of research into this domain suggests this dissertation research fills a significant gap in the current literature.

The one UTAUT-based study centered on technology acceptance in therapists examined technology in general and focused on providers in a single hospital.[66] That cross-sectional study questioned participants about the adoption of any of 16 different technologies that could be utilized (but use was not mandated) in their hospital. As illustrated in table 2, that study did show that UTAUT could explain 45.3% of the variance in the intention to use these systems and that intention could explain 56.7% of the variance in actual system use. Only Performance Expectancy had a significant association with Behavioral Intention, as measured by β-coefficients. These β-coefficients indicate how much Behavioral Intention changes with a change in each explanatory variable. As shown in other studies cited above, Facilitating Conditions had a greater association with reported system use than did Behavioral Intention. This finding underscores the need to explore the influences of the organizational factors on individuals' use of technology.

	β - Coefficient	R^2
Performance Expectancy → BI	0.585 **	0.453
Effort Expectancy → BI	0.118	
Social Influence → BI	0.014	
BI → Use	0.212 *	0.567
Facilitating Conditions → Use	0.625 **	

Table 3: UTAUT model performance from Liu et al. * $p < 0.05$, ** $p<0.01$

That study by Liu used therapists' perceptions of their use of the various systems rather than actual system-use logs, which does call into question the validity of R^2 calculations reported by the authors as true indicators of actual system use. Further, the technology utilized was confined to patient-facing gaming technologies, which are inherently different than the CIS studied in this dissertation. Additionally, the population was confined to a single hospital, so it is not clear if the results are generalizable. None the less, that was the first reported study of UTAUT used on therapists in practice and showed results similar to those seen with UTAUT applied in other medical settings.

A separate study explored the influencers of physical therapists' use of outcomes measures, not necessarily tied to technology systems [69] While that study did not specifically explore UTAUT as an underlying framework, it is interesting to point out that many of the themes in that study parallel the constructs of UTAUT. This was likely due to UTAUT's relationship with the Theory of Reasoned Action in the explanation of an individual's planned behavior. Specifically, the authors found that ease of use of the outcomes forms, social influence from the organization, and facilitating conditions such as training, mandated use, and dedicated time to administer the tool all influenced the therapists' decisions to use the measures. That research suggests UTAUT may have a strong application in understanding therapists' use of information technology specific to delivering and reported results of patient reported outcomes.

Schaper's study, cited above, focused on occupational therapists and sought to create a new, occupational therapy specific model of technology acceptance, the Technology Acceptance and Use Model (TAUM).[82,83] That multi-phased study started with an ethnographic and literature review phase to create a new model and accompanying questionnaire to test and refine TAUM. It explored several established frameworks, from which was created the new test model.[86] Next, therapists were surveyed and the survey data were analyzed. Finally, a longitudinal phase explored actual systems used, the results of which were never published but were presented in a PhD dissertation.[87]

While Schaper's study showed significant explanatory power of TAUM, that model has yet to be formally validated or utilized by other researchers, now eleven years later. According to Weber's guidelines reported above, TAUM may not have added much that already established models could not achieve, or was too narrowly focused to the field of occupational therapy. However, her approach gave a good framework of the necessary components of our research methods. We recognized that there was a need to first define PT and quality-based contextual constructs of interest into a UTAUT-based study model and define their measurement through survey questions. That approach is supported by one systematic review that noted many studies exploring organizational characteristics lack sound theoretical backing and scientific rigor in analysis.[88] For this reason, first establishing theoretical backing and then testing the reliability and validity of proposed extensions to an already established framework were necessary steps in this dissertation research process.

Specific Aims

The focus of this dissertation research was to test the validity of applying an established model to a specific setting and exploring the impact of adding contextualization,

rather than to create an entirely new theoretical model. It was beyond the scope of this dissertation research to then move to the longitudinal study of actual system use since there was inadequate time and resources for this additional aim. Further, most PT organizations have limited ability to effectively measure system usage. Thus, a longitudinal study would have relied on self-reported system adoption and would have the same limitations mentioned in the therapist-based UTAUT study cited above.[66]

Taking the above issues into consideration, this dissertation research consisted of a series of studies to explore what factors influence PT managers' use of CIS in their daily workflow, emphasizing the following three aims:

Specific Aim 1: Describe how the varying roles, stakeholder influences, and competing priorities combine into an overarching framework that represents how PT managers seek answers to clinical quality-related questions among their competing priorities. Referenced in chapter three, we performed an ethnographic study of clinical managers of PT practices in the United States. For this aim we focused on the competing priorities and actions of individual managers, in an effort to find common themes.

Specific Aim 2: Characterize the organizational contextual factors that influence the managers' use of their quality improvement information systems when overseeing clinical quality. Along with the study for Specific Aim 1 and described in chapter four, we focused on the role of organizational facilitators and barriers that impact managers' use of CIS in their administrative duties. The primary focus of this aim was on the management of clinical quality but also explored the impact of competing priorities.

Specific Aim 3: Qualitatively and quantitatively establish the applicability of UTAUT to PT managers using CIS to oversee quality in their organizations and explore the impact of contextual factors on the model's performance. Utilizing the outcomes of aims one and two, this research extended and validated a survey based upon past UTAUT studies. The primary focus was on the base UTAUT model and previously studied survey items. However, by extending the survey, we applied additional constructs as contextualizing factors and potential effect modifiers. This allowed for the performance of an exploratory analysis to establish the preliminary psychometrics of these new items. Those items that performed adequately were then further studied for the influence of these constructs on the UTAUT base model.

CHAPTER TWO. METHODS OVERVIEW

Studying complex systems in businesses requires a deep understanding of the inner structure of the organizations and what it means to work within these companies. Quantitative research methods, through a set of constrained study parameters, help to control for bias, empirically test *a priori* hypotheses, and often make causal inferences. These quantitative methods can systematically explore what an organization produces or what factors and processes are present within that organization, but not necessarily how and why certain processes or outcomes exist.[89,90] Qualitative methods, by contrast excel at explaining why certain processes or outcomes exist in businesses.[91] Mixed-methods approaches allow researchers to draw on the best aspects of both of these research methods for a more comprehensive view of healthcare research problems.[92,93]

This dissertation research utilized an exploratory sequential mixed-methods design.[94] We started with a qualitative phase to inductively explore the context of managers overseeing clinical quality. We then applied what we learned from the first phase to understand the validity of using UTAUT in this context in the quantitative phase. The justification for and description of the basic approaches used in each research phase is presented below and the specific protocols for each phase of the research are delineated in the manuscripts represented in chapters three through five.

Qualitative Phase: Rapid Qualitative Inquiry

Ethnographic research is an effective means of obtaining a deep understanding of sociological and organizational phenomena.[95] While formal ethnography allows for deep understanding, this comes at a cost of time and resources. An alternative approach, Rapid Qualitative Inquiry (RQI) combines the benefits of ethnography in a quicker

implementation, through a team-based, iterative approach.[96] Formal ethnography allows for gradual development of themes that can be organically tested in the field. RQI, on the other hand, requires agile generation and testing of inferences, which can introduce unconscious biases. For this reason, the increased speed of assessment necessitates RQI researchers to be much more reflexive and rigorous in their methods.[97]

The original RQI methods have been applied to and extended for improved utility in informatics related research.[30,98-102] McMullen and colleagues outlined a modification to the original approach with specific guidelines for informatics research.[103] The first recommendation is to establish a multidisciplinary team including clinicians, qualitative researchers, and informaticians. Next, the authors stress the importance of team-based planning prior to any fieldwork. Additionally, the authors suggest that an on-site navigator or liaison is essential to gain deeper access as well as an insider's perspective. As for sampling, in addition to purposive sampling, the authors recommend a "chain sampling" process where interviewees are asked to recommend additional interview candidates. This allows the original sample of interviewees to be organically extended in order to meet the needs of the study as themes emerge. The added study subjects can be selected based upon changes in the interview plan, in light of emerging information from the previous interviews.

RQI involves a combination of formal semi-structured interviews, impromptu interviews, observations, artifact review, and team debriefs. These team debriefs are essential to help refine the focus of site visits and build upon emerging themes in real time. Data analysis includes an iterative approach with immediate assessment after site visits, formal coding, and cooperative team analysis to give a well-rounded view of themes. This team approach draws upon the diverse perspective of the various members of the research

team. While RQI requires a great deal of planning and team coordination, this allows for a prompt focus of themes while keeping a broad perspective, drawing upon the team emphasis. This creates efficiency in work while gaining great depth of understanding of these complex clinical environments.

The following two chapters describe phase one of this research utilizing the RQI approach. These chapters include two separate manuscripts that were drawn from a single study and represent the first two research aims. The opportunity to secondarily analyze study data and explore emerging themes in refined depth, from a single study, is a strength of RQI.

Quantitative Phase: Structural Equation Modeling

The majority of models of technology acceptance cited in chapter one were both created and validated using various approaches to Structural Equation Modeling (SEM). TAM, the Theory of Reasoned Action, and UTAUT are complex theoretical models representing intricate relationships between multiple levels of variables. These inter-relationships require more sophisticated analyses than those afforded by traditional statistical methods. SEM is a combination of techniques aimed at exploring relationships between complex and thus not directly quantifiable constructs through the measurement of related indicator variables.[104] SEM often starts with a theoretical model of causal relationships between constructs and then tests the strength of those relationships mathematically. The use of SEM is common in social, psychological, and organizational research and parallels methods used in regression-based Ordinary Least Squares analyses. SEM is a second generation statistical technique that simultaneously tests two models shown in figure 5, an outer measurement model, and an inner structural model. SEM attempts to explain the

covariance between measured indicator variables and test the hypothesized relationships between the latent and observed model variables.[105-107]

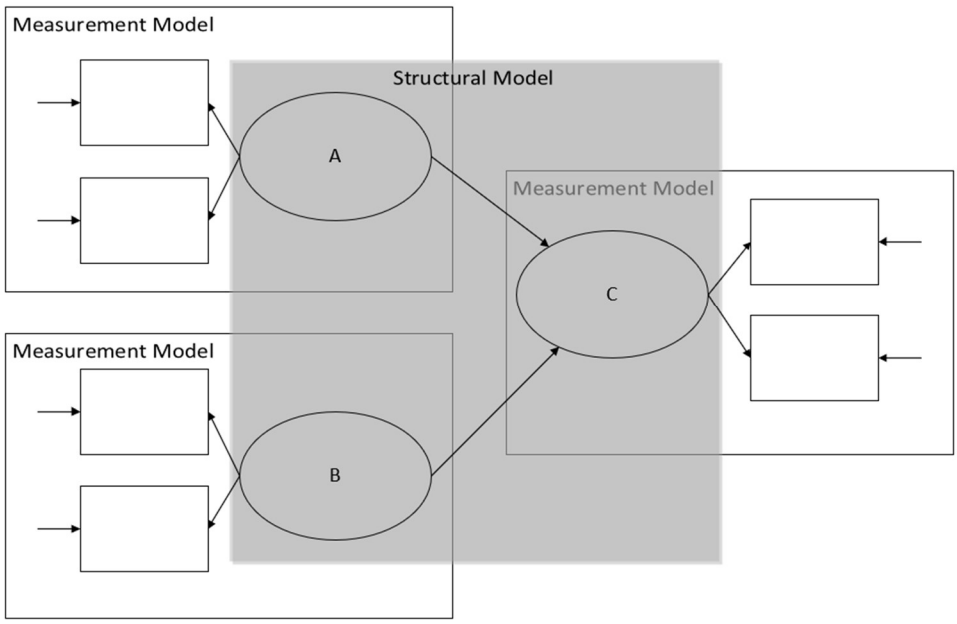

Figure 5: Structural Equation Model (Adapted from Nachtigall 2003)[108]

The measurement model seeks to optimize the amount of variance in each measured indicator variable that can be explained by the latent construct. This is achieved through factor analysis by assigning factor loadings or weights to the measured indicator variables until the explanation of the variation and model fit are optimized. The structural model seeks to explain the covariance between each of the observed variables in the outer model and the latent constructs in the inner model in an attempt to explore causal relationships. At its conclusion, the structural model creates path coefficients that can be interpreted similarly to regression coefficients used in multiple linear and logistic regression models. The difference between SEM and traditional regression methods is that SEM allows researchers to study multidimensional composite predictor and outcome variables as well as multiple

outcomes variables simultaneously, where traditional regression models can struggle with anything other than unidimensional factors and single outcome variables.[109,110]

Two related versions of SEM are used commonly in social science research. Partial Least Squares SEM (PLS-SEM) is a derivative of Covariance-based SEM (CB-SEM) and as such answers some of CB-SEM's limitations but also introduces its own.[111] These issues are discussed below. There is much debate as to which technique is better for studies of causal inference, but it is likely more beneficial to think of the techniques as useful in different circumstances.[112-116]

Beyond the subtle mathematical differences between the two approaches, the main distinction between CB and PLS-SEM rests in how each approach views the unmeasured latent variables.[114] CB-SEM claims the latent variables along with an error term can completely explain the unobservable constructs. PLS-SEM on the other hand, simply views the latent variables created from the model as approximations of the unobservable constructs. For this reason, PLS-SEM is often used when there is little theoretical support for a model and the aim of the research is primarily exploratory.[104] Because of this distinction and the increased theoretical research around CB-SEM, statistical estimates of model fit have been created for this approach. These allow researchers to compare between various models seeking to explain the relationships among the same indicator variables and latent constructs for CB-SEM but not yet for PLS-SEM.[112,116]

Compared to CB-SEM, PLS-SEM does not seek to perfectly explain all of the variance in a model. Rather PLS-SEM seeks to explore and estimate the relationship in variance between proxy variables in a model. As such, it is not as interested as CB-SEM in the covariance between the indicator variables, especially between competing models.[117,118]

Inferences drawn from CB-SEM are based upon model assumptions including lack of extreme collinearity between predictor variables, no outliers, multivariate normality, linearity of relationships, and homoscedasticity of residuals.[119]

Because PLS-SEM does not seek to explain all of the model variation by means of the indicator variables and their weights, it relaxes these model assumptions and can be performed with non-normal distributions and much smaller sample sizes than CB-SEM.[114,120] However, it must also be noted that simulation studies have suggested that CB-SEM estimates are often still valid even if the normality requirement is not met, as long as the sample size is large enough.[115] Thus, in cases of extremely non-normal distributions or with small sample sizes, PLS-SEM often performs better than CB-SEM in simulation studies. Conversely, in studies with nearly normally distributed data and with large sample sizes, CB-SEM can often provide estimates closer to population parameters in simulation studies than can PLS-SEM. However, because SEM is a suite of techniques, even with smaller sample sizes there are alternative non-parametric approaches to CB-SEM that do not rely on assumptions of normality.

There have been a few recommendations for *a priori* sample size estimates for SEM studies. An often used "Rule of 10" suggests models need at least 10 observations per indicator variable.[121,122] This general rule has been validated in simulation models for at least medium effect sizes in normal distributions.[115] However, comparison of *ex priori* power calculations suggest the majority of SEM published studies are under powered even when they meet sample estimates created from robust *a priori* power analyses.[123] Samples with non-normal distributions, analyses including interaction terms, and more complex models

necessitate much higher sample sizes to achieve necessary effect sizes than estimates of sample sizes proposed by *a priori* calculations.[123,124]

Both approaches to SEM involve causal inference of multivariate data.[125] As such they are often complementary to qualitative methods that make no claims of causation, but rather seek to inductively allow researchers to understand complex nuances found in organizational research. This complementary alignment between the two approaches is well suited for mixed-methods research. The next two chapters outline the qualitative phase and chapter five describes the SEM-based phase of this research.

CHAPTER THREE. INFORMATION PRIORITY: A QUALITATIVE STUDY OF MANAGERS' OVERSIGHT OF CLINICAL QUALITY AMONG COMPETING RESPONSIBILITIES

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Introduction

Physical therapists' competing priorities often leave them ineffective at creating measurable change in standardized outcomes measures, even with their advanced training and focus on patient-centered care.[126] While often cited as major components of healthcare quality, the field of physical therapy has historically shown limited uptake of quality measures and evidence-supported examination and treatment procedures.[70] Less than 50% of therapists participate in quality reporting or perform examinations that conform to evidence-supported guidelines.[71,127,128] While the cause of this lack of uptake can partially rest on the individual therapists, organizations and their managers bear much of the responsibility for ensuring quality of care through the support of clinic workflows.[69]

Managers' Role in Quality of Care

Mid-level managers are tasked with implementing corporate policy and mission, but also managing the expectations and needs of frontline workers.[18] While healthcare providers have information needs to facilitate the delivery of quality care, leaders also have their own information needs to oversee the quality of an organization.[19] If impactful, managers effectively synthesize organizational information and diffuse this information to the frontline workers, which facilitates practice optimization.[20] While hybrid clinician-managers are uniquely positioned to link providers to their organization's vision, these dueling roles compete for managers' time and attention.[19,21,129]

Like providers, healthcare managers are pulled in different directions based upon organizational priorities, various stakeholder perspectives, and competing tasks.[130] Their role identities are complicated by the fact that most physical therapy managers provide direct patient care for the majority of their time, limiting the resources they invest in management duties.[80] The act of serving multiple, simultaneous roles often distracts managers from exploring quality-based organizational metrics and proactively managing staff's clinical quality.[21]

Managers and Information Systems

If managers can effectively leverage technology to oversee clinical quality, the efforts of the rest of the organization can be more focused and efficient.[131] Several studies have shown that top-performing healthcare organizations have executive leaders who emphasize quality and use information systems to enhance those efforts.[28,132,133] However, for many reasons information systems in healthcare often distract from rather than support efficient clinical and business processes.

Most physical therapy information systems are not fully integrated nor assimilated into the workflows of the clinical staff and managers.[68] Electronic medical/health records, practice management systems, corporate internal communication systems, and quality improvement/management systems are often used independently for different information needs, requiring employees to access different systems based upon disparate tasks. Siloed applications, often dissociated from organizational priorities, are a major impediment to system use.[66] Additionally, previous studies have not explored the information needs of physical therapy managers and their approaches to fulfilling these needs through the performance of their duties.

In order to understand how to better link information systems with the needs of end-users, organizations must start by understanding the users' information seeking processes.[134,135] The aim of this study was to describe how the varying roles, stakeholder influences, and competing priorities combine into an overarching framework that represents how physical therapy managers seek answers to clinical quality-related questions among their competing priorities.

Methods

Rapid Qualitative Inquiry

This study utilized Rapid Qualitative Inquiry (RQI) based upon the work of Beebe and extended by McMullen and colleagues.[96,98,99,103] RQI is an iterative approach combining semi-structured interviews, observations, and team meetings for analysis and study process modifications. This particular study was part of a larger mixed-methods study exploring physical therapy managers' use of clinical information systems to manage clinical quality. This study was granted exemption by the Institutional Review Board at Oregon Health & Science University (OHSU).

The research team consisted of seven individuals, chosen for variety in perspective and expertise. The domain experience of five individuals included qualitative methods, physical therapy, medicine, and varying levels of informatics training from one to five years. Two additional team members were faculty in the OHSU Department of Medical Informatics and Clinical Epidemiology and Division of Management with expertise in qualitative methods, healthcare leadership, and research design. Additionally, the team consulted with navigators from each of the study sites to test inferences and member-check

information and themes. The team approach allowed for much broader and richer perspectives than could be achieved with a single researcher.

