BEFORE

1 Theoretical Framework

This research leverages the TOE Framework, a multi-perspective framework developed by Tornatzky and Fleischer (1990). For this study, the applied TOE framework focused on the organization-level consistent with the unit of analysis: Grady Hospital. This framework offers central and precise guidelines (accurate?) for enterprise-context adoption (Awa, et al., 2017), see Table 4 for brief descriptions of each context in the framework.

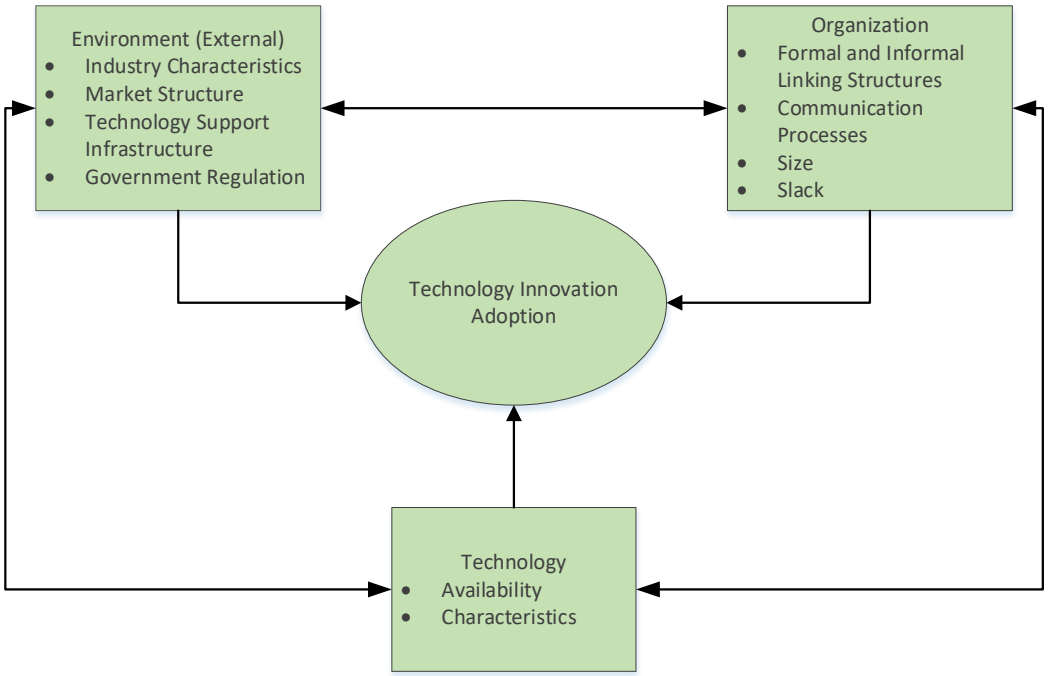
Table 4: TOE Contextual Framework

Context	Description
Technology	The technology context considers both internal and external organization-related relevant technologies and can incorporate hardware, infrastructure, or processes.
Organization	The Organization context refers to organizations' characteristics and resources, such as the organization's size, managerial structure, and capabilities of resources.
Environment	The Environment context includes pertinent industry information, such as size and structure, market competition, and regulatory considerations.

`Source: (Chen, 2019)

Many studies (Awa et al., 2017) use TOE framework with the three contexts and include evaluations of opportunities and constraints. Additionally, the theory offers a comprehensive view that does not assume industry or company size (Chen, 2019). The elaborated TOE model presents specific context and factors related to adopting the technology (Chen, 2019). Additionally, this setup earned credibility as an enterprise-wide context for IS adoption (Awa et al., 2017). Figure 1 depicts the model. Scholars, through a variety of studies, empirically validated elements of adoption such as innovation features, organization-specific technology, technical competence, financial commitment, competition, and other external environmental factors (Awa et al., 2017).

Figure 1: TOE Model



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1.1 Technology Context

The model focuses on how technology characteristics affect the EHR adoption process, such as technical features and perceived usefulness (Chen, 2019). Technical features include compatibility of the varying data standards and presentation tools. Compatibility proves to be essential for health care (Fawaz, Atkins, & Clare., 2016), since some health care organizations find it challenging to integrate new data with their existing clinical systems.

Multiple health care-related studies have noted complications with technology adoption because of a lack of interoperability and integration of the traditional EHRs or health care information systems (Miller, R., 2012; Sharmaa & Sehrawat, 2020; Walker et al., 2021). Another IT adoption study specifically focused on mobile platform adoption and use of the TOE framework, echoing Sharmaa's findings noting EHR adoption requires significant investment in IT infrastructure (Ngongo, et al., 2019). Finally, Awa et al. (2017) identify perceived simplicity, perceived compatibility, and perceived values, with simplicity being critical. Zhu et al. (2004) refers to this concept of perceived simplicity and compatibility as technology readiness; this contributes to substantial factor-related adoption. [Accurate?]