Sampling Strategy

Seven companies were invited to participate in the study, seeking diversity of organizational size and structure, clinical information system use, and focus on clinical quality. Five organizations agreed to participate. Each organization operated from four to more than 500 outpatient clinics. Organizations with fewer than four clinics were excluded since these organizations often do not employ managers. The study organizations operate primarily in the northwestern United States and are described in Table 1.

A navigator, identified at each organization, served as the primary point of contact for the site visits. This organizational leader nominated individuals directly involved in the management of clinic staff. The primary emphasis was to investigate their oversight of clinical quality within clinics. We sought individuals with a range of management experience and performance, as assessed by our on-site navigators, organizational leadership, and nomination from other interviewees. Additionally, we interviewed organizational leaders who were responsible for defining corporate vision around quality improvement and prioritizing corporate initiatives.

Analysis

The interview, observation, and analysis methods have been thoroughly described previously.[136,137] Pairs of team members completed site visits according to uniform interview and observations guides (Appendices A and B). Transcripts of these interviews were coded according to a standardized codebook. Through an inductive immersion/crystallization approach researchers identified key themes. The team added rigor to help control for

researcher bias through reflexivity exercises and triangulation via inter-organization comparisons, study-participant member checking, and comparison between team members' conclusions. The team used NVivo qualitative analysis software to assist in analysis and data organization (NVivo 12, QSR International Pty Ltd, Doncaster, Victoria Australia).

Role of the Funding Source

This work was supported by the Foundation for Physical Therapy under a Promotion of Doctoral Studies (PODS) scholarship – Level I; and the National Library of Medicine under clinical informatics training grant # T15-LM007088. The funders played no role in the design, conduct, or reporting of this study.

Results

The team visited 26 separate clinics interviewing and observing 40 individuals over eight months. The roles of the study participants are outlined in Table 2. Based upon the multiple team discussions and confirmed through study site member checking, the team identified several themes. A representation of quotes for each major theme are presented in Table 3.

Theme 1: Balance between managerial and professional priorities

All of the organizations held managers accountable for several business deliverables. These were components a thriving business unit should produce. They were divided into those the manager could directly influence and those that were outside of the manager's direct control, but integral to the health of the organization (respectively termed direct and indirect deliverables below). Described in more detail through the subsequent themes, these deliverables combined into a cohesive framework (Figure 1), attempting to balance

competing priorities. Circles denote the direct deliverables and ovals the indirect deliverables. The size of the objects indicates the level of focus and amount of time managers estimated spending overseeing these domains.

Direct deliverables

Managers described focusing primarily on tasks related to clinical operations, corporate compliance, human resources (HR), and direct patient care. To achieve these deliverables, managers typically oversaw a comprehensive set of metrics and processes. Governing these deliverables required the majority of managers' time.

Working as hybrid clinician-managers, providing direct patient care dominated the direct deliverables. Managers estimated that they spent the next highest amount of time overseeing clinical operations. They utilized uniform operational metrics (described in Theme 3 below) for these duties. Managers often deemed the remaining direct deliverables, "putting out fires". These typically involved dealing with HR and compliance issues, often with a reactive versus a proactive approach.

Indirect deliverables

While managers concentrated the majority of their focus on the management of direct deliverables, they were ultimately concerned with indirect deliverables that were largely outside of their control. Indicated by large white ovals in figure 1, these included financial results, quality, and experiences of both patients and employees. As described in Theme 5 below, all managers received incentive salary based upon the financial performance of their business units. While they regularly reviewed the profit margin of their clinics, they spent more time managing the direct deliverables as lead indicators of the eventual profits.

Managers reported a sense of personal responsibility and commitment to ensuring their business units were delivering exceptional experiences for their patients and employees, yet very few managed these deliverables with the focus they applied to oversight of the financial deliverables. As described in Theme 3 below, some organizations followed metrics that touched upon patient and employee experience, but their focus on and interaction with these metrics was much less systematic than for the financial deliverables.

Theme 2: Stakeholders influence on managers' priorities

None of the managers had complete autonomy. Instead, their work was heavily influenced by other stakeholders. These included patients, payors, corporate executives, supervisors, and subordinate employees, each having varying levels of influence over the managers' daily actions and focus.

Corporate Influence

All managers in this study were required to devote the majority of their time to direct patient care. As a result, all managers stated that they did not have adequate time to accomplish their administrative duties, often working outside of their regular work hours on managerial tasks. The influence of the corporate stakeholders will be described in more detail in Theme 3 below.

Patient influence

While managers were primarily focused on the needs of their patients, they also directed attention to their staffs' patients. All managers defined clinical quality with a strong emphasis on patient-centered care and patient-perceived value. However, managers' focus on the perspective of their staffs' patients typically emphasized dealing with negative online

reviews. Many managers reported spending strategic planning time both individually and with their staffs, developing systems, processes, and programs to better their service and ensure a positive experience for their patients. However, managers rarely reported measuring if those efforts were impactful for patients.

Payor influence

All managers reported payor mandates such as documentation and billing/coding requirements, and authorization mandates took an inordinate amount of their time compared to the impact of these tasks on patient outcomes. However, since these were required for reimbursement, managers were compelled to attend to them, often decreasing their available time to focus on other areas managers felt would be more impactful.

Subordinate employee influence

The majority of managers acknowledged their role in ensuring their staffs were supported and thriving. This included tasks like clinical mentorship, goal setting, performance reviews, engagement activities, and oversight of training and professional development. While satisfying all of the abovementioned stakeholders was a priority for managers, systematically attending to the needs of subordinate employees often was not. While nearly all managers expressed a strong desire to support their staffs, the majority stated that time focused on their employees was neglected when they were busy with other tasks.

Theme 3: Managers' internal conflict

The managers' focus was heavily impacted by the stakeholder influences cited above. With respect to their daily focus, serving all of these various roles often left managers feeling

conflicted, as in this quote: "The right thing to do is get that patient taken care of and do it quickly, but how do other responsibilities and things kind of fall into place in and around those work hours?"

Direct patient care

Emphasized by the size of its circle in Figure 1, all managers spent the vast majority of their time providing direct patient care. One manager voiced a common frustration with the expectation to see patients nearly 40 hours per week and manage on the side: "It's like how am I supposed to do that? I feel like that's two jobs you want me to do simultaneously."

When managers were pressed for time, developing relationships with their staffs, marketing, and exploring their business metrics received little proactive attention. Interestingly, most managers cited these factors as high priority items for the success of their business units. Some managers were afforded dedicated administrative hours, but most did not block these times and thus, often found themselves overbooking these times with patient appointments. Conversely, managers who maintained focus on these administrative tasks regularly blocked time in their schedule.

Other distractions from administrative priorities

In addition to managers' draw to direct patient care, they reported spending a great deal of time ensuring their staffs were meeting documentation and reporting compliance for insurance payors. Despite the time they spent focusing on these items, managers saw little value in them. None of the managers felt payor mandated reporting helped them to understand the quality of patient care as either a clinician or manager.

Managers spent a considerable amount of time, "putting out fires". These included a myriad of HR and payroll tasks in addition to dealing with clinic scheduling, and employee illness coverage. They felt these items were unavoidable and they could typically not prepare for them, but rather had to deal with them in the moment. However, dealing with these issues took a considerable amount of time.

Administrative priorities

With their small amount of non-patient-care time, managers typically focused on marketing, strategic planning, attending meetings, completing performance reviews, clinical mentoring, and reviewing metrics. As stated above, all managers primarily emphasized reviewing operational metrics. Depending on the organization and individual facility, these metric reviews happened anywhere from daily to quarterly. Consistently, managers reviewed the number of patient visits and new patients, units billed per visit, provider productivity, cancelation and no-show rates, and visits per new patient. Most organizations had formal reporting structures that made it easy for managers to review these metrics.

Concerning quality-based metrics, most managers focused on measures of patient satisfaction via the Net Promoter Score, which has been studied for use in healthcare.[138,139] Rather than emphasizing aggregate scores as recommended, most organizations focused on individual patient responses in addition to online reviews. Some of the organizations reviewed patient-reported outcomes (PRO) scores. Even when consistently collected, most managers did not feel PRO scores were a good representation of patient quality and often distrusted the numbers. These issues with measuring quality will be described in more detail in Theme 4 below.

Rather than focusing on outcomes scores like PROs to understand the quality of care in their clinics, most managers utilized operational metrics as a proxy for quality. For instance, many used cancellation and no-show rates or the count of new patients as an indication that their therapists were delivering quality care. Most managers described a somewhat circular relationship between quality and operations. They claimed either quality outcomes flow from sound operations, or profit is a result of quality care, so saw little added value in measuring quality directly. Thus, many managers rationalized their focus on operational numbers as their primary quality metric.

Theme 4: Issues with measuring and defining quality

In addition to the influences cited above, several additional factors dissuaded managers from systematically measuring quality. Managers across the study organizations felt quality is a complex combination of constructs and as such, cannot be measured with a simple PRO. In spite of this sentiment, all organizations collected PROs from patients, most often in response to insurance payor mandates or from a feeling of professional responsibility to collect them.

PRO measurement concerns

Organizations typically measured whether patients were completing an initial and a discharge measure, but very few monitored PRO score change over the episode of care. Even fewer organizations aggregated these scores to show provider performance across populations of patients. In addition to a lack of faith in the ability of a PRO to represent clinical quality, managers generally feared how therapists would receive critique of the measurable quality of the care they deliver. One organization implemented a provider quality scorecard shortly before our site visits. This organization spent a great deal of time

preparing managers to have conversations with therapists so as not to suggest managers were judging them. Managers were fearful that focusing on clinicians' PRO scores could be deflating for clinicians who cared deeply for their patients, but did not perform well on PRO change scores. This hindered managers from utilizing metrics to define clinical quality.

Alternative means of evaluating quality

Because of these measurement concerns, most organizations assessed the quality of their staff through direct observation and eavesdropping. Nearly every manager stated that they listen in to patient encounters in their clinics while they are treating their own patients. Managers also perform random chart audits to check for documentation quality as well as assess the clinical reasoning process of the clinician. Additionally, managers typically performed clinical mentoring with their staff where they often either co-treat patients or performed verbal case reviews. Most managers felt this process gave them a meaningful assessment of clinical quality, but acknowledged this approach would not be feasible for managers with large staffs due to the time necessary to perform these tasks.

Theme 5: Impact of organizational culture and structure

Organizational structure had little impact on the way managers performed their duties. Managers in hierarchical, matrixed, and flat organizations, as well as large versus small organizations, all behaved similarly. More notably, managers in organizations that emphasized "managing to the metrics" had much more attention to metrics. Similarly, managers in organizations that emphasized the value of collecting PROs generally focused on these measures more deliberately.

The greatest influence on a manager's metric checking behavior was interaction with a direct supervisor who met with the manager regularly to review metrics. Managers in some of the organizations had no regular meetings with supervisors while other organizations mandated these meetings weekly. Managers with direct supervisor interactions gave very consistent descriptions of the operational and quality metrics they regularly reviewed.

Role of executive focus

The executives in some organizations placed quality measures as a primary aim. Executives in all of the organizations cited clinical excellence, clinical outcomes, and positive patient experience as elements of their corporate missions. However, only a few measured these aims. Managers in organizations with less focus on formal quality measures had notably more variability in their metric checking processes. Some of the managers in these organizations focused on quality metrics primarily out of an intrinsic drive. Other mangers in the same organizations did not focus on quality metrics at all, even though often their staffs were collecting these measures on nearly all patients. Thus, executives' attention to measuring quality had a strong influence on how managers prioritized quality metrics. Whether an organization purchased dedicated quality-based information systems had less apparent impact on the focus of the managers than did their executives' priorities.

Role of Incentives

All managers in the study received some form of incentive salary. Most managers claimed that this influenced their focus on metrics. However, one organization provided managers with incentives based on organization-wide performance, and those managers did not feel incentives had any impact on their daily focus. In the remaining organizations, managers were incentivized as a percentage of their business units' profits. However, some

managers in these organizations still felt the profit of their business unit was not within their control and thus did not significantly motivate their daily focus. In all organizations, managers reported corporate culture and their intrinsic motivation had a greater impact on their behavior than did financial incentives.

Theme 6: Manager as a professional

Managers in the study organizations ranged from one to over 20 years of experience in their respective roles. As such, they exhibited varying levels of competence, confidence, and focus. Many of the more experienced managers also took on additional roles in the organizations including ownership. While most organizations gave managers a great deal of latitude in how they chose to manage their respective clinics, even the most experienced managers were held to very firm productivity standards. As cited in Theme 3 above, most managers were required to treat patients the majority of their time. Executives in many organizations felt that if managers were to block treatment slots to perform administrative duties, this would decrease managers' productive time, resulting in less revenue.

Especially the newer therapists reported feeling supported in their growth as a clinician through activities like clinical mentorship, continuing education, and clinical in-services. However, few managers felt their organization took an active role in understanding their individual goals apart from the goals of the clinic. They felt the organization assumed their primary goals were related to clinic success and not personal development. Some managers desired more clinical training, while other managers expressed interest in more structured business training to help them both in interpersonal management skills as well as attending to their various metrics. Organizations often proactively attended to professional development of newer therapists, but less to the more tenured managers. Managers

themselves regularly placed their time and focus on the goals of the clinic above their own professional development.

Discussion

Consistent with previous research, managers were pulled in numerous competing directions.[18,23,130] Their foci were heavily influenced by the perspectives of the various stakeholders they served. Managers directly attended to certain aspects of their practices and indirectly attended to others while trying to maintain equilibrium. As illustrated in Figure 1, it is as if they were attempting to balance aspects of administrative duties upon a seesaw of competing priorities. Supporting previous research, direct patient care monopolized managers' time.[19,23,140,141]

With the remainder of their time, managers balanced another seesaw of administrative priorities, dominated by operations and compliance duties and HR issues. The indirect deliverables were upheld and shaped by the direct deliverables on which the managers focused. Consistent with past research, because they were indirectly governed, managers spent little time proactively attending to them.[142] True of all healthcare providers, competing priorities overshadowed managers' personal growth, which they and the organizations often neglected.[143] Financial results and patient experience were clear priorities for the organizations and were supported by nearly everything the organization did. However, they were the most removed from proactive management, typically measured only in retrospect.

Due to competing priorities and commitments, managers resorted largely to impromptu management strategies. Direct patient-care, which monopolized managers' time, often hindered them from strategic planning and proactive management. Managers would

benefit from more structure in their schedule and additional support for their management efforts. This was most needed in their oversight of clinical quality.

As shown in Figure 1, clinical quality comprised a minority of manager's focus and was generally governed through emphasis on other factors believed to support quality. Rather than focusing on metrics, managers emphasized eavesdropping to appreciate the clinical quality of their staffs, which has been seen in past research.[144] With the corporate emphasis on financial results and its primary underpinnings (operations and compliance), managers had little time and attention to devote to quality management. This was compounded by the challenges with measuring and defining quality which have been shown in previous research.[128,145,146] Consequently, managers focused on operational and compliance metrics as proxy measures of quality. Consistent with past research, this gave managers a false sense of managing quality when in fact they were not attending specifically to quality measures.[71,72] However, as demonstrated by past research and one of the study organizations, when coupled with organizational prioritization, managers' strategic use of clinical information systems can be one element supporting improved quality-based focus.[147,148]

Limitations

Because of the exploratory design of this study, these inferences should be systematically tested in future research. Only five organizations (mostly in the northwestern United States) participated in this study, limiting generalizability to other regions. Additionally, participants were interviewed during their work time and were nominated by their organizations. It is possible that they withheld candor or we unknowingly excluded individuals with conflicting viewpoints from the sample. Finally, to test the inferences

drawn from this study, this research is part of a larger study including an anonymous survey, which should allow for more generalizability of our results.

Conclusion

This study is the first published inquiry into the competing priorities of physical therapy managers. The results suggest managers would benefit from accountability to quality metrics, time and resources for quality-based administrative tasks, and improved balance between organizational focus on financial results and the experiences of patients and employees. Understanding the contenders for managers' attention is the first step organizations must take in helping them to refocus on balanced corporate priorities. This balance is necessary to thrive in emerging value-based care models.

Tables and Figures

Organization	Accepted?	Setting	Navigator's role	Company size (Clinics)	Geographic coverage	Quality-based information system
A	Yes	Private – Urban & Suburban	Clinic Director and corporate Quality improvement	25	Northwest	Purchased, dedicated system
B	Yes	Private – Urban & Suburban	Clinical Research/Quality	800	National	Internally-developed EHR
C	Yes	Hospital – Urban & Suburban	Lead Therapist, Quality Council member	6	Northwest	EHR-based reports
D	Yes	Private – Urban	Owner and Clinic Director	4	Northwest	Purchased, dedicated system
E	Yes	Private – Urban & Suburban	Owner and Clinic Director	4	Northwest	Purchased, dedicated system
F	Declined	Hospital – Urban & Suburban	NA	15	Mountain	Internally developed dedicated system
G	Declined	Private – Rural & Suburban	NA	24	Mountain	EHR-based reports

Table 1: Study site characteristics

Role	Count	Average years of physical therapy experience (SD)	Average years of experience in current role (SD)	Gender
Manager	18	14.78 (9.40)	7.33 (6.86)	33% Female
Supervisor	3	8.6 (3.49)	2.33 (0.47)	67% Female
Regional Director	6	9.17 (3.44)	2.17 (2.99)	20% Female
Owner	4	15.0 (10.02)	8.0 (6.4)	25% Female
Executive	9	22.0 (8.27)	3.72 (3.58)	56% Female

Table 2: Study participant characteristics

Theme 1: Managers' deliverables	Theme 2: Stakeholder influence on managers
"I'm typically doing physical therapy, but in any time that I have remaining…I'm looking into things like, we have lost patient logs, so I'm making sure that people are getting scheduled appropriately, I'm checking in on if somebody has a light schedule, why is that schedule light? How can we like work on filling that?"	"If I'm really pressed for time, I will sub out an in-person clinic meeting with a phone meeting, which definitely saves lots of time because you don't have the driving, suck of time, but then you miss out on the human interaction piece of it. If you do that too much then I've noticed stuff just starts to fall apart."
Theme 3: Managers' focus	**Theme 4: Issues with measures of quality**
"We've been drinking through a fire hose. Let's just do what needs to be done and we'll figure out the other stuff later." "I think that I would be easily tempted to have someone call in and say I really need to get in and I would be like, okay, fine come in. So, if those aren't blocked off and that's just not a time that we're available, I think I would end up treating patients for those hours." "If [quality] is going well, everything's going well, right? I mean, if your quality sucks, your numbers are gonna suck, if your numbers suck, you should probably look at your quality."	"I think there's a bias issue and I think that people, in general, want to feel like they're doing a good job and they usually care. It's a very emotional profession and people don't like hearing that all the emotion they're putting into something isn't helping the person." "If you start with a foundation of I don't trust the numbers, does anything else matter?"
Theme 5: Organizational culture/structure	**Theme 6: Manager as a professional**
"I need to know now because I'm going to get a phone call at 10:00. I need to do a little bit of digging to understand what happened there." "She does a great job. We have a meeting once a week and we review these numbers so if I have questions I can ask her or if I want to find more data she can help facilitate that for me."	"I think like not just the clinic but what do you need? Like, what are your goals professionally? You know, where do you want to go?" "Anytime you disconnect that and say that patient care is different than leadership management, I think that you now run the risk of really losing what really keeps the lights on, what keeps your doors open."

Table 3: Themes and Representative Quotes

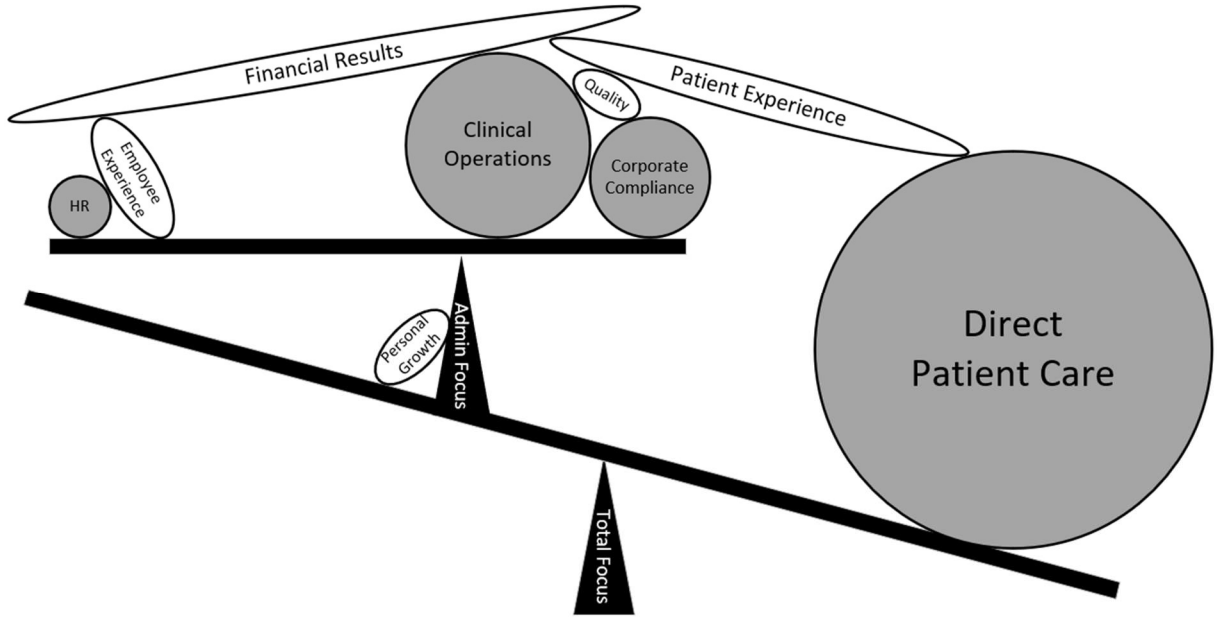

Figure 1: Proposed framework of the balance between managers' competing priorities

CHAPTER FOUR. FACILITATORS AND BARRIERS TO PHYSICAL THERAPY MANAGERS' USE OF CLINICAL QUALITY INFORMATION SYSTEMS: A QUALITATIVE ANALYSIS

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Introduction

Healthcare, including the field of physical therapy (PT), is undergoing a clear shift from a fee-for-service model to one that is focused more on quality and value than the quantity of care.[149] However, the meaning of the term quality depends on the perspective of the stakeholder (patient, provider, payor, etc.). Often differing stakeholder perspectives conflict with one another.[150] The healthcare "Triple Aim" framework describes a need for balance between perspectives of the patients, the health of populations, and cost per capita.[151]

Clinical Information Systems and Clinical Quality

Costs related to billing and insurance-related activities account for 17% of all healthcare spending.[152] Rather than contributing to direct patient care, much of the financial resources are diverted to pay for administrative payor mandates that do not meaningfully improve patient outcomes.[12] A significant portion of this expense is related to the purchase of clinical information systems (CIS) which have failed to show a systematic positive influence on quality outcomes measures.[13,14] Previous studies suggest that these failures are not solely based upon the information system itself. Often they are more related to the implementation process and the healthcare organization ecosystem in which the system is implemented.[26,27,29,153]

There are notable examples of organizations engaging both providers and payors by utilizing robust information systems to implement effective value improvement initiatives.[41,42,102] One commonality between these organizations is strong executive leadership, shepherding a transformation into a learning organization. This transformation requires integrating robust information systems into key workflows and connecting all relevant stakeholders.[154] Proactively making improvements in quality of care requires systems thinking and consideration of multiple, often conflicting perspectives.[24,155]

System-wide CIS implementations have been shown in some studies to be associated with higher quality, especially process-related, measures.[13,14,28] However, other studies show information system implementations relate to worse outcomes, increased medical errors, and safety concerns.[156] Additionally, if these systems are poorly implemented with limited institutional control, CIS can simply contribute to provider burnout rather than improved care quality.[11,28] For this reason, the "Triple Aim" of healthcare has been expanded to include a focus on provider wellbeing.[157] Upper and mid-level leaders of an organization are afforded powerful opportunities to establish a vision around quality improvement and also to support frontline providers' personal investment in quality outcomes.[16,17]

Managers' Use of Information Systems

When managers can efficiently utilize CIS to oversee clinical quality, providers become more invested in quality.[131] Likewise, when executives use information systems to monitor quality, the outcomes of the entire organization are enhanced.[28,132,133] However, most PT managers are busy hybrid clinician-managers.[21] Thus, if they are to use CIS in their management duties, these systems must be easy to use and integrated into their daily

processes. Unfortunately, rather than supporting efficient clinical and business processes, these information systems often simply distract and frustrate providers and leaders.[11]

In PT practices, most information systems are not fully or even marginally integrated with one another.[68] Additionally, they are rarely assimilated into the workflows of the clinical staff and managers. Electronic medical/health records, practice management systems, corporate internal communication systems, and quality improvement/management systems utilized in daily workflows are often used individually rather than combined through interfaces. This requires employees to access different systems for each work task. Because of these inefficiencies, information systems rarely serve to support organizational priorities. Rather, clinical and business workflows are often modified to account for system limitations.[68,158,159]

User Acceptance of Information Systems

End-users do not interact with information systems in a vacuum. Rather, they function within a sociotechnical system consisting of individuals, technology, organizational factors, and characteristics of the task for which the information system is being used.[33] In healthcare, Sittig and colleagues described and tested an eight-factor sociotechnical model.[26,27] These eight factors include clinical content, information systems, human-computer interactions, people, workflows, organizational policies, external rules and system monitoring. Within these sociotechnical systems, individuals' use and acceptance of CIS is shaped by their own perceptions and attitudes, but also factors external to the individual.

While sociotechnical models take the perspective of the entire organization, the Unified Theory of Acceptance and Use of Technology (UTAUT) seeks to explain contributions to end-users' embrace of technology from the perspective of the end-user.[48,53]

The UTAUT framework (shown in figure 1) identifies five constructs that predict an individual's intention to use, and subsequent use of, an information system. Three of the constructs relate to the individual's perceptions and actions, including performance expectancy (the perception of the system helping with the individual's task-related needs), effort expectancy (how easy the individual believes the system is to use), and habit.

The remaining UTAUT factors relate to external pressures on the individual, including social influence (how others in the individual's social world feel about the system), and facilitating conditions (those conditions that externally influence the individuals' use of the system). These latter two constructs align with the formally defined factors of sociotechnical models. Appreciating its place as a component of broader sociotechnical models, UTAUT serves as a useful framework to represent the impact of personal and external aspects of the ecosystem in which individuals function. For this reason, it was a suitable model to explore as a component of this study. However, UTAUT has never been examined for its application to PT managers.

To understand how to better connect information systems to the needs of end-users, organizations must first clearly understand the needs of these individuals as well as the make-up of the sociotechnical system in which they operate.[134,135] Likewise, the use of UTAUT in a specific environment should include contextual factors specific to that area of application.[54] The aim of this study was to identify the contextual factors that influence the manager's use of their quality improvement information systems. These additional constructs will be used in future UTAUT research focused on PT managers.

Methods

Rapid Qualitative Inquiry

A team of researchers employed Rapid Qualitative Inquiry (RQI) drawn primarily from the work of Beebe and extended by McMullen and colleagues.[96,99,103] We modified these methods only slightly to fit the details of our study setting. RQI is a team-based ethnographic approach that utilizes a combination of semi-structured interviews, observations, and team meetings. This particular study was part of a larger mixed-methods study exploring PT managers' oversight of clinical quality in the midst of all their competing priorities. The study was classified as exempt by the Institutional Review Board at Oregon Health & Science University (OHSU).

The research team was composed of seven individuals with a variety of perspectives and expertise. Five team members had experience in qualitative methods, PT, medicine, and had varying levels of informatics training from one to five years. Two additional team members were faculty in the OHSU Department of Medical Informatics and Clinical Epidemiology and Division of Management with expertise in qualitative methods, healthcare leadership, and research design. Additionally, we selected navigators from each of the study sites to test the team's assumptions and member-check information and themes. The team approach allowed for broad perspective and triangulation of themes and conclusions.

Sampling Strategy

Seven organizations were invited to take part in the study with five agreeing to participate. These organizations ranged from large corporate (> 100 clinics) to small corporate and hospital-based clinics. Organizations of differing sizes offer unique challenges

and opportunities that were expected to influence managers' actions and priorities. Organizations with fewer than four clinics do not typically employ managers, and thus were excluded from the study. The participating organizations, described in Table 1, were located primarily in the northwestern United States.

The navigator from each organization made the initial nomination of study subjects. The study sought individuals based upon their participation in the management of clinic staff, specifically the management of clinical quality within facilities. The research team also interviewed organizational leaders responsible for defining corporate vision around clinical quality and prioritizing corporate initiatives. As assessed by the on-site navigators, organizational leadership recommendations, and nomination from other interviewees, we recruited individuals of varying levels of experience, perspective, and managerial performance.

Interviews and Observations

Because RQI utilizes a team approach, the researchers used triangulation (multiple study sites, subject perspectives, and researcher views) to refine themes and verify conclusions. Team members performed semi-structured interviews and observations of managers using their various information systems.

A field guide, including interview questions and an observation guide, was pilot tested on four clinics in a single corporation prior to the first formal study site visit (Appendices A and B). Interview questions, were modified slightly between site visits to help reframe emerging themes in accordance with the recommendations of the RQI method developers. Interviewers worked in pairs for the majority of the semi-structured interviews

and observations, taking field notes during the interview. Team members audio recorded all interviews and the recordings were professionally transcribed following the site visits.

Managers were then observed utilizing their CIS as they assessed the clinical quality of their staff. These systems included electronic medical/health records, practice management systems, dashboard applications, ad-hoc reports, and dedicated quality management systems. Managers were asked to think aloud as they navigated the systems and reports. They were asked clarifying questions about the design of the interfaces, their impression of the system, and their specific processes for utilizing the information. The research team also observed ergonomics of the computer setup, related paper-based methods of managing quality, and environmental factors. Interviews and observations continued until adequate saturation was achieved.

Analysis

A portion of the analysis centered on the UTAUT constructs listed above, acknowledging these constructs guided the study development. In an attempt to broaden the team's perspective and challenge biases and pre-conceived notions, a more reflective and immersive approach was also performed through inductive review of transcripts and field notes.[160,161] The study sought both to describe the themes that emerged organically from interviews and observations, and to assess for the presence of the factors described in the UTAUT model. By employing both grounded and framework-based analysis strategies, we aimed to achieve both breadth and depth of understanding of the factors that influence managers' use of information systems, especially focusing on the impact of the UTAUT factors on these managers' actions.

Interviews, observations, and analysis proceeded iteratively.[161] By conducting team meetings and preparatory work prior to site-visits, interviewers reflexively examined their own potential biases and assumptions. Dyads of researchers coded each interview transcript and met to seek coding consistency and challenge inferences after the pilot and first formal study organization visits.

The research team met after the pilot site visits to further standardize coding. Dyads of team members presented codes to the group and these codes were compared to those of other dyads. The team collapsed similar codes and assigned overarching category and sub-category titles. Additionally, we held team meetings after the first two rounds of site visits to refine the list of codes and update the field guides.

For the remaining interview coding rounds, the list of categories served as the primary codebook for transcript coding. However, with each of the first two site visits we modified the codebook based upon emerging codes established by the team. After the second round of site visits the remaining transcripts were coded by a single team member since the team had established sufficient consistency in coding. These codes also served as the initial framework for theme generation. The group agreed upon these themes and adjusted them based upon emerging information through the site visits. To assist in analysis and study material organization, a single team member (CH) entered the codings from interview transcripts and field notes into a qualitative data analysis software application (NVivo 12, QSR International Pty Ltd, Doncaster, Victoria Australia).

In order to document perceived biases, assumptions, and preliminary thinking on themes and codes prior to and following site visits, interviewers completed analytic memoing. Post-site-visit meetings were held to review information from the visit, explore

preliminary themes, and modify the interview guides as needed to better test emerging hypotheses and themes. Finally, at the conclusion of each site visit as well as after the conclusion of the study, we utilized member checking with study participants to test our preliminary themes and conclusion. Using this iterative immersion/crystallization approach allowed team members to use the interviews, reflexivity, multiple transcript reviews, team meetings, and member checking to systematically develop emergent insights through each phase of the data collection and analysis process.[162]

Results

Over eight months the team interviewed and observed 40 individuals and visited 26 separate clinics within five organizations. The breakdown of the specific characteristics of the study participants are listed in Table 2. Through the multiple team meetings and study site member checking, the team identified several themes relative to the study aims. Many of these themes included aspects of UTAUT and broader sociotechnical model elements, but the majority of the themes did not fall exclusively within either framework.

Theme 1: influence on manager's personal agency

None of the managers had complete personal agency since they worked for organizations that directly and indirectly influenced their actions. That said, even within a single organization we observed individualized approaches to tackling those managerial tasks, indicating managers had some level of autonomy. Some managers desired more organizational guidance for their daily tasks while others voiced a desire for more freedom. All managers described a tension between their competing roles.

Hybrid clinician-manager

A major sub-theme represented in all of the study sites was the impact of the managers serving dual roles of manager and clinician. Most of the managers interviewed were required to spend at least 80% of their time treating patients and often saw themselves as primarily clinicians. Many managers saw patients 40 hours per week and conducted their administrative duties by extending their hours or during free moments throughout the workday. The majority of interviewees stated this hybrid role negatively impacted their focus on clinic management.

Because of their primary draw to treating patients, most managers felt time limitations forced them to neglect interpersonal leadership tasks such as connecting with staff. Additionally, limited time hindered many managers from systematically utilizing organizationally-established metrics to govern their practices. One interviewee put it this way:

"Ideally I would like to have more time for management and being able to work actually on the practice versus in the practice, in the trenches. I love clinical practice. That's actually what I want to do. I never want to get out of clinic practice completely, but we're kind of at this cusp or threshold [between historical ways of operating and necessary changes for the [future]."

This lack of time to manage was often cited as a major barrier to proactively utilizing CIS to explore clinic metrics. We found that those managers with protected time in their week dedicated to administrative duties reported more consistency in their management approach and spent more time connecting with their staffs than those managers without dedicated administrative time.

Additionally, as practitioners themselves these clinician-managers generally showed a strong desire to do what is best for the patient. As managers they voiced a need to balance this desire with doing what is best for the organization. With a need to optimize clinical productivity, billing efficiency, and other metrics, managers reported simultaneously keeping the best interests of multiple stakeholders in mind. The majority of the metrics the managers drew from the CIS were operationally focused. However, much of their verbalized priorities revolved around maximizing value for the patients and supporting their staffs.

Stakeholder influence on manager's priorities

As noted above, the hybrid clinician-managers limited their management tasks in order to focus on the clinical care of their patients. Thus, the needs of the clinician-managers' patients had the strongest influence on their daily prioritization of tasks. Managers spent a great deal of their time overseeing documentation and billing compliance issues in an effort to maximize reimbursement. Insurance mandates were cited by nearly all managers as a primary area of focus. Managers also spent a great deal of their time working on staffing and human resources issues as well as business-related tasks such as budgeting and marketing. Thus, the patient, employee, and business stakeholders influenced the work of the managers and often this drew manager's time away from utilizing the quality-based CIS systems most organizations possessed.

Theme 2: variety and use of information systems

All of the study organizations utilized an electronic medical record that was capable of generating reports for managers. Additionally, most organizations utilized other information systems such as practice management, human resources, payroll, knowledge

management, patient home exercise program management, data visualization, and quality-based information systems. Very few of these systems were integrated, which required managers to query each system individually to meet specific information needs. The hospital and large corporate organizations employed systems analysts who were responsible for mining some, but not all, of the information required by the managers. However, even in these larger organizations, the managers spent time retrieving data from various reporting systems.

A few of the organizations utilized data visualization applications to help managers interpret their data. These visualizations included both tabular and graphical views and allowed managers to filter and stratify data by multiple factors. Additionally, in some of these organizations the software was able to "push" information to the manager by email rather than the manager manually "pulling" data from a report. Even in those organizations that did not have visualization applications, managers were often given spreadsheets and Excel-based graphs of key metrics.

Only two of the five study organizations utilized dedicated quality-based information systems. The majority simply mined quality data from their medical record applications. There was no appreciable difference in the managerial focus on quality metrics between the organizations with dedicated quality-based systems and those without these systems. A larger determinant of CIS use for quality management appeared to be organizational mandates and culture, the manager's personal preference, habit, training, and ease of use of whichever system was used. These determinants are discussed in more detail in the UTAUT section below.

Theme 3: process of gaining knowledge to manage

As noted above, some managers, especially in the larger organizations, were "pushed" metrics to review rather than "pulling" the information manually. All of these managers felt this was a major driver of their eventual use of the various metrics. Most often these managers received an email with a link to specific metrics. An even greater facilitating factor in one organization was the manager's ability to define desired metrics filtered by certain factors and delivered at defined times through the week. One manager described the impact of these emails:

"I wish there were a few more applicable reports that I could get through Tableau, from a clinic standpoint, that could be e-mailed to me so that I could just click on that link or just see it and not have to actually go open up my computer and access all the reports."

While the remaining managers utilized a strategy of "pulling" information from various information systems, nearly every manager in every study site primarily utilized in-person clinical mentorship or a manual chart review approach to explore the quality of their clinical staffs' care. Managers felt they would see and experience quality care better through this qualitative interpersonal approach than by simply looking at a number in a report. Speaking about his desire to have personal conversation versus look at metrics, one manager put it this way: "I'd rather do a face-to-face with them than look at numbers and just hand numbers in front of them." However, most managers recognized the non-sustainable level of effort for this high-touch approach for more than a staff of a few employees.

Often times this manual chart review was necessary because of how the CIS stores clinical data, as one manager described:

"This is a manual chart review, because for outcome data gathering, it has to be documented in flowsheets to be retrievable information. Prior to me starting here a year-and-a-half ago, the team had already been working on trying to figure out how to get this data. I think they finally gave up and are doing manual chart reviews." While the time limitations and personal preferences of the manager may inhibit them from utilizing CIS to manage quality, their personal and organizational definitions of quality also contributed. Additionally, as voiced by many managers, this inter-personal approach offered them additional context not conveyed through metrics alone.