1.2 Organization Context

The TOE framework provides details that organizations should consider when adopting technological innovation, such as receiving and integrating external clinical data. The framework evaluates organization-related concepts—such as organization readiness, organization leadership support, and competitive pressure—all attributes proven to impact health care IT adoption (Ahmadi et al., 2018). Organization characteristics for health care IT adoption offers items that facilitate or constrain adoption (Ahmadi et al., 2018). Items include:

- The quantity of internally available resources;
- The quality, or the dynamic capabilities, of the human resources;
- The organization hierarchy and their support of the innovation; and
- The organization size.

Chen notes that influential characteristics for health care include (Chen, 2019):

- Formal organization system development and management programs; and
- Organization support for technology training and educational programs.

Organization size significantly influences adoption (Awa et al., 2017; Chen, 2019; Zhu, 2004). Chen (2019) also notes that top-down management support provides a critical variable in adoption. Top-down management support includes how executives see the technology impacting the overall organization (Fawaz et al., 2016). Studies indicate an increase in adoption may first require organization structural changes. Resistance can occur and can be a significant factor in adoption (Fawaz et al., 2016).

1.3 Environment Context

The environment context refers to external areas where organizations conduct their businesses. It also speaks to their abilities to access and utilize resources external to their environments, such as interaction with the government and other health care providers. Within the framework, competition proves a significant driver of adoption (Chen, 2019). However, in this context, CMS's MIPS program, and

the associated payment adjustments, become the driving forces. The government's involvement also can influence adoption (Chen, 2019), but the government's interaction is not a holistic solution, as the prior literature demonstrates. In health care specifically, ONC posits to govern by providing standards used by health care organizations, EHR vendors, and service providers ("Office of National Coordinator for Health IT," 2018). This governance can impact decisions health care organizations and providers make that influence adoption. Other external governance decisions around security and privacy also heavily influence the health care industry and technology adoption (Fawaz et al., 2016). Health care organizations and providers must comply and monitor compliance with regulations and security (Fawaz et al., 2016).

Other environmental influences include industry and competitive pressures and market uncertainty (Awa et al., 2017; Chen, 2019). Work by Awa et al. (2017) validates that mimicry of competitors' approaches related to technology adoption, which proves to be a significant predictor of adoption. Another driver includes externally adopted policies that encourage increased use of technology and subsequently spur organization IT investment (Ngongo et al., 2019). Zhu et al. (2004) confirm that external regulations significantly related to creating value for the business.

1.4 Recent TOE Literature

A review of current literature revealed that studies continue to validate the broad applicability of the TOE framework (Ahmadi et al., 2018; Ahmed, 2020; Ngongo, Ochola, Ndegwa, & Katuse, 2019; Sharmaa & Sehrawat, 2020). Several studies continued to use the TOE framework for alignment with current IT solutions across various disciplines (Ahmed, 2020; Ngongo et al., 2019; Sharmaa & Sehrawat, 2020). As noted with the wide-ranging value of the TOE framework, there is a positive association among the three TOE concepts: technology, organization, and environment. One study based on interviews and literature review (Ahmed, 2020) concluded with considerations for organizations regarding their evaluations of cloud computing adoption (Ahmed, 2020). Another study using a

qualitative interview approach investigated the slow adoption of mobile health applications in Kenya, aligned with the TOE framework (Ngongo et al., 2019). Several criteria revealed themselves in all three studies, such as complex technology and organizations' information technology (IT) expertise (Ahmed, 2020; Ngongo et al., 2019; Sharmaa & Sehrawat, 2020). The environment factors were contextual to the study, such as industry participant adoption, as demonstrated by Ngongo et al. (2019) on studying adoption of digital health care technologies by commercial insurance, governmental plans, and industry knowledge when evaluating cloud computing for health care (Sharmaa & Sehrawat, 2020). The TOE framework continues to prove to be a valuable tool for assessing technology adoption while considering the three conceptual variables of technology, organization, and environment.

1.5 TOE Applied to Health Care IT and EHR Adoption

As mentioned, the ARRA regulations targeted health care organizations to increase adoption and utilization of EHRs. In 2015, 96% of the reporting hospitals acquired and implemented certified EHRs (Henry, 2016). Between 2008 and 2015, adopting basic EHR functions rose from 9.4% to 84%, where basic functions include collecting patient demographics, problems, medications, allergy listing, discharge summaries, and viewing pertinent clinical data such as labs and imaging test results (Henry, 2016). The notably upward adoption of basic EHR functions confirms and supports claims that EHR usage has moved past acquiring and basic implementation. Additionally, fully embodied EHR adoption is associated with a higher quality of care (Shih et al., 2011). Thus, I organized the HIT and EHR adoption literature into three themes:

- Technology: Use of clinical decision support (Ballard et al., 2007; Shih et al., 2011; Wright et al., 2012), system integration and design for advanced features configurations (Alanazi, et al., 2020; Deily, Hu, et al., 2013; Holmgren, et al.; Jha & Adler-Milstein, 2021; Salleh et al.; 2021; Shih et al., 2011; Tsai et al., 2020), and technical support including training (Alanazi et al., 2020; Ballard et al., 2007; Ryan et al., 2013; Tsai et al., 2020).