Theme 4: personal and organizational definitions of quality

The majority of managers across all of the study organizations gave fairly similar definitions of clinical quality. These definitions included elements of patient satisfaction, progress towards patients' goals, clinical-guideline-adherent care, visit utilization, patient-reported outcomes, and progress towards impairment-based clinical goals. Organizations rarely cited process measures as a definition of quality and one regional director put it bluntly: "Clinical quality for me boils down to one thing. It's basically results with the patient." In spite of this sentiment, managers commonly emphasized the therapist's personal connection with the patient as an aspect of quality, as in in this quote: "So, the patient needs to feel that they have a connection with the staff [so]...that they know what they're working on and why they're working on it."

With respect to formal measures of patient outcomes, most organizations utilized standardized patient reported outcomes tools and then emphasized either total change in the outcome score over a PT episode or the amount of change per visit. However, most managers voiced skepticism in these standardized measures as a true representation of

clinical quality. Because of this skepticism a common reason for not viewing these metrics was echoed in this quote: "I believe in data but I also believe that if it's garbage in, it's garbage out… So, I don't know. I don't have a lot of faith in that at this point." When managers did focus on patient-reported outcomes measures, the primary emphasis was often simply on measuring if an intake and discharge survey had been collected, rather than on the change in those scores. Managers claimed this was largely because certain insurance payors now mandate collection of these measures but do not base any decisions on the actual change scores.

Theme 5: prioritizing operational over quality-based metrics

As with the definitions of quality, we saw a striking consistency in the metrics used by managers. These included very standardized operational metrics, some measure of patient reported outcome as cited above, and patient satisfaction. In general, the focus of the managers weighed much more heavily on operational metrics than quality-based metrics. This was seen through the refined systems used to provide operational information to the managers. Most managers received weekly, if not daily, reports on key operational metrics. These were often standardized across the organization and came with clear benchmarks. By contrast, the quality metrics were often delivered quarterly, with no formal benchmarks, and often in a system that required the manager to manually pull the information from a report.

Interestingly, most managers included classically-defined operational metrics when asked about which quality metrics they followed most closely. These often included patient cancelation and no-show metrics, visits per episode, units billed per visit, visits per week, and number of new patients. For some organizations these operational metrics were seen as predictive of quality outcomes. For others these operational metrics were seen as the result

of providing quality care. Regardless of the reason, this connection between operationally-based metrics and quality often served as a barrier to the manager using CIS to explore purely quality-based metrics. This appeared related to two factors. First, managers only had a limited amount of time to view metrics and the operational metrics took priority, often because the manager was held accountable for them. Second, many managers simply felt the operational metrics were an accurate and easy to measure surrogate for clinical quality.

These observations are consistent with our findings that managers were much more adept at working in CIS to gather operational metrics than quality metrics. Additionally, these operational metrics were more "top of mind" as managers could list their top operational metrics with little effort, but generally struggled to list dedicated quality metrics they utilized.

Theme 6: influence of organizational culture and structure on managers' personal agency

Organizational culture appeared to have a greater impact on managers' CIS use than did organizational structure. We saw similar manager behaviors across all of the organizational sizes. Regardless of size, those organizations that had a corporate emphasis on metrics also had managers who used CIS more consistently. Managers at some of the study organizations were held accountable for certain metrics by their direct supervisors. For some organizations, supervisors directly oversaw managers and had regular meetings to discuss metrics among other business topics. Organizations using this approach had much more consistency in the managers' metric checking processes and subsequent CIS use than did organizations with looser supervisory approaches.

All of the organizations reported having some form of regular managerial strategic meetings. However, in companies where the organizations directed the process for meetings with managers, these managers utilized the CIS both in preparation for these meetings as well as for daily management tasks throughout the week. One senior regional director described her relationship with new managers this way: "With new [managers], I'm very hands on and physically walk them through the report and usually I just pick one report a week because it's information overload. Then I physically have to show them, click here; go here." Managers receiving this level of support from their organization reported greater facility with the use of their CIS, greater satisfaction with the systems, and more regular use of the systems. In this regard, a supervisory approach including a layer of oversight of managers appeared to greatly influence managers' behavior and perceptions.

Evidence for the influence of UTAUT factors

Several facilitators and barriers to CIS use were cited within the themes above including stakeholders' influence on managers' priorities, limited administrative time, competing roles, information delivery mechanisms, and managers' accountability to the metrics. Additionally, UTAUT-based factors had a heavy representation in the overall facilitators and barriers we observed.

Several managers directly stated that they did not use certain information systems because they felt the systems did not contain metrics that would help them in their managerial duties. This was most notable in managers choosing to use clinical mentoring and manual chart reviews as their primary means of quality assessment. These managers often had metrics at their disposal, but they did not see the value in accessing these metrics. Additionally, the effort required to use the systems was also a barrier to CIS use. This was

compounded by the fact the managers often had very limited time in which they could perform administrative duties. The most commonly cited design issues included poorly designed interfaces, systems requiring excessive mouse clicking, poorly organized filters, and menus that were difficult to navigate.

More notable than the system-centric factors, facilitating conditions seemed to significantly influence managers' use of the systems. These included training, time dedicated to metric exploration, automated delivery of information, organizational support, and managers' accountability to the metrics. Managers in organizations that emphasized these facilitating factors seemed to have a more keen focus on the metrics in general as well as a more structured process for accessing these metrics in their CIS.

Similarly, social influence heavily impacted managers' CIS use. Those managers who had regular meetings with their own supervisors to review key metrics were more likely to use the CIS on a regular basis to monitor the metrics on their own. Additionally, those individuals who had previously worked for managers who utilized CIS to explore the metrics were more likely to emulate that CIS use. This later point supported the observed impact of habit; managers often attributed either their use or non-use of their CIS to habit above other factors.

Discussion

We offer an overarching conceptual framework in Figure 2 that builds on many aspects of UTAUT and sociotechnical models. Consistent with sociotechnical models, the first set of themes related to actions of the manager while doing their work. These are indicated by the grey circles at the base level of figure 2. The managers had varying levels of perceived personal agency both between and within each organizations. This experience of

personal agency and freedom influenced how they went about defining clinical quality for their staffs, and how they gathered information to perform their quality management duties. Personal agency was exhibited within each of the companies by the lack of uniformity in how individual managers fulfilled their administrative duties across separate clinics within a single organization.

As seen with both UTAUT and the sociotechnical models, managers' personal agency was indirectly influenced by a myriad of external pressures indicated by the black ring surrounding the grey managers' actions in figure 2. Some of the pressures were facilitatory, pushing managers towards using quality-based CIS. Two examples were organizations affording managers time to view the metrics and training them in the use of the CIS. Facilitating conditions like these have been shown in previous UTAUT research to strongly predict healthcare workers' eventual information system use.[63,66] Other pressures were inhibitory, and pulled managers away from the use of these systems. A strong example of this inhibitory pressure was the required hybrid clinician-manager role seen in all of the organizations. This supports previous research which has shown hybrid clinician-managers often neglect their administrative duties due to the pull of patient care.[21]

Represented as the white circles in Figure 2 are the organizations' structural influences on managers' use of CIS to manage quality. As seen in sociotechnical models, these included the metrics on which the organizations focused, the overarching organizational structure and culture, and the systems used by the business. All of the study organizations chose a fairly soft accountability approach relative to quality-based metrics and CIS use which, as predicted by UTAUT factors, contributed to managers' inconsistent CIS usage. Through direct incentives or penalties and mandates to use systems to regularly

report on key metrics, organizations could have compelled managers to comply with system use and metric performance compliance. This approach is effective, but likely not sustainable. This was seen with the keen focus managers had on billing compliance issues mandated by payors. However, despite their compliance, managers all voiced extreme frustration at these mandates that, in their views do not improve patient care.

Organizations that facilitated system use and performance on key metrics, through regular manager meetings with organizational leaders, had managers who seemed more engaged with the metrics and CIS use for their managerial duties. However, managers at all of the study organizations did seem more facile with operationally-based metrics when compared to quality-based metrics. Consistent with UTAUT facilitating conditions and the external pressure of sociotechnical models, this was likely due in part to their organization's focus on operational metrics, but also potentially related to incentives.

The vast majority of organizations had incentive programs where managers were given bonuses for performance on operational and finance metrics. However, no organizations provided bonuses for quality-based metric performance. This combination of organizational focus and incentive did appear to have an impact on how the managers prioritized their time.

While organizations could take a heavy-handed approach to gain compliance with CIS use and focus on quality-based metrics, the majority of the study organizations took a very light approach to accountability. Our results suggest the most effective approach is likely from a moderate position, focused on encouraging managers' CIS use by supporting facilitating conditions. Potential facilitators for managers could include dedicated administrative time, incentives grounded in quality-based metrics, training on CIS use, and

manager's regular accountability to the metrics. This last factor seemed the most striking. When managers had efficient access to reports and regular meetings with their superiors to discuss the metrics, the manager's focus on the metrics and their use of the CIS was markedly increased. The culture of the organization and the messages communicated by the managers' supervisors appeared to have a strong influence on the managers' behavior. Organizational priorities emphasizing quality metrics, managerial accountability, and support strategies appeared to have a strong impact on managers' eventual use of quality-based CIS.

Limitations

This study had limitations. Because of the exploratory design of this study, the recommendations made should be systematically tested in future research to better understand their impact on managers' actual use of the CIS. Additionally, this study included only five organizations, mostly in the northwestern United States. Thus, the results may not be generalizable to organizations in other regions. Additionally, the interviewees were nominated from within their organizations and were interviewed during their work time. It is possible that they held back on their answers or that individuals with conflicting viewpoints were excluded from the sample. This research is part of a larger study including an anonymous survey and it is hoped that this survey will allow for candid responses from a wider sample to test the inferences drawn from this study. Finally, this research did not focus on actual patient outcomes or other measures of quality. Future research should focus on a small number of this study's recommendations and then explore the impact facilitating managers' use of these systems has on the quality measures for patients.

Conclusion

Using this new conceptual framework, organizations can deliberately facilitate managers' use of clinical quality information systems, helping them to more systematically oversee clinical quality. Most notably, organizations should hold managers accountable to quality metrics and provide them protected non-patient-care time to prioritize their managerial duties. Utilizing CIS to drive practice improvements will allow these learning healthcare systems to thrive in this changing environment.

Tables and Figures

Organization	Accepted?	Setting	Navigator's Role	Company Size (Clinics)	Geographic coverage	Quality-Based information system
A	Yes	Private – Urban & Suburban	Clinic Director and corporate Quality improvement	25	Northwest	Purchased, dedicated system
B	Yes	Private – Urban & Suburban	Clinical Research/Quality	800	National	Internally-developed EHR
C	Yes	Hospital – Urban &Suburban	Lead Therapist, Quality Council member	6	Northwest	EHR-based reports
D	Yes	Private – Urban	Owner and Clinic Director	4	Northwest	Purchased, dedicated system
E	Yes	Private – Urban & Suburban	Owner and Clinic Director	4	Northwest	Purchased, dedicated system
F	Declined	Hospital – Urban & Suburban	NA	15	Mountain	Internally developed dedicated system
G	Declined	Private – Rural & Suburban	NA	24	Mountain	EHR-based reports

Table 1: Study Site Characteristics

Role	Count	Years of Experience Mean (SD)	Experience in Current Role Mean (SD)	Gender
Manager	18	14.78 (9.40)	7.33 (6.86)	33% Female
Supervisor	3	8.6 (3.49)	2.33 (0.47)	67% Female
Regional Director	6	9.17 (3.44)	2.17 (2.99)	20% Female
Owner	4	15.0 (10.02)	8.0 (6.4)	25% Female
Executive	9	22.0 (8.27)	3.72 (3.58)	56% Female

Table 2: Study participants' characteristics

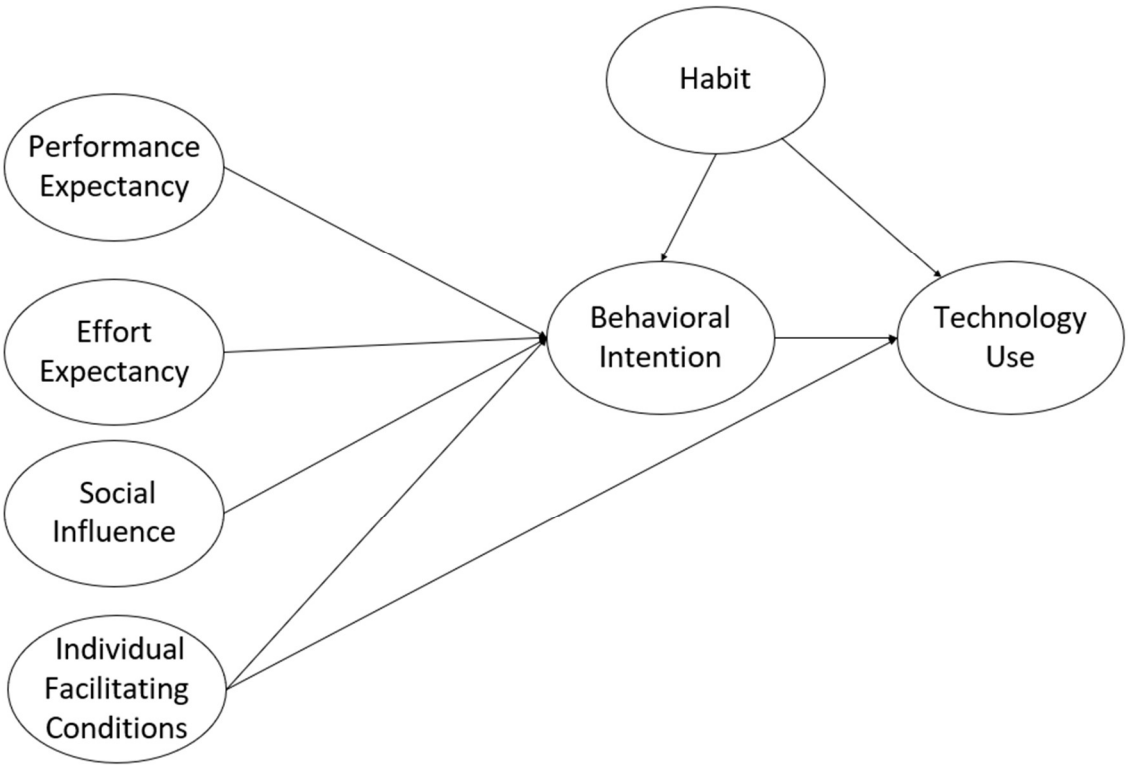

Figure 1: Simplified view of the Unified Theory of Acceptance and Use of Technology

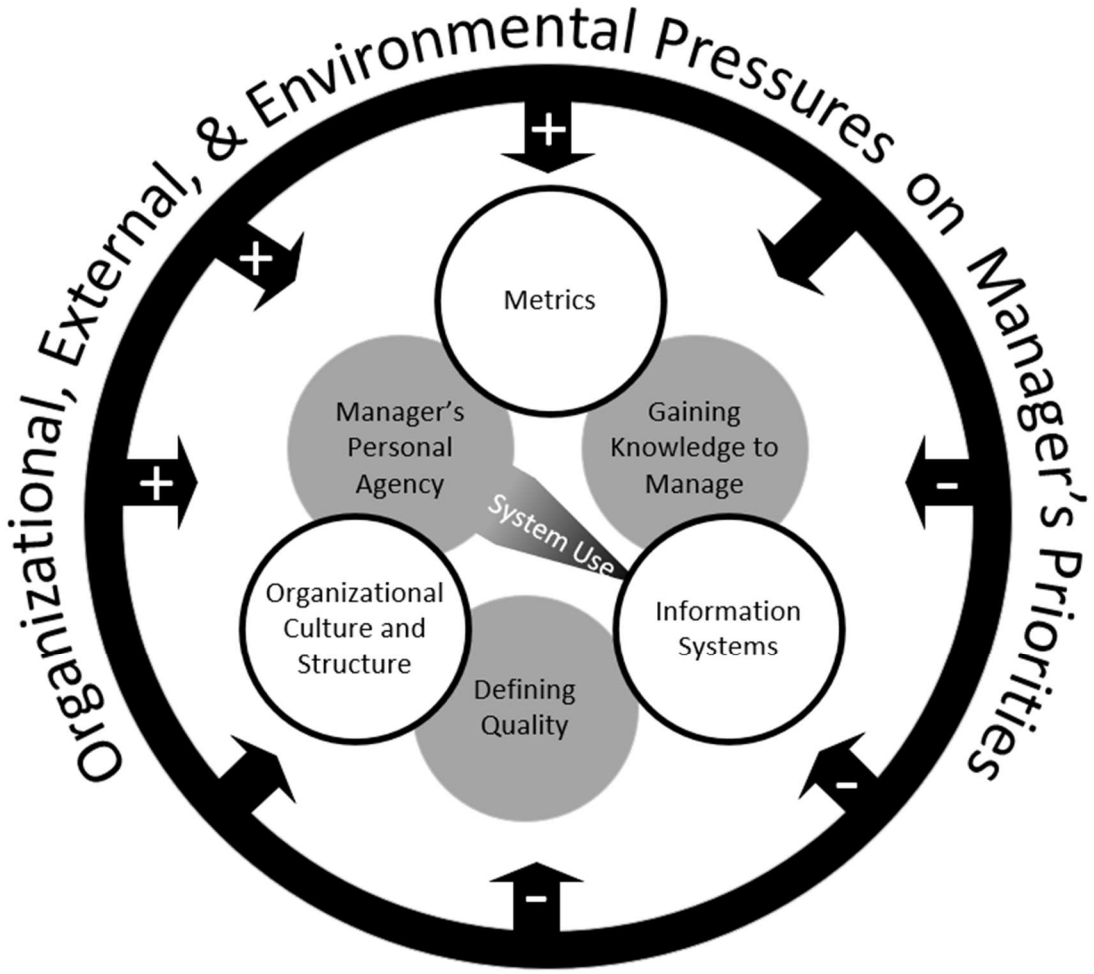

Figure 2: Study theme interaction framework

CHAPTER FIVE. ACCEPTANCE OF CLINICAL QUALITY INFORMATION SYSTEMS BY PHYSICAL THERAPY MANAGERS: A SURVEY-BASED ANALYSIS TO IMPROVE SYSTEM UTILIZATION

This manuscript will be submitted to Physical Therapy Journal

Introduction

Healthcare is experiencing a transformation with increasing regulatory demands, shrinking margins, and an increased emphasis on measurable value.[163] Catalyzed by payer mandates, organizations must find innovative means of survival through an increased focus on proactive management of clinical quality.[164,165] Clinical information systems (CIS) offer organizations promising support in their efforts to optimize measurable clinical outcomes.[41,42,102,166] However, many organizations struggle to effectively utilize the CIS they spend so much to implement.[27,153,167] Because individuals' use of information technology is shaped by many psychosocial influences, healthcare organizations benefit from supporting their employees' use of CIS and align CIS with clinical workflows to promote employees' use of these systems.[168-172]

Technology Acceptance

Understanding what influences individuals' acceptance of technology has broad application from consumerism, to industry, to healthcare. Most studies of technology acceptance have roots in social psychology research.[47] In healthcare, applying a keen understanding of the motivations of clinicians and managers can allow organizations to better support system users, which can help the organization better harness the power of their information.[154]

Much of the research exploring human motivation towards a planned behavior is drawn from the Theories of Reasoned Action and Planned Behavior.[38-40] These models have shown that performance of a target behavior is preceded by the individual's attitudes about the behavior. These attitudes are shaped by the individual's past experiences and the beliefs of others with whom the individual interacts. These models were modified to focus specifically on the acceptance of technology in one of the most widely studied models of technology acceptance, the Technology Acceptance Model (TAM).[47,50,52,51] One critique of the later versions of TAM is that it became overly complex, which limited its interpretability.[51] In response, the Unified Theory of Acceptance and Use of Technology (UTAUT) was created in an attempt to unify competing models while maximizing model parsimony and predictive power.[48]

UTAUT (Figure 1), like TAM seeks to explain users' acceptance of technology based upon their conscious intention to use a technology. The model posits that individuals' perceptions of the ease of use and utility of that system to their daily work, in addition to habit influence their intention to use the system. Additionally, beliefs about the system by people the individual respects, and facilitating factors like training and provision of adequate time to use the system also influence the individual's intention to use the system. It is these latter two factors that suggest an organization can impact the individual's intention to use the system by maximizing facilitating factors and encouraging socialization of system use amongst employees. Later versions of UTAUT show that the impact of each of these antecedent factors on the individual's intention to use the information system could be moderated by factors such as the individual's age, gender, and their experience with the system.[53]

In healthcare-related studies, UTAUT explains between 28 – 57% of the variance in the individuals' intention to use their respective information systems. Additionally, behavioral intention explains between 43 – 57 % of the variance in actual system use in these studies.[62-65,67] There have been very few studies of UTAUT in physical therapy and no studies of UTAUT applied to physical therapy managers.[66,84] One study found that UTAUT could explain 45% of the variance in therapists' intention to use these systems and that intention could explain 57% of the variance in actual system use.[66]

The Role of Context in Conceptual Models

Much of the study of technology acceptance has focused on the end user as a solo actor, isolated from the influences of external factors. In healthcare, significant research has described a sociotechnical system in which individuals interact with information systems within an influential ecosystem that impacts their actions and perceptions.[26,27,100,101,156] Studying the impact of the ecosystem in which an individual works can yield more meaningful insights than studying individuals in isolation.