- Organization: Includes leadership engagement, such as organization directives and goals (Baird et al., 2017; Ballard et al., 2007; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Tsai et al., 2020).

  Another important quality offers [WHAT does it offer?] (Alammari et al., 2021; Ballard et al., 2007; Deily et al., 2013; Ryan et al., 2013; Salleh et al., 2021; Seblega et al., 2015; Tsai et al., 2020) and Cost (Adler-Milstein et al., 2013; Tsai et al., 2020). [still accurate?]
- Environment: Regulatory requirements with potential increased reimbursements (Baird et al., 2017; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Ryan et al., 2013; Shih et al., 2011; Tsai et al., 2020; Wright et al., 2012), collaboratives or network participation (Baird et al., 2017; Ballard et al., 2007; Ryan et al., 2013), and individual value, perceptions, and motivators for use of EHR health care technology (Alanazi et al., 2020; Baird et al., 2017; Choi, 2020).

All of the above research reflects outcomes highlight factors that support significant, positive results and any identified barriers that prevent the desired outcomes. For example, one 2020 published systematic literature review denoted positive effects of an EHR implementation include increased efficiency, communication, and accessibility (Tsai et al., 2020). Alternately, common barriers include inadequate training, insufficient technical support, and a lack of technological literacy and skills by users (Tsai et al., 2020). The identified barriers repeatedly appear in multiple systematic literature reviews (Tsai et al., 2020).

1.5.1 Technology

Quality-focused studies used technology—specifically the use of alerts, or notifications—as tools to possibly drive EHR adoption (Ballard et al., 2007; Shih et al., 2011; Wright et al., 2012). These studies employ a physician-driven alerting mechanism to encourage adoptive EHR usage for managing clinical preventive services or specific conditions. One scenario that focused on a meaningful use metric of

maintaining active and chronic problems on a patient problem list demonstrated a 41% increase in problem list maintenance, with more than 70% of the updates made from the alerting mechanism (Wright et al., 2012). Other studies using alerting technology demonstrated significant performance increases a group of small health care practices in NY experienced equally-distributed population management of clinical monitoring for conditions where alerting was deployed (Shih et al., 2011). Health Texas Provider Network documented moving from 68% compliance to 92% compliance in five years using alerting for clinical preventative services (Ballard et al., 2007).

Prior literature validates the importance of EHR system integration, design, and clinical data accessibility. Holmgren et al., empirically validated this distinction in a study focused on strategies and practices hospitals use to drive EHR adoption and hospitals with system integration scored 12 points higher in EHR adoption (Holmgren et al., 2021). [still accurate?] More specifically, system integration reduced duplicate data entry, allowing for greater efficiencies and possibly even reduced or repurposed staff (Ballard et al., 2007; Holmgren et al., 2021). One organization activated clinical preventative services following a system upgrade; more than half of the research participants increased documentation, thus increasing monitoring of clinical details including items such as blood pressure control for hypertension, patient's A1C for diabetes, or breast cancer screening (Shih et al., 2011). A fully integrated system designed to support efficient clinical workflows and discrete clinical data documentation increases electronic patient data and empirically proves to drive EHR adoption and improve clinicians' performances (Baird et al., 2017; Ballard et al., 2007; Holmgren et al., 2021; Salleh et al., 2021). As a result, increased knowledge creates a more informed clinician, allowing for better decision-making and performance results (Salleh et al., 2021). However, organizations must be cautious to ensure that the system design does not create inefficient data entry to meet documentation or regulatory goals (Momenipour & Pennathur, 2019). Aligned with this caution, other studies denote

health care clinicians' perceived usability, based on systems designed as barriers to adoption (Alanazi et al., 2020).

Technology and technology adoption also enable EHR data accessibility, data quality, and data accuracy. Each of these is notable in several studies as benefits of EHR adoption (Baird et al., 2017; Deily et al., 2013; Holmgren et al., 2021; Salleh et al., 2021; Tsai et al., 2020). Data accessibility includes the ability to access information in a timely manner, as well as the ability to have multiple users accessing the data simultaneously (Tsai et al., 2020). Another study echoed the importance of data accessibility: the clinicians' abilities to access data documented by health care peers in the non-hospital care settings proved to reduce complications and adverse outcomes for patients in other care settings, such as hospitals or ancillary services (Deily et al., 2013). EHR adoption also improves data quality and accuracy. Positive benefits, which also encourage technology adoption included clinical documentation entries in a consistent and standardized format (Baird et al., 2017; Deily et al., 2013; Tsai et al., 2020) and fulfilling regulatory and health care fulfillment accreditation requirements. Salleh et al. (2021) completed a quantitative study evaluating performance indicators in three government hospitals. Knowledge quality, which directly relates to using a standardized data structure, fulfills documentation guidelines and requirements. One study, however, revealed negative results noting that clinicians spend more time completing clinical documentation than caring for patients (Momenipour & Pennathur, 2019). Literature also indicated that while EHR data is present and accessible, providers report difficulty finding pertinent clinical data like notes and lab results (Tsai et al., 2020). Also, complete and comprehensive data is essential for adoption; as literature notes, a lack of complete and comprehensive information is a barrier to EHR adoption (Baird et al., 2017; Holmgren et al., 2021; Salleh et al., 2021; Tsai et al., 2020). A common theme noted that free text in EHRs proves to be a data quality barrier (Baird et al., 2017; Salleh et al., 2021; Tsai et al., 2020).

Empirical evidence validates positive impacts of technology support and training on EHR adoption (Alanazi et al., 2020; Baird et al., 2017; Ballard et al., 2007; Ryan et al., 2013; Tsai et al., 2020). Millions of dollars have been and are available to assist with EHR adoption. For example, in 2009, ARRA allotted $643 million for a Health care IT Extension program to aid smaller health care providers with use (Ryan et al., 2013). In one study, a regional extension center identified that high-quality EHR use came from nine months of use and continuous technical support, including onsite visits (Ryan et al., 2013). Groups without onsite visits did not yield improved adoption rates until after 24 months of usage (Ryan et al., 2013). Additional literature finds the same outcome; suggesting that long-term, multi-prong support, and training approaches drive adoption and greater utilization of the EHR (Baird et al., 2017; Ryan et al., 2013; Salleh et al., 2021). While the measurements across studies differ, the concept of technical support and its impact remains the same. Salleh et al. (2021) evaluated the effects of service quality on providers' performances. The frequency of technical assistance—which includes efficient follow-up activities, fully resolved problems, and subsequent follow-up calls to validate complete user satisfaction—is significant in improving clinician performance and productivity. Small health care practices, which successfully increased the use of the EHR's clinical preventative services, attribute success to ongoing technical support that includes quality improvement, technical coaching, performance feedback, and advanced EHR feature training (Shih et al., 2011). Baird et al. (2017) engaged reflective learning to evaluate technology assimilation in health care practices; this study's participants demonstrated increased EHR usage and further adoption. This adoption is partly attributed to the grant-funded scenario that allowed EHR experts to facilitate workshops and serve as consultants for evaluating problems, EHR optimization, and subsequent onsite follow-up sessions to evaluate workflow or EHR utilization adjustments (Baird et al., 2017). Health care clinicians' perceptions of EHR training, support, and education on computer literacy also present reported barrier to adoption (Alanazi et al., 2020). [accurate?]

1.5.2 Organization

Prior literature outlines how organizational leadership engagement impacts EHR adoption (Baird et al., 2017; Ballard et al., 2007; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Tsai et al., 2020). Holmgren et al. studied impacts of organization practices on EHR adoption. Organizations in the top tier for adopting demonstrated engaged leadership, including full ongoing participation of hospital boards in EHR optimization (Ballard et al., 2007; Holmgren et al., 2021). [Boards? Hospital boards? what boards?] provide essential participants for EHR optimization with the larger organization strategic goals or federal regulations (Holmgren et al., 2021). Secondly, organizations in the top tier included their boards and top leadership in planning corporate efforts to implement and optimize the EHR (Holmgren et al., 2021). They used organization campaigns to share quality and cost reduction plans aligned with organizations' strategies and included EHR optimization (Holmgren et al., 2021). The organization campaign included principles in several studies where leadership set the initiative in motion (Baird et al., 2017; Ballard et al., 2007). [accurate?]

Two examples of leadership engagement successes include:

- A multi-provider network designed to increase compliance with clinical preventive studies and use a network-wide ambulatory process improvement initiative with leadership champions to disseminate best practices (Ballard et al., 2007) and;
- Individual clinical leaders desired to increase their use of EHRs and clinical efficiencies; the leaders joined a collaborative group and subsequently, through their leadership, were able to assimilate EHR usage, including using several advanced features, in their practice (Baird et al., 2017). These leadership examples were motivated by further compliance with the federal requirements of meaningful use (Baird et al., 2017; Ballard et al., 2007).

In both instances, the leadership engagement yielded a multi-prong approach to increase EHR use associated with specific goals (Baird et al., 2017; Ballard et al., 2007). Momenipour and Pennathur

(2019) caution organizations, however, to be thoughtful about the EHR documentation requirements supporting organization goals and federal requirements as this leadership directive has empirically proven that clinicians can inadvertently spend more time charting than caring for patients.

Another literature trend focuses on the adoption of an EHR and its impact on quality. Many studies emphasize quality as related to the use of the EHR. One study deploys an empirical survey to assess variables that influence a provider's performance or quality use of the EHR (Salleh et al., 2021). This study evaluated:

- System quality, referring to IT infrastructure and technical support;
- EHR data quality, referring to ease of use and data availability;
- Service quality, referring to the vendor and technical partner's support; and
- Knowledge quality, referring to how well clinicians convert clinical data in the EHR to tactics to avoid medical errors, address clinical preventative medicine, or efficiently diagnose and treat [diagnose and treat what? (Salleh et al., 2021). [Is this the right place for the citation?]