Additionally, attempts to quantify the influences on end user's acceptance of information systems with models such as TAM and UTAUT have focused on the individual user and not the impact of outside influences on that individual's perceptions and actions. Multiple authors suggest models of technology acceptance must be contextualized in order to add specificity as well as explore the influence of context-specific factors on the model.[54,56] A model may perform very well in one setting or even in one task in a given setting, but perform poorly in others.

Physical therapy practices, like the rest of healthcare, are increasing their focus on measurable value.[173] Healthcare managers are uniquely positioned to help organizations

thrive in value-based care models.[131] The aim of this study was to establish the utility of UTAUT in explaining managers' use of CIS for overseeing clinical quality within outpatient physical therapy practices. We expected UTAUT would perform similar to other healthcare settings and the addition of PT-specific contextual factors would improve the explanatory power of the model.

Methods

Participants

Survey invitations were sent to two groups of participants. We invited all 3577 members from the American Physical Therapy Association (APTA) Private Practice Section group mailing list. Additionally, 855 managers from organizations participating in a previous qualitative phase of this study were also invited to participate. Invited individuals were asked to complete the survey if a component of their job responsibilities included managing clinical quality in a physical therapy clinic. We sent two reminder messages to non-respondents in an attempt to increase participation. This study was classified as exempt by the Institutional Review Board at Oregon Health & Science University (OHSU).

Measures

The survey was administered only in English and included seven demographic questions and 37 multiple choice questions related to technology used in the management of clinic quality (Appendix C). Items were measured on a seven-point Likert scale ranging from "Strongly Disagree" on one end, "Strongly Agree" on the other, and "Neutral" in the middle based upon recommendations from previous studies.[174,175] Participants were asked to answer questions relative to the information system they used most often in the management of

clinical quality. The survey was administered via REDCap version 9.5.1 (Vanderbilt University, Nashville, TN) between October 21 and November 22, 2019.

Twenty-two of the items were modifications of previously validated questions drawn directly from earlier UTAUT studies.[48,53,54] Three of the questions related to the end users' satisfaction with the system and were also drawn from previous research.[176] Because system satisfaction has also been shown to predict system use, it was added to understand its impact on the UTAUT-based factors in the model.[176] The remaining twelve questions measured three novel context-specific constructs established from a previous qualitative phase of this research.[136]

These new constructs included Manager's Personal Agency, Gaining Knowledge to Manage Quality, and Organizational Pressures. Manager's Personal Agency focused on the organizational influences like required adoption of competing roles of clinician and manager as well as time pressures on their work. Gaining Knowledge to Manage Quality focused on managers' preference towards use of metrics versus personal observation as a basis for assessing clinical quality. Finally, Organizational Pressures focused on incentives related to meeting quality-based benchmarks as well as guidance given to managers regarding the oversight of, and accountability to, these metrics.

Analytic Approach

The proposed study model is shown in Figure 2, with two outcome factors (Behavioral Intention and System Satisfaction) and seven predictor factors. We chose Behavioral Intention rather than actual system use since we were more concerned with the direct effect of the exogenous factors on a single outcome factor for this initial research. If this research supports the initial model, future studies could explore the mediation of actual

system use through Behavioral Intention, but that aim was beyond the scope of this study. Four of the exogenous factors, denoted as grey ovals in Figure 2 were components of the UTAUT model. The three additional exogenous factors, added from the previous qualitative phase of this research, are denoted as white ovals. Several of the components of the study model in Figure 2, indicated by both the grey and black objects, were validated in past research.[48,53,176]

Utilizing confirmatory factor analysis (CFA) we explored determined the correlations between each indicator variable and the related latent factor (Factor loadings) of each survey item. Then, using structural equation modeling (SEM), the model based upon only the grey factors was used to validate the UTAUT model. UTAUT has previously been validated, but not within the domain of physical therapy managers' use of information systems. Based upon the analysis of factor loadings and goodness of fit estimates, the items included in the model were iteratively adjusted to balance model performance, goodness of fit, and parsimony.

Additionally, we explored the impact of moderating factors (age, gender, and years of service in current role, denoted as the grey rectangles in Figure 2) on the model performance in accordance with previous research and recommendations.[53,54] After fitting the base model, we undertook an exploratory analysis to validate and understand the impact of adding the new constructs (System Satisfaction, Manager's Personal Agency, Gaining Knowledge to Manage Quality, and Organizational Pressures) that had not been previously studied. This also was achieved with a combination of CFA and SEM. All models were estimated and evaluated utilizing MPlus software (Version 8.3; Muthen & Muthen, 2019).

Role of the Funding Source

This work was supported by the Foundation for Physical Therapy under a Promotion of Doctoral Studies (PODS) scholarship – Level I; and the National Library of Medicine under clinical informatics training grant # T15-LM007088. The funders played no role in the design, conduct, or reporting of this study.

Results

Descriptive Information

Three hundred eighty four surveys were returned (8.66% response rate). Two surveys were excluded from analysis since > 15% of the questions were missing answers, leaving 382 surveys available for analysis. We did not have demographic data on survey non-respondents to establish the generalizability of our results. Instead, we performed a variation of a non-response analysis, comparing the characteristics of respondents to a 2018 report of APTA members indicating their primary role was as an administrator/supervisor.[177] The demographics of these two groups were similar on all factors (Appendix E, Table A1). While survey respondents' demographics were statistically different than APTA survey respondents (slightly younger, slightly more years in current role, and fewer females), the effect sizes of these differences were quite small (< 0.25 for all measures).

Missing data was very low for all variables with < 1% missing for any variable. Additionally, there was low correlation in missingness between variables. This, coupled with the demographic similarity of this sample compared to the APTA survey, suggests the

missingness was at random (MAR). This allowed for using Full Information Maximum Likelihood in the analysis.[178,179]

Many survey item measure responses were slightly negatively skewed with mild kurtosis. These measures of skewness ranged from -1.627 – 0.694. Only six of the indicator variables had a skewness of > |1.0|. Measures of kurtosis ranged from -0.996 – 3.149. All but two indicator variables had a kurtosis of < |1.0|. This also supported the use of a Maximum Likelihood approach for parameter estimation in the SEM analysis.[119]

Confirmatory Factor Analysis

The vast majority of intra-factor indicator variable correlations were greater than inter-factor indicator variable correlations, indicating basic model discriminant validity (Appendix D). Composite reliabilities were estimated using McDonald's ω coefficients since it has been shown to be an accurate measure of composite reliability in samples of more than 100 subjects, and Cronbach's α has been shown to under-estimate composite reliabilities in non-tau equivalent models (Appendix E, Table A2).[180-183] Reliability coefficients for the base UTAUT factors were all above 0.72. For this reason, and because the aim of the study was to confirm the performance of a UTAUT model drawn from past research, all of the base UTAUT indicator variables were included in the final SEM analysis. Standardized and unstandardized factor loadings based upon Unit Loading Identification are listed in Table 1.

Base Model Performance

The base UTAUT model explained 64.9% of the variability in Behavioral Intention, which was similar to past UTAUT research.[53,66] Table 2 shows the parameter estimates for each of the model factors. Only parameter estimates for Performance Expectancy and Habit

were found to be statistically significant in the base model (Figure 3). Because of mild skewness in a few of the model indicator variables, we performed a secondary analysis using bootstrapping to estimate standard errors, which allowed us to relax the requirement for normality for Maximum Likelihood analysis. Bootstrapping did not meaningfully alter the confidence intervals of the model parameter estimates. Additionally, the base UTAUT model had relatively good fit according to established benchmarks (Table 2).[184]

In order to achieve a more complete view of model fit, we calculated several fit indices. These included the χ^2 measure of badness of fit and three measures of approximate fit, the Root Mean Square Error of Approximation (RMSEA) as well as the Bentler's Comparative Fit (CFI) and the Tucker-Lewis Indices (TLI). We also included a measure of absolute fit, the Standardized Root Mean Square Residual (SRMR). Finally, to compare the fit between competing models we utilized two predictive fit indices, the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC). For comparing subsequent models to the base model, we used all of the fit indices when possible, but relied on AIC and BIC for models with interaction terms, where additional indices could not be calculated due to the estimation procedures necessary to fit models with later factor interactions.

For the moderation analysis, we mean-centered age and years of service in current role to minimize multicollinearity and improve interpretability of the results, according to multiple recommendations.[51,119,185] The product coefficients for years of service in current role, and gender interacting with Personal Facilitating Conditions and Habit were not significant, nor did they significantly alter the base model parameter estimates. However, as shown in Table 3, when age interacted with Habit, the product coefficient was significant ($p = 0.03$). As age increased, the effect of Habit on Behavioral Intention also increased.

Adding this age X Habit interaction term did improve the R^2 slightly, but resulted in slightly worse model fit overall (BIC 24267.48 vs. 27159.48).

Exploratory Model Modifications

There was generally poor composite reliability for the new physical therapy-centric factors except for Manager's Personal Agency (Appendix E, Table A2). System Satisfaction had an ω coefficient of 0.94 which was similar to past research and indicates good composite reliability.[176] For these reasons, the exploratory phase of the research focused on the impact of adding System Satisfaction as an endogenous factor and only Managers' Personal Agency as an exogenous factor to the base model. Because question MA1 had a markedly lower factor loading than the remaining three indicator variables for Managers' Personal Agency in the CFA, it was excluded from the SEM analysis.

As shown in Table 3, adding Manager's Personal Agency and System Satisfaction factors to the UTAUT model marginally altered the findings from the base model. Performance and Effort Expectancy both contributed significantly to System Satisfaction, collectively explaining 52.1% of the variance in the factor. Adding System Satisfaction to the model slightly improved the full UTAUT R^2 compared to the base model. More notably, adding System Satisfaction markedly decreased the parameter estimate for Performance Expectancy on Behavioral Intention. This suggests that much of the effect of Performance Expectancy is mediated through System Satisfaction.[186] This was confirmed by the significant ($p < 0.001$) indirect parameter estimate for Performance Expectancy's influence on Behavioral Intention, through System Satisfaction of 0.093 (95%CI 0.045 – 0.140). However, the parameter estimate for Performance Expectancy's direct effect on Behavioral intention was reduced to 0.021 (95% CI -0.083 – 0.126) when System Satisfaction was

added. Conversely, System Satisfaction had minimal impact on the parameter estimate of Effort Expectancy on Behavioral Intention.

Unlike System Satisfaction, adding Manager's Personal Agency had little impact on the base model. There was little change in the R^2 and model fit indices, and none of the base model factors' parameter estimates changed meaningfully. Additionally, the product coefficient estimates for age, years of service in current role, and gender with Manager's Personal Agency all had 95% confidence intervals including zero and made little difference to the R^2 and model fit indices.

Finally, because Habit had the lowest composite reliability of the base model factors, and also because Habit was not included in the original UTAUT research, we chose to explore the impact of removing this factor.[48] Removing Habit resulted in a model with slightly better fit than the base model. However, the R^2 of the new model was moderately lower than that of the base UTAUT model. Shown in Table 3, removing Habit from the model had the greatest impact on the parameter estimates of the remaining UTAUT factors than on any of the other exploratory factors.

Discussion

This is the first known quantitative study exploring influences on physical therapy managers' use of information systems to oversee clinical quality. Practices must increase their use of these systems as they move into fee-for value payment arrangements and consumers raise demand for measurable clinical quality. These results suggest UTAUT factors can effectively explain the variation in managers' intention to use information systems for these purposes. The R^2 and model parameter estimates calculated for these models were similar to those achieved in past research.[48,53,66]

Past studies of UTAUT, specifically in healthcare have been performed with Partial Least Squares (PLS) SEM. Our analysis utilized covariance-based SEM. These two approaches produce similar but not identical results.[112-114] An advantage of covariance-based SEM is the ability to calculate estimates of model fit, which we used to compare our various exploratory analyses. This is not possible in PLS-SEM.[104] Therefore, it must be noted that beyond comparisons of R^2 and factor parameter estimates, we cannot directly compare our models' performances to those of past studies.

Our research found Performance Expectancy and Habit had the greatest explanatory power of the model factors. These results were similar to the study that introduced the second version of UTAUT.[53] The only other reported study of UTAUT in physical therapy produced an R^2 similar to our results, but found a significant parameter estimate for only Performance Expectancy's effect on Behavioral Intention.[66] That study used the original version of UTAUT, excluding Personal Facilitating Conditions and Habit. Our results suggest organizations, which have often placed a heavy emphasis on the ease of use of systems, might be better served by ensuring the information contained within these systems is meaningful to the work of the end users, and aligned with their daily workflows.

Unlike past research, adding age, years of service in current role, and gender to the base UTAUT model had limited impact on the model's performance. It must be noted that past research models controlled for additional moderating factors that were not appropriate for this study.[53] In our analysis, age did have some minimal interaction with Habit. This age X Habit interaction had an impact on the model performance and parameter estimates of the other factors. This interaction suggests organizations have room to proactively impact

habits earlier in managers' transition into the role, rather than waiting for habits to develop organically.

Exploratory Analysis

Consistent with past research, variance in System Satisfaction was explained by Performance Expectancy.[176] However, previous research has not explored the impact of adding System Satisfaction into UTAUT. Our results suggest System Satisfaction partially mediates the impact of Performance Expectancy on managers' intention to use their CIS for quality oversight. This finding is important because it is possible UTAUT could be simplified by asking only the four System Satisfaction questions versus the six Performance and Effort Expectancy questions. However, System Satisfaction cannot be directly influenced where, through system optimization projects, organizations can influence Performance and Effort Expectancy. Additionally, since adding System Satisfaction resulted in slightly worse model fit and only marginally improved the R^2, the more parsimonious base model is preferable.

Contrary to our pre-study hypothesis, the addition of new physical therapy-specific contextual factors had little impact when added to the base model. This was likely due to a few causes. First, the indicator questions of two of the three contextual factors showed limited composite reliability and discriminant validity. Additionally, adding the factors Gaining Knowledge to Manage and Organizational Pressures created a model with worse fit and minimally higher R^2 than the base UTAUT model. Manager's Personal Agency did have an acceptable, but still somewhat low, ω coefficient and was included in the exploratory analysis. However, its addition did not create improvements over the base UTAUT model.

Future research should explore modifications to the indicator questions of these new factors that stemmed from previous qualitative work.[136,137]

Our results illustrate how qualitative effects on human behavior are not easily quantified, especially in team environments.[187] In the qualitative phase of the research that preceded this manuscript, these three physical therapy-specific contextual factors were strongly associated with managers' reported use of information systems to oversee clinical quality.[136,137] This discrepancy between the quantitative and qualitative findings of this research underscores the assertion that quantitative and qualitative components of mixed-methods research are complementary and often both necessary to explain complex systems.[188-190] It is also possible that the relatively small sample size of this SEM study contributed to some of the lack of consistency in responses and that we may see different results with replication of this work with a larger sample size.

When Habit was removed as a factor from the model, the impact on the model fit was minimal, but the impact on the estimates of the remaining parameter estimates was interesting. The R^2 for this new model was slightly lower than that of the base model. This is expected, if for no other reason than because the new model had fewer factors than the base model. The parameter estimates for Performance Expectancy, Effort Expectancy, Personal Facilitating Conditions, and Social Influence were all increased in the model without Habit. However, the confidence intervals of these estimates were quite wide. These results suggest that Habit may have a confounding effect on the other model factors. This supports including Habit in the UTAUT model, which is consistent with past work.[53] These findings should be tested in future studies with larger sample sizes.

Study Limitations

As noted above, this study had a somewhat small sample size for SEM research.[191] This was largely due to our low survey response rate, which itself is a limitation to the study. The confidence intervals were fairly wide for all model estimates and the results of this research should be replicated at a larger scale to validate our findings. Additionally, a few of the study indicator variable responses were skewed. The measures of skewness were minimal and, as noted, bootstrapping standard errors did not markedly change the confidence intervals. This indicates that skewness had little impact on our assertions.

Finally, because of the low response rate, we were unable to keep a hold-out cohort for model cross-validation. This step is essential in SEM research to ensure the model has not been over-fit to the sample data. This means our study assertions must be tempered against the possibility that the results may not generalizable. However, it was not the aim of this study to create a new model. In fact, based upon the good overall model fit and R^2 calculations and agreement with the results of our complementary qualitative inquiry, our findings support previous research. This strongly suggests UTAUT is an appropriate model for use in technology acceptance studies involving physical therapy managers. This was the primary aim of this study and supports future research using UTAUT in physical therapy.

Conclusion

Organizations can likely influence managers' intention to use CIS to oversee clinical quality through managing expectations and habits. Managers' expectation of a system that provides meaningful information that supports their daily work and their habits developed using those systems were most impactful. Habit also impacts how organizations can influence managers' use of systems through socialization and direct facilitation efforts. For

this reason, organizations should work to engage newer managers in developing sound system use habits early in their tenure, and emphasize aligning these systems with their daily workflows.

Tables and Figures

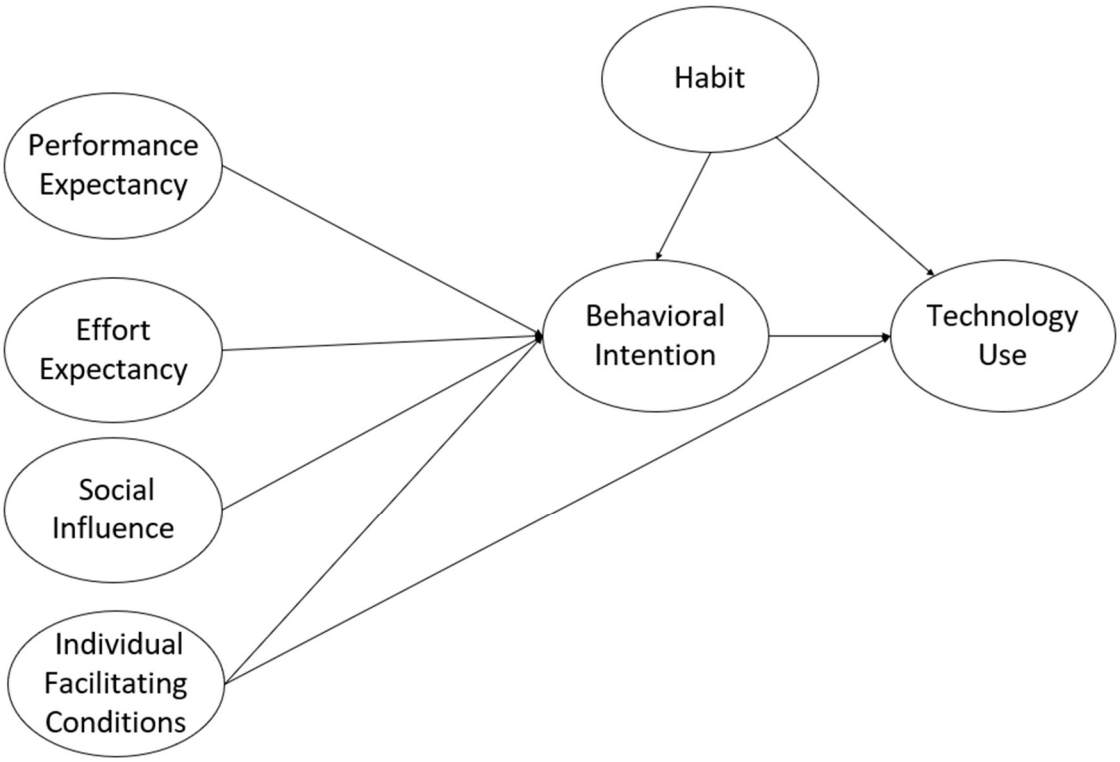

Figure 1: Simplified view of the Unified Theory of Acceptance and Use of Technology

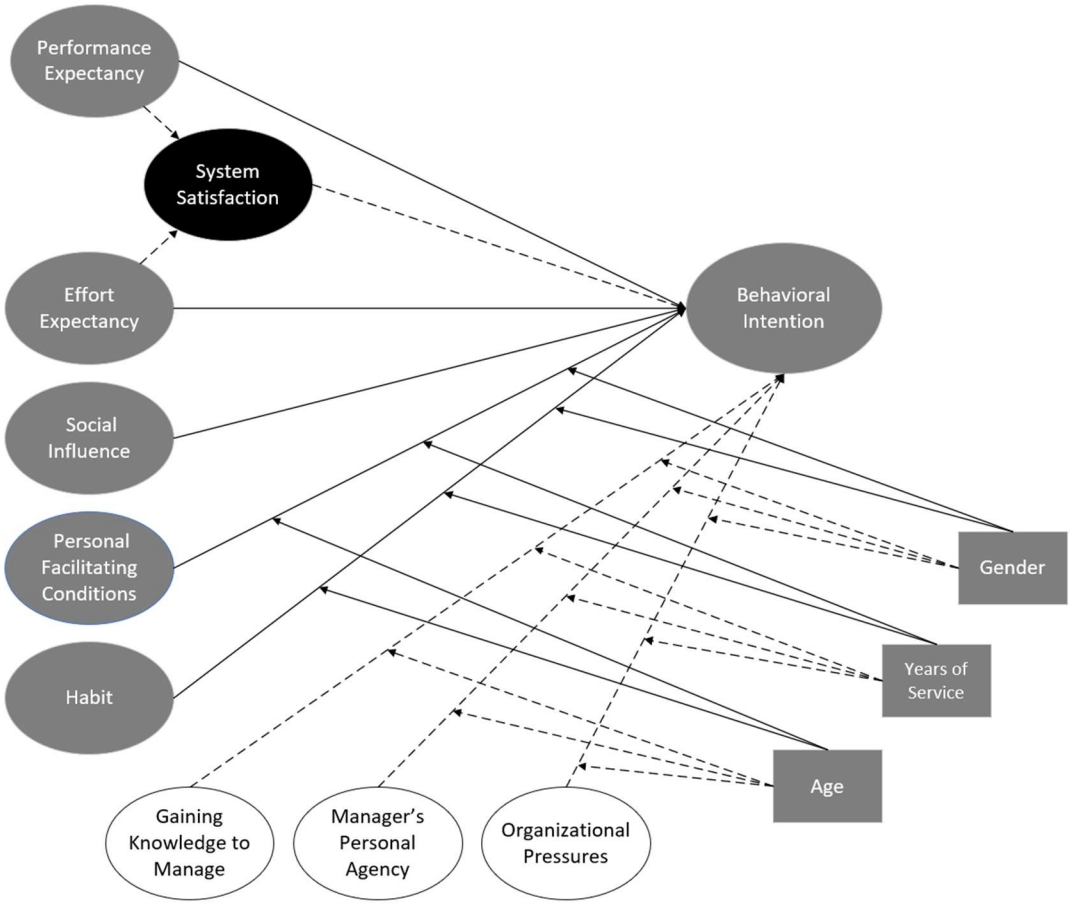

Figure 2: Proposed study structural study model – Grey factors and solid lines are from the validated UTAUT model (Study base model). White factors (new physical therapy-centric factors) and System Satisfaction were added in the exploratory phase of the research.

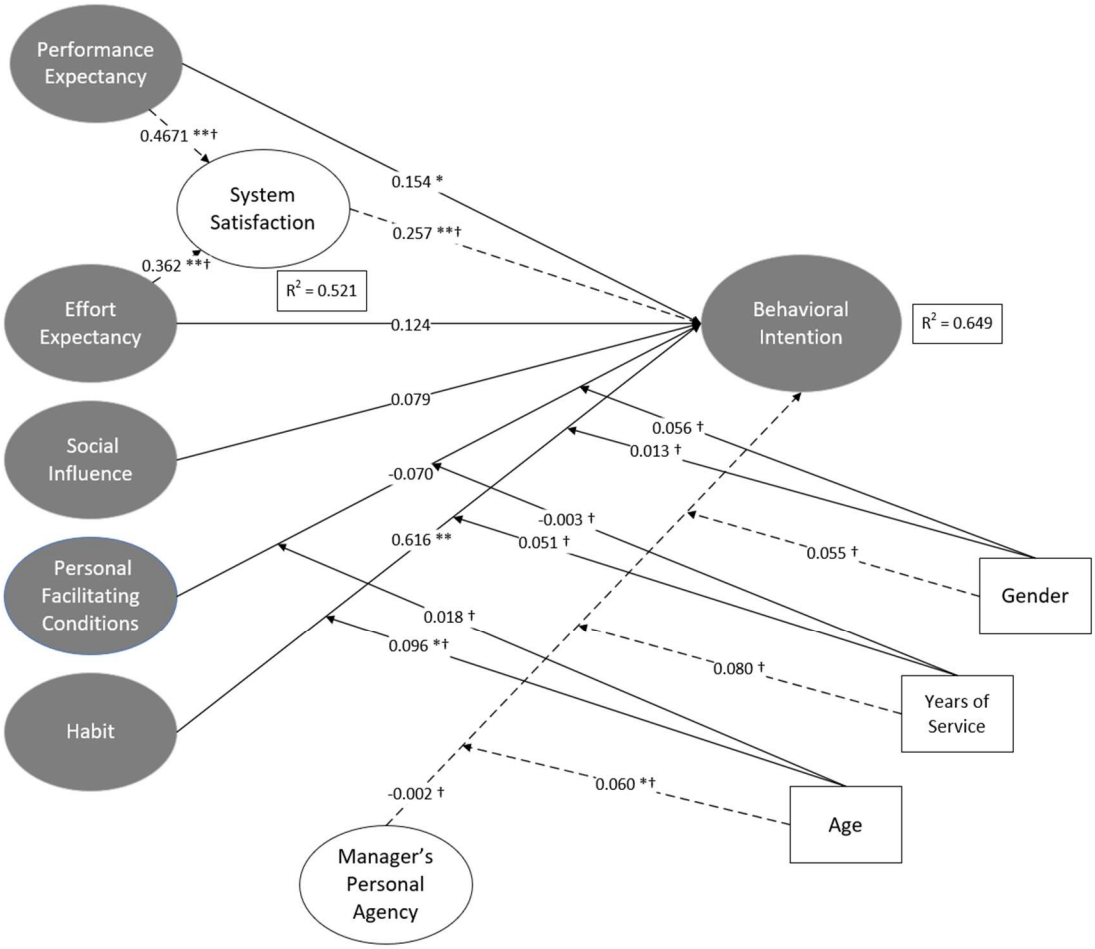

Figure 3: Standardized SEM parameter estimates for study model. Only grey items were included in the final analysis and Behavioral Intention R^2 calculation. * $p < 0.05$; ** $p < 0.001$, † Parameter estimate not included in final analysis

	Indicator Variable	Standardized Loadings	Unstandardized Loadings
Base Model Factors	Performance Expectancy		
	PE1	0.791 (0.747 – 0.834)	1.000
	PE2	0.944 (0.920 – 0.968)	1.321 (1.195 – 1.448)
	PE3	0.858 (0.826 – 0.891)	1.231 (1.103 – 1.360)
	Effort Expectancy		
	EE1	0.807 (0.768 – 0.846)	1.000
	EE2	0.898 (0.873 – 0.924)	1.064 (0.964 – 1.164)
	EE3	0.869 (0.840 – 0.899)	1.047 (0.943 – 1.151)
	EE4	0.890 (0.863 – 0.917)	1.099 (0.996 – 1.202)
	Social Influence		
	SI1	0.860 (0.828 – 0.892)	1.000
	SI2	0.919 (0.895 – 0.943)	1.055 (0.971 – 0.1.140)
	SI3	0.902 (0.876 – 0.928)	1.014 (0.930 – 1.098)
	Personal Facilitating Conditions		
	PFC1	0.749 (0.693 – 0.804)	1.000
	PFC2	0.828 (0.783 – 0.873)	1.010 (0.877 – 1.142)
	PFC3	0.484 (0.398 – 0.569)	0.750 (0.552 – 0.858)
	PFC4	0.680 (0.616 – 0.744)	0.892 (0.756 – 1.029)
	Habit		
	H1	0.830 (0.778 – 0.883)	1.000
	H2	0.647 (0.577 – 0.718)	0.804 (0.673 – 0.934)
	H3	0.585 (0.507 – 0.663)	0.800 (0.653 – 0.947)
	Behavioral Intention		
	BI1	0.830 (0.791 – 0.869)	1.00
	BI2	0.817 (0.776 – 0.859)	1.235 (1.102 – 1.367)
	BI3	0.888 (0.856 – 0.920)	1.227 (1.110 – 1.344)
Exploratory Factors	System Satisfaction		
	SS1	0.908 (0.886 – 0.930)	1.000
	SS2	0.914 (0.893 – 0.936)	1.029 (0.959 – 1.100)
	SS3	0.920 (0.900 – 0.941)	1.066 (0.994 – 1.137)
	Gaining Knowledge to Manage		
	GKM1	0.721 (0.633 – 0.809)	1.000
	GKM2	0.578 (0.488 – 0.668)	0.900 (0.680 – 1.113)
	GKM3	0.484 (0.386 – 0.582)	0.634 (0.473 – 0.795)
	GKM4	0.421 (0.315 – 0.528)	0.546 (0.367 – 0.726)
	Manager's Personal Agency		
	MPA1	0.349 (0.251 – 0.448)	1.000
	MPA2	0.726 (0.663 – 0.788)	2.129 (1.456 – 2.803)
	MPA3	0.796 (0.741 – 0.852)	2.281 (1.559 – 3.002)
	MPA4	0.804 (0749 – 0.860)	2.224 (1.529 – 2.919)
	Organizational Pressures		
	OP1	0.707 (0.638 – 0.776)	1.000
	OP2	0.494 (0.368 – 0.560)	0.692 (0.510 – 0.875)
	OP3	0.339 (0.233 – 0.444)	0.591 (0.380 – 0.801)
	OP4	0.619 (0.540 – 0.699)	0.920 (0.736 – 1.104)

Table 1: Standardized and unstandardized factor loadings (95% Confidence Interval)

	Base Model	Addition of Demographic Moderation	Addition of System Satisfaction	Addition of Manager's Agency	Removal of Habit
Badness of Fit					
χ^2	414.915, 155 df, p<0.001		593.808 212 df, p<0.001	483.210 209 df, p<0.001	253.178 109 df, p<0.001
Approximate Fit					
RMSEA (90% CI)	0.066 (0.059 – 0.074)		0.069 (0.062 – 0.075)	0.059 (0.052 – 0.065	0.59 (0.049 – 0.068)
CFI	0.951		0.943	0.952	0.969
TLI	0.940		0.932	0.942	0.961
Absolute Fit					
SRMR	0.052		0.058	0.049	0.044
Predictive Fit					
AIC	23917.57	23972.65 – 26852.38	27148.96	28204.34	19854.99
BIC	24267.48	24276.45 – 27164.07	27492.21	28559.43	20086.66

Table 2: Model fit statistics

		Base UTAUT Model	Addition of Demographic Moderators	Addition of System Satisfaction	Addition of Managers' Personal Agency	Removal of Habit
Base Factors	Behavioral Intention	R^2 = 0.649 ** (0.563 – 0.735)	R^2 = 0.659 ** (0.569 – 0.749)	R^2 = 0.673 ** (0.591 – 0.755)	R^2 = 0.649 ** (0.563 – 0.735)	R^2 = 0.507 ** (0.425 – 0.589)
	Performance Expectancy	0.120 * (0.024 – 0.216)	0.111 * (0.013 – 0.208)	0.021 (-0.083 – 0.126)	0.121 * (0.024 – 0.217)	0.231 ** (0.137 – 0.325)
	Effort Expectancy	0.100 (-0.063 – 0.262)	0.099 (-0.064 – 0.262)	0.099 (-0.063 – 0.261)	0.099 (-0.064 – 0.262)	0.159 (-0.012 – 0.329)
	Social Influence	0.054 (-0.030 – 0.138)	0.046 (-0.038 – 0.131)	0.069 (-0.013 – 0.150)	0.054 (-0.032 – 0.139)	0.178 ** (0.099 – 0.256)
	Personal Facilitating Conditions (PFC)	-0.059 (-0.246 – 0.129)	-0.070 (-0.260 – 0.120)	-0.139 (-0.327 – 0.050)	-0.056 (-0.253 – 0.140)	0.134 (-0.045 – 0.314)
	Habit	0.427 ** (0.289 – 0.565)	0.443 ** (0.298 – 0.587)	0.410 ** (0.278 – 0.542)	0.426 ** (0.288 – 0.564)	
	Age		-0.003 (-0.010 – 0.004)			
	Habit X Age		0.006 * (0.001 – 0.012)			
Exploratory Factors	System Satisfaction			0.173 ** (0.093 – 0.254)		
	Manager's Personal Agency				-0.002 (-0.071 – 0.068)	
	System Satisfaction			R^2 = 521 ** (0.443 – 0.599)		
	Performance Expectancy			0.538 ** (0.420 – 0.657)		
	Effort Expectancy			0.432 ** (0.313 – 0.551)		

Table 3: Unstandardized SEM model parameter estimates (95% Confidence Interval) * $p < 0.05$; ** $p < 0.01$. Endogenous Factors in grey

CHAPTER SIX. DISCUSSION

Summary of Findings

This dissertation research sought to define the influences on managers' use of CIS to oversee clinical quality in outpatient physical therapy practices, both extending and looking beyond UTAUT. We utilized a mixed-methods approach beginning with Rapid Qualitative Inquiry to create a framework (chapter three, Figure 1) of those factors that competed against managing clinical quality (Aim 1). We found that most managers served a hybrid clinician-manager role, which severely limited their time and attention available for administrative duties in general. Additionally, managers typically lacked specific processes for and dedicated focus on clinical quality metrics. Managers were responsible for several deliverables that were outside of their direct control, including financial results, patient experience, and with much less refined focus on employee experience and clinical quality. With their administrative time, managers attempted to balance HR and corporate compliance tasks against clinical operations related tasks. Rarely did they proactively manage quality according to standardized metrics.

Along with the interviews and observations used for Aim 1, we established a model (chapter four, Figure 2) explaining how managers' use of CIS to intentionally govern quality metrics was influenced by organizational sociotechnical factors (Aim 2). We found that managers' personal agency was impacted by many factors that influenced their use of information systems. Managers in organizations with a culture that emphasized metric checking and accountability to those metrics utilized information systems in their administrative duties more consistently than managers in other organizations. Most organizations did not proactively push quality metrics to managers. Rather, organizations

required managers to actively pull these metrics, if they desired to view them. However, most managers preferred observing clinicians working with patients to determine care quality, versus viewing metrics. Additionally, many organizations used operational metrics as surrogates for quality. This finding, coupled with their desire to observe rather than measure quality, mitigated against managers seeking quality metrics, let alone use CIS to view them.

In addition to the above-mentioned findings, several of the UTAUT factors appeared to influence managers' use of CIS. While Performance Expectancy and Effort Expectancy appeared to influence CIS use somewhat, Facilitating Conditions and Social Influence appeared to have much greater impacts. Most notably, those mangers who had regular accountability meetings with their direct supervisors used information systems to gather key metric data much more consistently than other managers.

Finally, we distilled the information gained in the qualitative portion of the research into PT-specific contextual factors. We added these factors to the UTAUT model to determine the ability of an SEM-based UTAUT model (chapter five, Figure 3) to explain managers' intention to use CIS to oversee quality (Aim 3). We found UTAUT to have high explanatory power ($R^2 = 0.649$, 95% CI 0.563 – 0.735). However, the PT-specific contextual factors, for the most part had poor composite reliability, and when added to the UTAUT factors, added little explanatory power to the model. We did find that of all of the UTAUT factors, Habit and Performance Expectancy contributed the most to the model. Habit also appeared to act as a confounder to the other UTAUT factors. Additionally, System Satisfaction appeared to act as a strong mediator to the effect of Performance Expectancy on managers' intention to use their CIS. Finally, we found that age interacted slightly with Habit, showing the effect of Habit on Behavioral Intention increased as age increased.

These findings agreed, in large part, with past research on technology acceptance in healthcare and specifically PT. However, the lack of agreement on the impact of the PT-centric factors and Facilitating Conditions on CIS acceptance between the qualitative and quantitative components of our research was unexpected. Despite this disagreement, we found many useful results that can help direct future research as well as influence the sociotechnical environments of PT managers as they seek to efficiently manage clinical quality.