Knowledge quality presents the most significant variable in improving effective use of EHRs and serving as an indicator of provider performance. Following knowledge quality, system and record quality predict practical use and performance. Finally, service quality also predicted performance but was not significantly related to the effective use of EHRs (Salleh et al., 2021). Knowledge quality is empirically denoted in other studies, too; for example, studies on clinical preventive services documented improvement in addressing preventative medicine with patients by presenting the required or recommended preventative medicine information in an organized way, with clinical alerts (Ballard et al., 2007; Shih et al., 2011). Another study, which also adds emphasis on EHR adoption, exemplified the importance of EHR knowledge quality. Knowledge quality resulted in providers modifying their workflows to allow data entry of past values and the new values for comparison and reconciliation

(Baird et al., 2017). Prior literature also notes that the use of comprehensive, system-based, integrated EHR's also validated a higher quality of care, including reducing readmissions and decreased adverse outcomes, such as complications (Deily et al., 2013; Tsai et al., 2020). Another study notes that EHR implementation does not necessarily translate into high-quality care but rather time, plus continued technical support and education combined, produce high-quality results (Ryan et al., 2013). This finding aligns with a retrospective study Alammari et al. (2021) evaluated EHR capabilities, such as providers' abilities to maintain an active problem list and viewing lab results, etc. for four screening-oriented quality measures, such as tobacco use, blood pressure screening, obesity screening, and obesity education (Alammari et al., 2021). The results included a significant finding for blood pressure screening, obesity screening, and obesity education, but not a significant correlation between the EHR capabilities and tobacco screening (Alammari et al., 2021). Finally, a comprehensive data analysis focused on the impact of EHRs on mortality for several clinical conditions identified mixed results compared to prior literature (Seblega et al., 2015). Only one infection, pneumonia, was significantly correlated with the implementation of clinical IT (Seblega et al., 2015). Seblega et al. acknowledged that other studies revealed no correlation between pneumonia mortality and adopting clinical IT (Seblega et al., 2015).

Additional literature articulates EHR adoption on cost. One study compared the per member per month (PMPM) claims data of four years for 806 clinicians to 18 months post EHR implementation (Adler-Milstein et al., 2013). These clinicians participated in a collaborative project. They identified a 3% PMPM cost decrease. Plus, the study also revealed a significant reduction in redundant radiology and lab testing (Adler-Milstein et al., 2013). Tsai et al.'s (2020) comprehensive systematic literature review found other cost savings, such as reducing transcription and paper costs (Tsai et al., 2020).

1.5.3 Environment

Prior literature also discusses the influence of regulatory requirements or the possibility of increased reimbursement as motivators for expanding adoption of EHR and health care IT (Baird et al.,

2017; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Ryan et al., 2013; Shih et al., 2011; Tsai et al., 2020; Wright et al., 2012). Regulatory requirements—such as Meaningful Use and accreditation organizations—included Patient-Centered Medical Home, actively encouraging EHR design that supports clinical preventative services and use of advanced features, consequently motivating research and adoption (Baird et al., 2017; Holmgren et al., 2021; Ryan et al., 2013; Shih et al., 2011). The study conducted by Momenipour and Pennathur (2019) was not motivated by regulatory requirements. The findings suggest organizations should be cautious about designing EHR's specifically around the regulatory and organization mandatory requirements. As a result, they may yield undesired outcomes (Momenipour & Pennathur, 2019). Another study by Wright et al. (2012) was motivated by the meaningful use objective of maintaining the patients' problem lists. This meaningful use metric, which had low compliance, was the motivation behind evaluating the use of alerts to increase compliance (Wright et al., 2012). Of interest, many of the studies and the study participants include organizations or health care provider groups who are participating with larger networks or mulit-organization collaboratives (Adler-Milstein et al., 2013; Baird et al., 2017; Ballard et al., 2007; Momenipour & Pennathur, 2019; Ryan et al., 2013).

Also, external or inherent influences shape users' values, perceptions, and motivation, all of which influence adopting EHR health care technology (Alanazi et al., 2020; Baird et al., 2017; Choi, 2020). Choi's (2020) research specifically explored clinicians' motivations for quality and efficient computerized physician order entry (CPOE) usage with users' perceptions of system benefits as a moderator. The results indicate that doctors' and nurses' perceptions of EHR system benefits mediate their motivation for efficiency on their CPOE usage. In contrast, when evaluating quality and its impact on CPOE usage, system benefits perception only mediates for nurses (Choi, 2020). The study concludes that doctors perceive they provide high-quality care from their training and implicit knowledge versus an EHR. Using a standardized workflow derived from EHRs' limits on their abilities to personalize patients'

care (Choi, 2020). Similarly, Baird et al.'s (2017) research findings support literature on reflective learning, noting that values play a part in assimilation. However, a distinction of this study denoted that reflective learning, in conjunction with the technology user's discounts, may or may not change behavior (Baird et al., 2017). In some instances, such as maintaining efficiency, the values confirmed the behavior, and no behavior modification occurred in conjunction with reflective learning (Baird et al., 2017). Finally, Alanazi et al. (2020) conducted a systematic literature review that echoed the findings of both Baird et al. (2017) and Choi (2020). The premise for the research is how health care users' perceptions influence EHR adoption. Like Choi's (2020) research, Alanazi et al.'s (2020) study denoted the influence of systems benefits on health care providers' perceptions, as well as the impact of challenges and risks and personal factors, like those concluded by Choi with regards to the health care clinicians' training related to their motivation for quality. The health care clinicians' perceived benefits lead to an increased usage of the EHR (Alanazi et al., 2020). Like Baird et al. (2017), the identified negative perceptions include concerns over workload increases or inefficiencies, thus making them less likely to pursue adoption (Alanazi et al., 2020). Additionally, like Baird et al. (2017), health care perceptions are influenced by indivuals or past experiences that impact EHR adoption (Alanazi et al., 2020).

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2 Theoretical Framework

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This research leverages the TOE Framework, a multi-perspective framework developed by Tornatzky and Fleischer (1990). For this study, the applied TOE framework focused on the organization-level consistent with the unit of analysis: Grady Hospital. This framework is theoretical with empirical regard in the information systems area (Awa, et al., 2017); the framework dominants research for studying enterprise-context Adoption (Awa, et al., 2017), as its generic tri-factorial approach provides a meaningful lens for understanding users' opinions. See Table 4 for brief descriptions of each context in the framework.

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comprehensive view that does not assume industry or company size (Chen, 2019). The elaborated TOE model presents specific context and factors related to adopting the technology (Chen, 2019). Additionally, this setup earned credibility as an enterprise-wide context for IS adoption (Awa et al., 2017). Figure 1 depicts the model. Scholars, through a variety of studies, empirically validated elements of adoption such as innovation features, organization-specific technology, technical competence, financial commitment, competition, and other external environmental factors (Awa et al., 2017).

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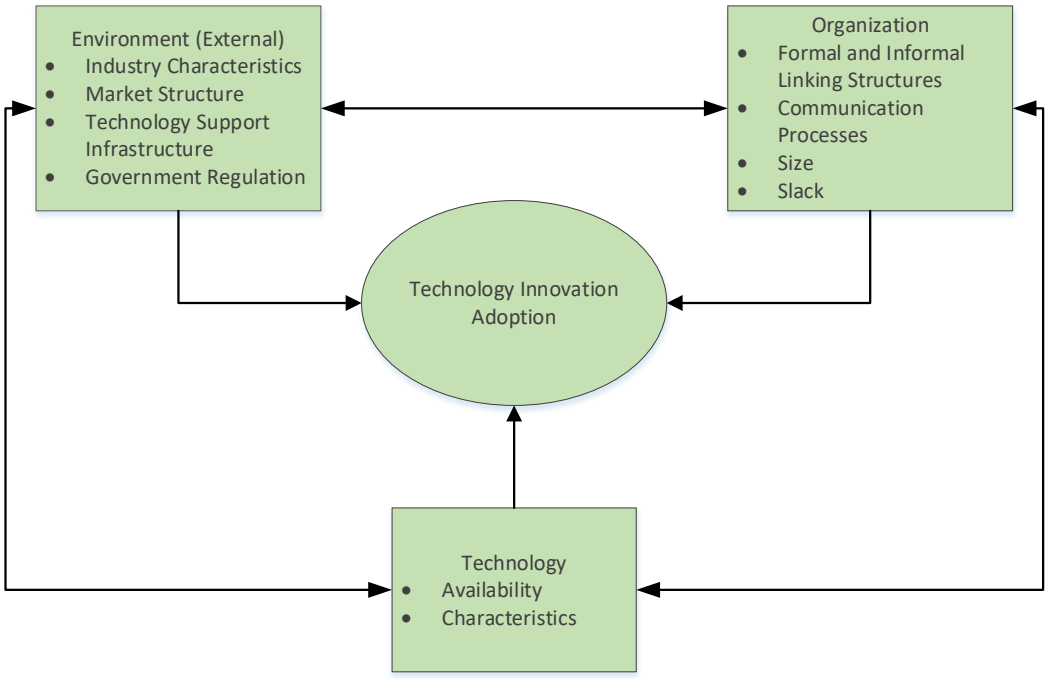

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evaluates organization-related concepts—such as organization readiness, organization leadership support, and competitive pressure—all attributes proven to impact health care IT adoption (Ahmadi et al., 2018). Organization characteristics for health care IT adoption offers items that facilitate or constrain adoption (Ahmadi et al., 2018). Items include:

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As mentioned, the ARRA regulations targeted health care organizations to increase adoption and utilization of EHRs. In 2015, 96% of the reporting hospitals acquired and implemented certified EHRs (Henry, 2016). Between 2008 and 2015, adopting basic EHR functions rose from 9.4% to 84%, where basic functions include collecting patient demographics, problems, medications, allergy listing, discharge summaries, and viewing pertinent clinical data such as labs and imaging test results (Henry, 2016). The notably upward adoption of basic EHR functions confirms and supports claims that EHR usage has moved past acquiring and basic

implementation. Additionally, fully embodied EHR adoption is associated with a higher quality of care (Shih et al., 2011). Thus, I organized the HIT and EHR adoption literature into three themes:

- Technology: Use of clinical decision support (Ballard et al., 2007; Shih et al., 2011; Wright et al., 2012), system integration and design for advanced features configurations (Alanazi et al., 2020; Deily, Hu et al., 2013; Holmgren et al., 2021; Jha & Adler-Milstein, 2021; Salleh et al., 2021; Shih et al., 2011; Tsai et al., 2020), and technical support including training (Alanazi et al., 2020; Ballard et al., 2007; Ryan et al., 2013; Tsai et al., 2020).
- Organization: Includes leadership engagement, such as organization directives and goals (Baird et al., 2017; Ballard et al., 2007; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Tsai et al., 2020), EHR adoption on organization quality (Alammari et al., 2021; Ballard et al., 2007; Deily et al., 2013; Ryan et al., 2013; Salleh et al., 2021; Seblega et al., 2015; Tsai et al., 2020) and EHR adoption on organizational cost (Adler-Milstein et al., 2013; Tsai et al., 2020)
- Environment: Regulatory requirements with potential increased reimbursements (Baird et al., 2017; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Ryan et al., 2013; Shih et al., 2011; Tsai et al., 2020; Wright et al., 2012), collaboratives or network participation (Baird et al., 2017; Ballard et al., 2007; Ryan et al., 2013), and individual value, perceptions, and motivators for use of EHR health care technology (Alanazi et al., 2020; Baird et al., 2017; Choi, 2020).

The research above reflects outcomes highlight factors that support significant, positive results and any identified barriers that prevent the desired outcomes. For example, one 2020

published systematic literature review denoted positive effects of an EHR implementation include increased efficiency, communication, and accessibility (Tsai et al., 2020). Alternately, common barriers include inadequate training, insufficient technical support, and a lack of technological literacy and skills by users (Tsai et al., 2020). The identified barriers repeatedly appear in multiple systematic literature reviews (Tsai et al., 2020).

2.5.1 Technology

Quality-focused studies used technology—specifically the use of alerts, or notifications—as tools to potentially drive EHR adoption (Ballard et al., 2007; Shih et al., 2011; Wright et al., 2012). These studies employ a physician-driven alerting mechanism to encourage adoptive EHR usage for managing clinical preventive services or specific conditions. One scenario that focused on a meaningful use metric of maintaining active and chronic problems on a patient problem list demonstrated a 41% increase in problem list maintenance, with more than 70% of the updates made from the alerting mechanism (Wright et al., 2012). Other studies using alerting technology demonstrated significant performance increases a group of small health care practices in NY experienced equally distributed population management of clinical monitoring for conditions where alerting had deployed (Shih et al., 2011). Health Texas Provider Network documented moving from 68% compliance to 92% compliance in five years using alerting for clinical preventative services (Ballard et al., 2007).

Prior literature validates the importance of EHR system integration, design, and clinical data accessibility. Holmgren et al. (2021) empirically supported this distinction; this study's results offered strategies and practices hospitals can use to drive EHR adoption. Using a survey, Holmgren et al. (2021) placed hospitals into quartiles benchmarking their EHR adoption performance with one another. Hospitals in the top quartile for system integration had greater

integration across all technology systems and did not report duplicative data entry. Hospitals in the top quartile scored 12 points higher in EHR adoption than hospitals in the subsequent quartiles (Holmgren et al., 2021). More specifically, system integration reduced duplicate data entry, allowing for greater efficiencies and even reduced or repurposed staff (Ballard et al., 2007; Holmgren et al., 2021). One organization activated clinical preventative services following a system upgrade; more than half of the research participants increased documentation, thus increasing monitoring of clinical details including items such as blood pressure control for hypertension, patient's A1C for diabetes, or breast cancer screening (Shih et al., 2011). A fully integrated system designed to support efficient clinical workflows and discrete clinical data documentation increases electronic patient data and empirically proves to drive EHR adoption and improve clinicians' performances (Baird et al., 2017; Ballard et al., 2007; Holmgren et al., 2021; Salleh et al., 2021). As a result, increased knowledge creates a more informed clinician, allowing for better decision-making and performance results (Salleh et al., 2021). However, organizations must be cautious to ensure that the system design does not create inefficient data entry to meet documentation or regulatory goals (Momenipour & Pennathur, 2019). Aligned with this caution, other studies denote health care clinicians' perceived usability, based on systems designed as barriers to adoption (Alanazi et al., 2020).