Synthesis of Findings

UTAUT performance

A major objective of this research was to replicate the administration of a previously validated survey within the specific context of PT managers overseeing clinical quality. Performance of our SEM model was similar to past research. As described in chapter five, we could not compare model fit between our models and most of those of past UTAUT research since those studies utilized PLS-SEM, which does not allow for fit estimation calculations. However, our model did achieve R^2 and parameter estimates similar to past research.

Much of the core research utilizing UTAUT has focused on consumer-based technologies. However, a few studies have been performed in healthcare settings.[62,64-67,192] The explanatory power of our UTAUT models exceeded those of previous UTAUT studies in healthcare. Additionally, one of these studies utilized CB-SEM for their analysis and their fit indices were similar to the indices of our models.[64] This supports our assertion that UTAUT is an appropriate model for use in studying technology acceptance in PT managers.

While our models performed similarly to past research with respect to explanatory power, they did differ somewhat with respect to which factors contributed the most to the models. All of the above-mentioned studies found Performance Expectancy's parameter estimate to be highly significant and the most impactful of the included factors. However, most of these studies utilized variations of the first version of UTAUT, excluding the impact of Habit and Personal Facilitating Conditions on Behavioral Intention. We found Performance Expectancy to have a significant impact on the model, but markedly less than Habit.

It is possible that the omission of Habit as a factor in those previous studies could have confounded their model results somewhat, based upon the effect we saw when we removed Habit from our model. When we removed Habit from the model, the parameter estimate for Performance Expectancy increased markedly to a level similar to these past studies. Additionally, by using the initial version of UTAUT, these past studies looked only at the impact of Personal Facilitating Conditions on actual system use and not Behavioral Intention. For our study, we focused only on the factors' impact on Behavioral Intention. Had our study explored the impact on actual system use, we may have found slightly different results.

We were surprised to find that Personal Facilitating Conditions and Social Influence did not have a significant impact on Behavioral Intention in the SEM analysis, because these factors seemed highly influential in our qualitative phase. However, our SEM findings were very similar to the only other research using UTAUT to explain CIS adoption in PT.[66] One potential explanation is how we included those two factors in the model. UTAUT views Personal Facilitating Conditions and Social Influence as having direct effects on Behavioral

intention.[53] However, TAM views these two factors as indirectly impacting Behavioral Intention through Performance Expectancy, versus directly effecting Behavioral Intention as we did in our study models.[50] Additionally, a separate UTAUT study modeled these two factors as significantly impacting system use directly, and not impacting Behavioral Intention.[192] Thus, it is possible that we missed the effect of these two factors in our study model because of its structure. Additionally, it is possible that these two factors do not have the impact they did in past healthcare research because PT managers overseeing clinical quality is a novel context in which to study CIS adoption.

UTAUT contextualization

UTAUT has not previously been studied within the context of a PT manager overseeing clinical quality. The fact our model's performance was similar to past studies suggests UTAUT is an appropriate model for studying technology adoption in this setting. We did not seek to show UTAUT was the best model for use in this setting, but simply that it could be an effective model. It was beyond the scope of this study to compare competing models' performance within this new context. This is a recommended step when testing models in new domains.[56] With more time and a larger sample size, we could have compared the performance of UTAUT to TAM. However, based upon past research, we expected that difference would have been minimal.[48,193]

We followed recommendations from Hong and Venkatesh, and added new context-specific factors to UTAUT to explore the impact on model performance and fit.[54,56] However, we did not find adding PT-specific factors to the model altered its performance significantly. UTAUT did perform well in this specific context, which is the first step in Hong's recommendation to contextualize a theory.

Unfortunately, we were not able to effectively measure our PT-specific contextual factors through the survey due to poor composite reliability of two of the three factors. Thus, we could not be confident the administered questions adequately represented especially two of the three newly proposed PT-specific constructs. In spite of this finding, we included these items into the UTAUT model exploratory analysis and they did not meaningfully change the model's explanatory power, and also resulted in a new model with worse model fit than the base-UTAUT model. Had we conducted a formal psychometric development phase for item creation in the survey, we may have been able to better measure the proposed PT-specific contextual factors. That full item-development process was beyond the scope of this study. Instead, we followed an established protocol for face-validity and understandability assessment described in chapter five, which suggested the new survey items were appropriate for inclusion.[194]

We initially planned to also explore the interaction between the new PT-specific contextual factors and the base-UTAUT factors in the exploratory analysis, according to the recommendations of Hong.[56] However, because the new PT-specific factors had poor composite reliability and minimal direct influence on Behavioral Intention, adding them to the model as interaction terms added little to the base model. Had these new PT-specific factors had better composite reliability, it is possible they would have shown some interaction with the base-UTAUT factors. We claim this because our qualitative work on Aims 1 and 2 suggested these factors did impact how managers utilized their CIS for their administrative duties. The qualitative work also suggested we would find Personal Facilitating Conditions and Social Influence to have strong direct effects on Behavioral Intention, but as stated above we did not see this effect in the SEM analysis. This was partially due to the difficulty we had measuring these new factors. However, this

inconsistency between our qualitative and quantitative analyses also underscores the difficulty of studying the acceptance of technology within an organizational ecosystem.[187,195,196]

Organizational sociotechnical ecosystems

As described in chapter one, employees' adoption and continued use of CIS is influenced by a complex sociotechnical ecosystem. Studying one of the parts of this ecosystem without concurrently studying the other aspects can cause interpretation problems. In the qualitative phase of our work we identified influence from all eight factors of a previously established sociotechnical model, on the managers' reported use of their CIS to oversee clinical quality.[26] This sociotechnical model influenced which PT-centric factors we chose to add to the UTAUT survey. However, as stated above, those additional factors did not show meaningful effect on Behavioral Intention in the SEM analysis.

While it is probable that measurement error and a lack of composite reliability in the indicators for these new factors contributed to the minimal measured effect, our frame of focus for the SEM analysis also likely played a role. One review of the relevant literature found 81 separate instruments available to measure team factors relative to clinical quality improvement efforts in healthcare.[197] These authors showed that multiple factors across more than 80 different instruments could be measured to understand how teams manage quality. However, the role of managers is represented in only a small number of these factors. We attempted to focus on the viewpoint of the manager, but emphasized the manager's perspective of the influence of external sociotechnical factors. Authors suggest that comingling internal and external constructs can make it difficult to identify model effects because of construct contamination.[198] This could have contributed to our inability to effectively measure the impact of the PT-specific factors, Personal Facilitating Conditions,

and Social Influence on Behavioral intention in the SEM analysis. Thus, use of quantitative methods alone to understand complex team dynamics are insufficient and often require connection to results from qualitative research.[94,188]

Need for mixed-methods research

We utilized a mixed-methods design in this study in an attempt to address the limitations of relying purely on quantitative or qualitative methods alone. Our aim was to qualitatively merge and extend upon previous theories and then test aspects of the new, extended framework empirically. We utilized a modification of the formal exploratory sequential design proposed by Curry.[94] This approach is useful in inductively exploring context in a qualitative study and then applying what was learned to a second quantitative phase. This approach is distinct from a convergent mixed-methods design where the researcher is looking for the results from both phases of the research to agree.

It is important to explore both the design of a mixed-methods approach and the integration of the results between the phases of the research.[188] The two phases of our research were somewhat integrated because we used similar sampling frames for both. Managers from the outpatient PT practices in phase one were invited to participate in the quantitative phase of the study. The conclusions from this dissertation represent an embedded integration.[94] If we view the results of the SEM as a sub-focus of the qualitative phase of the research, we are freed from the rigid need for the results of both phases of the research to agree completely, as is necessary in a convergent study design.

With the framework of embedded integration of the two phases of the study, we can appreciate that the themes generated in the first phase complement rather than compete with the results of the quantitative phase. The concepts of Social Influence, Personal

Facilitating Conditions, Manager's Personal Agency, Gaining Knowledge to Manage, and Organizational Pressures all influenced manager's use of CIS to oversee quality when this dissertation research is considered collectively. While they do not add to the explanatory power of UTAUT in this context based upon our SEM analysis, they still appear to influence manager's use of the CIS when combining our qualitative and quantitative results. Again, this underscores the complexity of individual behavior within sociotechnical ecosystems. Attempting to find consistency within and between these ecosystems is further complicated by the lack of agreement on even a common definition of quality between the various stakeholders studied in the qualitative phase of this research.

Measuring and managing clinical quality

Consistent with our findings, multiple authors have suggested that clinical quality cannot be defined by a single measure and is often not even defined uniformly among the various healthcare stakeholder groups.[2-4,199,200] We did not include patients or payors in our qualitative sample frame, but we did include hybrid clinician-managers. When asked directly about definitions of quality in our study, managers and organizational leaders gave uniform responses, but these responses were not constrained into a single definition. These definitions primarily included evidence-based practice, patient reported outcomes, patient satisfaction, safety, and equitability. Our results echoed the findings of the above-cited authors. However, we were surprised to see the strong connection between operational and quality metrics in the eyes of these individuals.

As described in chapters three and four, different than the responses they gave when asked to define clinical quality, when asked about measuring quality, most managers cited metrics classically associated with clinical operations. These included patient cancellation and no-show rates, visits per episode, visits per week, and the number of new patients.

Organizations regularly held managers accountable for these measures. As supported by previous research, we found managers felt they were measuring quality when in fact, they were measuring operations in the name of quality.[128,145] This focus on clinical operations was compounded by how the organizations forced managers to oversee multiple disparate aspects of the company and how these other area of focus competed with their oversight of clinical quality. Consistent with past research on the priorities of managers in healthcare, we also learned of managers dividing their focus on patients, other providers, the organization, and health policy.[130]

According to Differentiation and Consolidation Theory and the concepts of cognitive bias and satisficing, it is probable these managers were simplifying their daily decision making to a smaller number of factors and the operational metrics won out for their attention.[201-204] This types of sub-optimal decision making is also seen in direct clinical care, especially when performed under stress.[205] Additionally, corporate leaders in this study also emphasized operational metrics over quality metrics. As noted from past research, when managers in this study did emphasize quality metrics, it was often for achievement of financial incentives and payor mandates.[12]

Study Recommendations

Increasing organizational focus on clinical quality

In order to establish a balanced perspective, business leaders should set clear organizational stances on quality/value and clinical operations as the foundation for a refined set of metrics. In turn, these metrics can help ensure the organization delivers on its priorities. However, in most of the organizations we observed, the specific stances on both of these domains were often blurred and the basis for the metrics managers oversaw, blurred

even further. As noted above and graphically depicted in Figure 6, managers were charged with delivering organizational results of financial success and positive experiences for patients and employees.

Achievement of these results was largely outside of managers' direct control, since they relied upon the totality of business actions. Additionally, a set of metrics representing lead measures were expected to support these results for which managers were ultimately responsible. These lead measures were the focus of managers' administrative work and were grounded in organizationally established clinical operations and definitions of quality and value. The strategic purpose for these lead measures was not always clearly delineated to the managers and this often left them over-focused on clinical operation while neglecting clinical quality/value measures. We do not suggest the current metrics are wrong, but rather they should be augmented and their purpose refined.

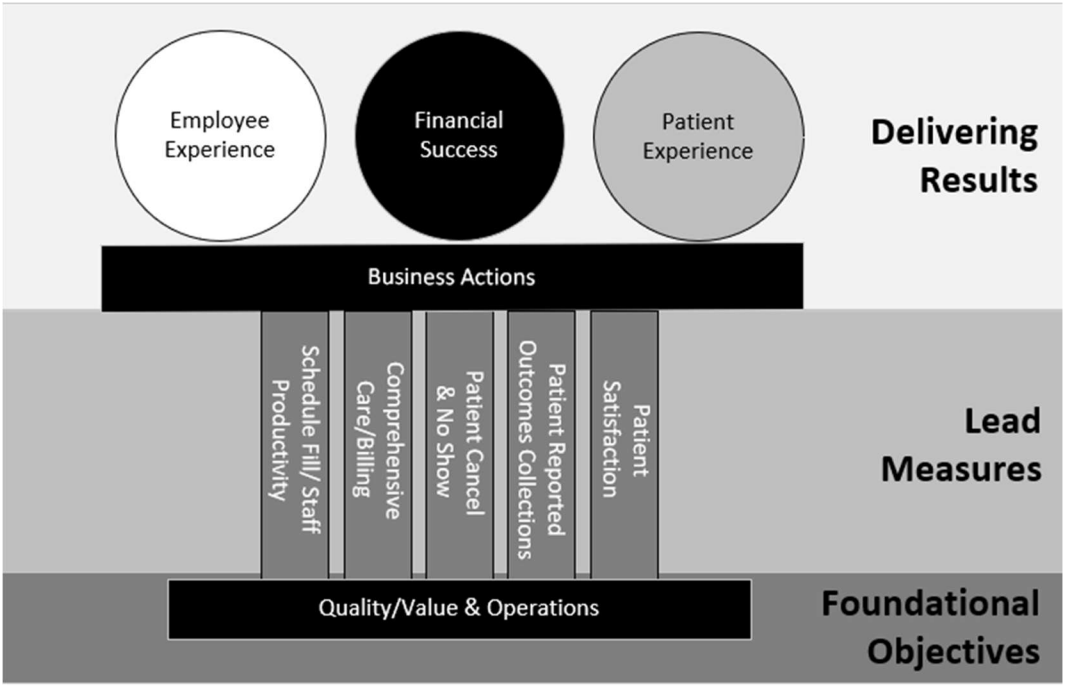

Figure 6: Manager's business priorities

Instead, we recommend organizations take two key steps. First, foundations for healthcare managerial work, operations and quality/value, should be seen as separate but complementary. There is a natural tension between optimizing operational efficiencies and measurable clinical quality that should be recognized and embraced.[206] We suggest organizations should be more explicit in the underlying basis for the measures to which managers are accountable. For instance, denoted in Figure 7 by the association between the pillar shading and both the foundational objective and organizational result shading, patient satisfaction measures and patient reported outcomes measures should primarily be collected to support quality/value-based objectives, in an effort to optimize the patient experience. Patient reported outcomes collections and outcomes/value measurement should also be a separate focus since they serve separate corporate objectives.

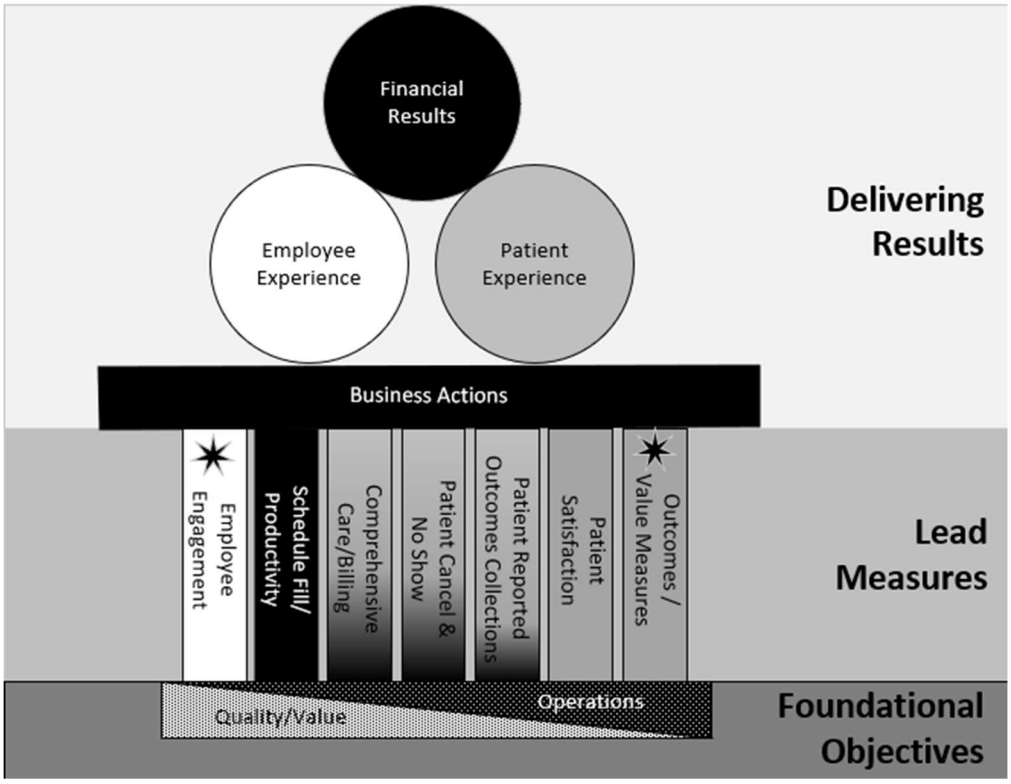

Figure 7: Recommended modification to managers' business priorities. Stars indicate recommended new measures

Recognizing that the result each measure supports cannot be fully disentangled, patient reported outcomes collections compliance, patient no-show and cancelation rates, and measures of comprehensive care/billing should be seen as supporting both quality and operational foci, which in turn uphold primarily financial results and the patient experience. We also recommend organizations add a specific measure of employee engagement with an emphasis on ensuring they are creating a positive employee experience. We recommended this because of the tendency for the professional to neglect his/her own wellbeing as described in chapter five and the fact employee engagement supports all other clinical objectives. Delineating the strategic purpose for these measures can help ensure managers keep a balanced view of their work between quality/value and operational foci.

Second, organizations should view financial results as a product of organizational focus on employee and patient experiences. Figure 7 does not suggest financial results are the most important deliverable, but rather the fact they are upheld by everything else the organization does. While certainly, financial success is a primary objective of both for-profit and not-for-profit organizations, it is mediated through patients and employees, and the experiences of both throughout the course of patient care. This emphasis is increasingly important as payors implement more value-based reimbursement strategies. Organizations are tempted to manipulate quality measures to maximize incentives or minimize penalties. However, keeping the patient at the center of these strategic decisions will provide a more sustainable solution and keep these organizations focused on their purpose of making a business out of serving patients, rather than serving patients as a means of supporting a business.

Facilitating managers' use of CIS to oversee quality

Taken together with past studies, our results suggest organizations' attempts to increase systems adoption should emphasize the information content of the systems, integration of the systems into daily workflows, and early training to establish sound system-use habits, especially in newer managers. This focus is true of implementing any CIS. However, because organizational proactive clinical quality management is lacking in most PT companies, even more emphasis must be placed on ensuring managers and PTs perceive quality-based CIS as supporting their daily work if they are to willingly adopt these systems.

Additionally, direct supervisors should hold managers accountable for quality measures. This accountability may be financially-based, or may simply be through direct interaction with a supervisor. However, our results strongly supported past research that showed leaders whose performance evaluations were based in part on quality-based clinical metrics were much more likely to use CIS to govern these metrics than individuals who did not have this accountability.[132] This supervisor oversight of managers is also an external demonstration of organizations commitments to metrics and developing a culture of quality. That commitment directly influenced managers' use of CIS to oversee metrics in the qualitative phase of our study.

Study Limitations

While this study produced many useful insights, there are several limitations to this work. First, both phases of this research were performed within the domain of outpatient physical therapy practices. It is unclear if these results are generalizable to other PT settings. Additionally, as mentioned in chapters three and four, the qualitative phase of this research was conducted with employees in their place of work. Thus, it is possible these individuals

held back their true feelings in certain answers. Finally, the results from the qualitative phase of this research were drawn from clinics largely in the northwestern United States. While we cannot be certain we would have observed the same findings in other regions, we did not see geographic differences in the answers of the SEM phase of the research. This suggests sentiment regarding managers' adoption of CIS to oversee clinical quality is similar between the various regions.

We were unable to perform a formal non-response analysis for our survey. Thus, we cannot be assured that some unmeasured bias did not influence study invitees to either complete or not complete the survey, or how they answered certain questions. However, when we compared the demographics of our survey respondents with an APTA survey of individuals claiming a role of manager or administrator, we found similar demographics. While we used this similarity along with the low level of survey item missingness to suggest items were at least missing at random (MAR), it is possible that using maximum likelihood estimation was not warranted in the SEM analysis. However, the impact of this assumption being wrong is minimal given the primarily confirmatory nature of the SEM phase of the research. Additionally, because of the skewness of some of the item responses, we could not be certain of the assumption of multi-factor normality of the survey items. However, as mentioned in chapter five, even when we added bootstrapping to the parameter estimation, the estimates and confidence intervals did not change meaningfully.

With respect to UTAUT focus, we emphasized Behavioral Intention as our endogenous factor instead of actual system use. Thus, we cannot claim that this model can explain actual system use as well as it was able to explain Behavioral Intention. However, past research has shown Behavioral Intention to effectively explain system use in previous

PT settings.[66] Additionally, our sample size was somewhat small for SEM research with as many factors as we included in our models. This contributed to wide confidence intervals for most of the parameter estimates. This potentially resulted in committing a type-II statistical error, claiming several of the parameter estimates were not significantly different than zero when in fact they were.

Finally, because of the small sample size, we were unable to keep a holdout cohort for cross validation of the SEM analysis. Thus, it is possible that we over fit our model to the study data and the model inferences may not be generalizable to other samples. However, as noted in chapter five, our aim was not to suggest UTAUT was the best model for this domain. Rather, we showed UTAUT was an acceptable model for this domain. Our qualitative results and the similarity between our quantitative results and those of past research studies supported this conclusion.

Future Directions

Management of quality in outpatient physical therapy

Our primary outcome factor was managers' intention to use CIS to oversee clinical quality. However, the primary focus should be on actual system use. Our research fulfilled a necessary first step. The simplest extension of this research would be to replicate the SEM portion of this research but using a single quality-based CIS from which researchers could extract actual system user logs. They could then link survey respondents to their actual system use and measure the relationship between the UTAUT factors studied in this research and that system use. Researchers could then replicate this design on several other quality-based CIS implemented in different organizations.

Additionally, in this dissertation, we have suggested that use of CIS to oversee clinical quality will contribute to measurable improvements in clinical quality. A natural parallel study to the focus described above would be to explore the influence of actual system use on the many definitions of clinical quality that study participants provided in the qualitative phase of this research. However, that creates a much more complex research problem, likely requiring a more rigorous approach using randomized controlled trials and controlling for multiple potentially confounding variables.

Finally, this research focused on managers' use of CIS to oversee clinical quality. While we have made the case that managers serve an important role in clinical quality assurance, providers are directly responsible. Future research should focus on information systems aimed at guiding clinicians' decision-making regarding treatment selection, specialist referral, and continuation of care. The methods framework used in this research is generalizable to other areas of PT and in other healthcare domains.

Information system acceptance action-based research

The emphasis of this dissertation was on systematically testing refined research questions. However, RQI has often been used in action-based research in organizations. Rapidly understanding a business problem, ideating on and implementing an intervention, and studying the outcome produces a continuous quality improvement framework. A small team could use the design from phase one of this study to explore managers' use of CIS in a specific organization.

Researchers could then add what was learned to the recommendations from our research to create an intervention. Once that intervention was implemented, the team could even quantitatively measure for any change in a behavior or outcome. Following the

intervention, again a qualitative phase could seek to understand what factors contributed to the success or failure of the intervention. This approach is known as the Intervention Mixed-Methods Framework.[188] Research conducted in healthcare under this framework has even been used to marry qualitative approaches with formal clinical trials.[189,207] This framework offers promising opportunities for mixed-methods approaches to catalyze organizational change efforts.

CHAPTER SEVEN. CONCLUSION

PT providers must increase their emphasis on providing care that produces measurable value-based results as payors alter reimbursement strategies and patients become more savvy healthcare consumers. Organizations must also support their providers in these efforts through managerial guidance, well integrated CIS, strong corporate vision, effective training, and creating a culture of quality. Organizations must also give managers adequate time for their administrative duties and hold them accountable to quality metrics if managers are to be effective leaders of clinical quality.

This research establishes a novel mixed-methods approach for studying CIS adoption that can be utilized in PT and other healthcare settings. We found that when managers are held accountable to metrics, they utilize CIS to regularly monitor these metrics more consistently. However, in general hybrid clinician-managers in our study organizations tended to heavily prioritize direct patient care over administrative duties, which limited their available time and focus for quality monitoring. Additionally, we found organizations' substantial emphasis on operational metrics and managers' incentives based on financial outcomes pushed managers' focus towards operations over clinical quality. Managers clearly desired delivering quality care in their clinics, but rarely systematically measured quality as part of continuous quality improvement initiatives.

Our quantitative work especially supported the premise that organizations can influence managers' use of CIS, but emphasized the importance of matching systems to users' workflows and the influence of habit on the intended use of these systems. By attending to the multiple facets of the sociotechnical ecosystem, organizations can improve managers' adoption of CIS.

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Appendix A: Interview Guide

It's [date] and this is [X and X] interviewing [Y] at [site name]. As I mentioned when we reviewed the Information Sheet, we would like to record this interview, and we need your verbal consent- do you agree to recording?

1. **About You**
    a. First, we'd like to learn a little about you. Could you give us a few words about your background?
    b. Would you please describe your role here?
    c. How long have you been with this organization?

2. **Management priorities**
    a. How do you spend your average day?
    b. Please discuss your highest managerial priorities
    c. How are these dictated (are they mandated, suggested, your personal prioritizations)?
    d. Discuss the metrics you look at most often for your managerial duties
    e. Do you feel you have adequate time for your managerial duties
        i. If not, what often gets missed?
    f. Do you receive incentives for your staff/clinic meeting certain benchmarks?
        i. How do these incentives motivate you?

3. **Questions from managing quality**
    a. How do you personally define quality care?
    b. How would the organization modify that definition?
    c. How is the patient's perspective of quality measured in your company?
    d. Please talk about how you monitor the quality performance of your staff
    e. What quality measures do you track for your staff?
    f. How often do you look at quality performance of your staff?
4. **Information seeking for quality improvement related questions**
    a. Describe how you find & gather information about the quality performance of your staff
    b. Are you satisfied with that process?
    c. How could that process be improved?
    d. What support do you receive to help you manage the quality of your staff?

5. **About your quality-based information system**

a. Describe the information system(s) you use to manage clinical quality
b. Is it integral in your management of clinical quality?
    i. Why?
c. Describe the usefulness of this system is in your quality management duties
d. How easy is it to use?
e. Describe any support you receive on the use of this system
f. How could it be improved?

6. Onward and Upward Questions

a. In a perfect world, how could things related to your management of quality be better?
b. What are the first steps would you take towards reaching this ideal?
c. How might PT as a whole get better at prioritizing clinical quality in daily practice
d. What is the biggest impediment to PTs focusing on clinical quality?

7. Additional Questions Based on Fieldwork

8. Observing request

a. Would you be willing to have a team member shadow you for an hour or so while you go about your work in your management duties?

Appendix B: Observation Guide

Context in managing Quality Observation Guide (Location)

Participant's name: _____ Observer's name:_____

Location:_____ Date: _____ Start Time:_____ End Time:_____

1. **Reflexivity**
   a. Assumptions

   b. Personal Notes

2. **New Terms**

3. **Summary Memo**

4. **Areas of Focus**
   a. **Quality-based CIS use**

   b. **Other systems used**

   c. **Quality-based questions**

   d. **Ease/difficulty of info search**

   e. **"I wish" statements**

   f. **Self-efficacy indicators**

   g. **Org policies on monitoring quality**

   h. **Quality-based mentoring with staff**

   i. **Competing priorities**

   j. **Time management**

Appendix C: Phase Two Survey

Confidential

Information System Acceptance

Please read the following before continuing to answer the questions

Please answer the remaining questions relative to the system containing the most relevant information to your management of clinical quality (Referred to below as Quality Improvement System). These can include reports from your medical record system, company dashboards, dedicated quality improvement systems, and ad hoc reports. Also, please answer in relation to your role as a clinical manager versus your role as a clinician in the use of this system

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Please define your PRIMARY Quality Improvement System (Described above):

◯ Dedicated quality improvement system (FOTO, ROMS, CareConnections, etc.) ◯ Metric dashboard program (Tableau, etc) ◯ Reports from your electronic medical/health record ◯ Excel spreadsheets
◯ Other

Which dedicated outcomes application do you use?

◯ FOTO ◯ PT Outcomes Registry ◯ ROMS ◯ Web Outcomes ◯ CareConnections
◯ PROMIS ◯ Other

Performance Expectancy

I find using the quality improvement system useful in my daily life

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Using this quality improvement system helps me accomplish things more quickly

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Using the quality improvement system increases my productivity

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Effort Expectancy

Learning how to use the quality improvement system is easy for me

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

My interaction with the quality improvement system is clear and understandable

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I find the quality improvement system easy to use

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

It is easy for me to become skillful at using the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Social Influence

People who are important to me think I should use the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

People who influence my behavior think I should use the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

People whose opinions I value prefer that I use the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Personal Facilitating Conditions

I have the RESOURCES necessary to use the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I have the KNOWLEDGE necessary to use the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

The quality improvement system is compatible with other technologies I use

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I can get help from others when I have difficulty using the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Habit

The use of the quality improvement system has become a habit for me

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I am addicted to using the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I must use the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Gaining Knowledge to Manage Quality

I require more than just observing my therapists working with patients or reviewing charts to truly understand the quality of the care they deliver

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I use formal metrics more than either direct observation of my therapists and/or chart reviews to assess quality in my clinic

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I feel that I can just sense the clinical quality of my therapists and do not require formal measures

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Deliberately exploring the clinical quality of my therapists is one of the tasks on which I focus the most

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Manager's Agency

The direct care I deliver to patients takes priority over my managerial duties

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I feel my dual role as a clinician and manager takes away from my abilities to effectively perform my management duties

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Most weeks I am asked to do more than I feel I can reasonably complete in my scheduled work hours

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

A lack of time hinders me from focusing on quality metrics available in my quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Organizational Pressures

Metrics related to clinical quality are easily accessible through the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I am held directly accountable for metrics related to the clinical quality of my facility

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I receive a meaningful incentive and/or a penalty based upon the clinical quality performance of my clinic

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I receive guidance from my organization on how to explore clinical quality with my staff

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Intention

I intend to continue using the quality improvement system in the future

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I will always use the quality improvement system in my daily work

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I plan to continue to use the quality improvement system frequently

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Satisfaction

I am very contended with the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

I am delighted with the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Overall, I am very satisfied with the quality improvement system

◯ Strongly Disagree ◯ Moderately Disagree ◯ Slightly Disagree ◯ Neutral ◯ Slightly Agree
◯ Moderately Agree ◯ Strongly Agree

Appendix D: SEM Indicator Variable Correlation Matrix

	PE1	PE2	PE3	EE1	EE2	EE3	EE4	SI1	SI2	SI3	PFC1	PFC2	PFC3	PFC4	H1	H2	H3	K1	K2	K3	K4	MA1	MA2	MA3	MA4	OP1	OP2	OP3	OP4	BI1	BI2	BI3	SAT1	SAT2	SAT3
PE1	1																																	
PE2	0.744	1																																
PE3	0.644	0.82	1																															
EE1	0.473	0.364	0.31	1																														
EE2	0.449	0.387	0.367	0.734	1																													
EE3	0.456	0.421	0.399	0.658	0.81	1																												
EE4	0.496	0.407	0.382	0.747	0.779	0.766	1																											
SI1	0.395	0.418	0.403	0.231	0.256	0.239	0.28	1																										
SI2	0.393	0.409	0.43	0.261	0.273	0.265	0.304	0.794	1																									
SI3	0.444	0.417	0.448	0.271	0.332	0.309	0.331	0.773	0.829	1																								
PFC1	0.355	0.28	0.275	0.43	0.471	0.513	0.542	0.316	0.363	0.359	1																							
PFC2	0.359	0.227	0.209	0.607	0.636	0.605	0.676	0.251	0.301	0.293	0.613	1																						
PFC3	0.272	0.224	0.243	0.304	0.364	0.367	0.363	0.091	0.11	0.134	0.432	0.368	1																					
PFC4	0.308	0.241	0.212	0.399	0.495	0.483	0.477	0.233	0.29	0.313	0.556	0.525	0.38	1																				
H1	0.524	0.392	0.346	0.509	0.509	0.47	0.551	0.352	0.407	0.401	0.479	0.512	0.207	0.459	1																			
H2	0.383	0.463	0.444	0.304	0.323	0.333	0.386	0.386	0.405	0.418	0.292	0.306	0.191	0.264	0.534	1																		
H3	0.284	0.262	0.192	0.172	0.219	0.195	0.256	0.411	0.434	0.417	0.254	0.199	0.07	0.201	0.465	0.437	1																	
K1	0.347	0.327	0.294	0.154	0.125	0.191	0.192	0.339	0.302	0.324	0.169	0.113	0.005	0.049	0.288	0.315	0.252	1																
K2	0.254	0.271	0.22	0.114	0.174	0.176	0.22	0.229	0.174	0.206	0.185	0.193	0.03	0.188	0.241	0.27	0.236	0.433	1															
K3	0.218	0.196	0.164	0.124	0.099	0.114	0.123	0.183	0.198	0.242	0.097	0.106	-0.006	0.063	0.263	0.16	0.166	0.41	0.229	1														
K4	0.275	0.253	0.191	0.216	0.246	0.198	0.254	0.16	0.136	0.162	0.165	0.241	0.07	0.224	0.351	0.285	0.174	0.256	0.269	0.129	1													
MA1	0.053	0.141	0.116	0.056	0.067	0.043	0.073	0.172	0.129	0.155	0.07	0.129	-0.041	0.076	0.069	0.154	0.022	0.109	0.141	0.265	0.117	1												
MA2	0.069	0.042	0.035	0.124	0.216	0.217	0.132	-0.029	-0.042	-0.021	0.159	0.202	0.109	0.16	0.117	0.022	-0.025	-0.05	0.052	0.045	0.138	0.292	1											
MA3	0.022	-0.002	0.041	0.076	0.15	0.096	0.124	-0.016	-0.043	0.005	0.162	0.18	0.055	0.191	0.083	0.018	-0.08	-0.053	0.095	0.044	0.073	0.248	0.582	1										
MA4	0.075	0.085	0.08	0.17	0.228	0.2	0.215	0.029	-0.016	0.004	0.239	0.227	0.096	0.221	0.193	0.112	0.012	0.015	0.146	0.165	0.207	0.287	0.565	0.65	1									
OP1	0.355	0.348	0.311	0.362	0.432	0.424	0.447	0.23	0.218	0.257	0.436	0.319	0.358	0.399	0.309	0.317	0.197	0.225	0.236	0.046	0.192	-0.045	-0.061	-0.06	0.104	1								
OP2	0.31	0.31	0.265	0.201	0.225	0.176	0.251	0.329	0.327	0.286	0.212	0.185	0.153	0.155	0.298	0.248	0.263	0.169	0.178	0.147	0.155	0.036	-0.045	-0.111	0	0.281	1							
OP3	0.213	0.224	0.206	0.091	0.106	0.069	0.142	0.214	0.205	0.2	0.133	0.076	0.163	0.11	0.22	0.147	0.196	0.063	0.087	-0.019	0.175	-0.005	-0.074	0.038	-0.029	0.153	0.474	1						
OP4	0.295	0.314	0.286	0.246	0.375	0.319	0.324	0.311	0.351	0.355	0.403	0.349	0.231	0.441	0.367	0.324	0.28	0.197	0.258	0.071	0.246	0.018	0.088	0.083	0.145	0.413	0.329	0.282	1					
BI1	0.481	0.428	0.376	0.379	0.45	0.395	0.411	0.405	0.425	0.458	0.4	0.31	0.241	0.396	0.515	0.325	0.393	0.353	0.252	0.256	0.194	0.01	0.001	0.004	0.075	0.394	0.309	0.199	0.307	1				
BI2	0.496	0.448	0.377	0.371	0.428	0.376	0.422	0.365	0.374	0.39	0.349	0.327	0.15	0.366	0.588	0.425	0.433	0.318	0.312	0.202	0.286	0.033	0.065	0.049	0.106	0.351	0.33	0.198	0.312	0.676	1			
BI3	0.519	0.488	0.4	0.399	0.489	0.413	0.432	0.406	0.419	0.466	0.401	0.33	0.196	0.396	0.577	0.404	0.452	0.372	0.337	0.243	0.274	0.08	0.097	0.057	0.116	0.414	0.307	0.2	0.343	0.748	0.717	1		
SAT1	0.48	0.536	0.508	0.342	0.473	0.503	0.471	0.325	0.295	0.385	0.483	0.327	0.424	0.426	0.408	0.44	0.191	0.238	0.249	0.096	0.178	0.057	0.098	0.099	0.195	0.563	0.264	0.199	0.414	0.488	0.433	0.513	1	
SAT2	0.489	0.573	0.539	0.354	0.46	0.487	0.477	0.314	0.286	0.357	0.448	0.313	0.399	0.413	0.393	0.49	0.259	0.245	0.274	0.071	0.226	0.113	0.139	0.11	0.203	0.596	0.274	0.219	0.42	0.451	0.434	0.512	0.831	1
SAT3	0.501	0.541	0.539	0.355	0.511	0.553	0.472	0.314	0.301	0.363	0.484	0.377	0.431	0.434	0.412	0.468	0.257	0.259	0.259	0.117	0.192	0.083	0.168	0.121	0.192	0.553	0.271	0.209	0.435	0.502	0.455	0.529	0.838	0.838

Appendix E: Supplementary Tables

	Study (n=382)	APTA (n=6972)	Difference	Significance	Effect Size
Age in years (SD)	46.97 (10.42)	49.38 (10.98)	- 2.41	2-tailed t-test, $p < 0.0001$	Hedges' g = 0.22
Years Since Graduation (SD)	21.51 (10.97)	22.20 (10.72)	-0.69	2-tailed t-test, $P > 0.05$	Hedges' g = 0.06
Years in Current Role (SD)	11.24 (9.33)	8.96 (9.38)	2.28	2-tailed t-test, $p < 0.0001$	Hedges' g = 0.24
Gender	44.09% Female	49.38% Female	5.29%	$\chi^2(1,N=7354) = 4.232, p < 0.05$	Cramer's v = 0.02

Table A1: Comparison between survey respondents and managers from 2018 APTA membership survey

	Factor	Composite Reliability (ω)
UTAUT Factors	Performance Expectancy	0.90
	Effort Expectancy	0.92
	Social Influence	0.92
	Personal Facilitating Conditions	0.79
	Habit	0.73
	Behavioral Intention	0.88
Exploratory Factors	System Satisfaction	0.94
	Gaining Knowledge to Manage	0.64
	Managers' Personal Agency	0.78
	Managers' Personal Agency (Without Item MA1)	0.82
	Organizational Pressures	0.62

Table A2: Composite reliability of study factor indicator variables