Technology and technology adoption also enable EHR data accessibility, data quality, and data accuracy. Each of these is notable in many studies as benefits of EHR adoption (Baird et al., 2017; Deily, Hu et al., 2013; Holmgren et al., 2021; Salleh et al., 2021; Tsai et al., 2020). Data accessibility includes the ability to access information in a timely manner, as well as the ability to have multiple users accessing the data simultaneously (Tsai et al., 2020). Another study echoed the importance of data accessibility: the clinicians' abilities to access data documented by

health care peers in the non-hospital care settings proved to reduce complications and adverse outcomes for patients in other care settings, such as hospitals or ancillary services (Deily, Hu et al., 2013). EHR adoption also improves data quality and accuracy. Positive benefits, which also encourage technology adoption included clinical documentation entries in a consistent and standardized format (Baird et al., 2017; Deily, Hu et al., 2013; Tsai et al., 2020) and fulfilling regulatory and health care fulfillment accreditation requirements. Salleh et al. (2021) completed a quantitative study evaluating performance indicators in three government hospitals. Knowledge quality, which relates to using a standardized data structure, fulfills documentation guidelines and requirements. One study, however, revealed negative results noting that clinicians spend more time completing clinical documentation than caring for patients (Momenipour & Pennathur, 2019). Literature also indicated that while EHR data is present and accessible, providers report difficulty finding pertinent clinical data like notes and lab results (Tsai et al., 2020). Also, complete, and comprehensive data is essential for adoption; as literature notes, a lack of complete and comprehensive information is a barrier to EHR adoption (Baird et al., 2017; Holmgren et al., 2021; Salleh et al., 2021; Tsai et al., 2020). A common theme noted that free text in EHRs proves to be a data quality barrier (Baird et al., 2017; Salleh et al., 2021; Tsai et al., 2020).

Empirical evidence validates positive impacts of technology support and training on EHR adoption (Alanazi et al., 2020; Baird et al., 2017; Ballard et al., 2007; Ryan et al., 2013; Tsai et al., 2020). Millions of dollars have been and are available to assist with EHR adoption. For example, in 2009, ARRA allotted $643 million for a Health care IT Extension program to aid smaller health care providers with use (Ryan et al., 2013). In one study, a regional extension center identified that high-quality EHR use came from nine months of use and continuous

technical support, including onsite visits (Ryan et al., 2013). Groups without onsite visits did not yield improved adoption rates until after 24 months of usage (Ryan et al., 2013). Additional literature finds the same outcome; suggesting that long-term, multi-prong support, and training approaches drive adoption and greater utilization of the EHR (Baird et al., 2017; Ryan et al., 2013; Salleh et al., 2021). While the measurements across studies differ, the concept of technical support and its impact remains the same. Salleh et al. (2021) evaluated the effects of service quality on providers' performances. The frequency of technical assistance—which includes efficient follow-up activities, fully resolved problems, and subsequent follow-up calls to validate complete user satisfaction—is significant in improving clinician performance and productivity. Small health care practices, which successfully increased the use of the EHR's clinical preventative services, attribute success to ongoing technical support that includes quality improvement, technical coaching, performance feedback, and advanced EHR feature training (Shih et al., 2011). Baird et al. (2017) engaged reflective learning to evaluate technology assimilation in health care practices; this study's participants demonstrated increased EHR usage and further adoption. This adoption is attributed to the grant-funded scenario that allowed EHR experts to facilitate workshops and serve as consultants for evaluating problems, EHR optimization, and subsequent onsite follow-up sessions to evaluate workflow or EHR utilization adjustments (Baird et al., 2017). A health care clinicians' literacy level influences their perceptions of EHR training, support, and education; this training, support, and education perception can be a barrier to adoption (Alanazi et al., 2020).

2.5.2 Organization

Prior literature outlines how organizational leadership engagement impacts EHR adoption (Baird et al., 2017; Ballard et al., 2007; Holmgren et al., 2021; Momenipour &

Pennathur, 2019; Tsai et al., 2020). Holmgren et al. (2021) studied impacts of organization practices on EHR adoption. Organizations in the top tier for adopting demonstrated engaged leadership, including full ongoing participation of hospital boards in EHR optimization (Ballard et al., 2007; Holmgren et al., 2021). Hospital board members and senior organizational leadership play an essential role as participants for EHR optimization with the larger organization strategic goals or federal regulations (Holmgren et al., 2021). Secondly, organizations in the top tier included their boards and top leadership in planning corporate efforts to implement and optimize the EHR (Holmgren et al., 2021). They used organization campaigns to share quality and cost reduction plans aligned with organizations' strategies and included EHR optimization (Holmgren et al., 2021). There is mention of organization campaign utilization in several studies, and senior leaders set the initiatives in motion verbally echoing the campaigns (Baird et al., 2017; Ballard et al., 2007).

Two examples of leadership engagement successes include:

- A multi-provider network designed to increase compliance with clinical preventive studies and use a network-wide ambulatory process improvement initiative with leadership champions to disseminate best practices (Ballard et al., 2007) and;
- Individual clinical leaders desired to increase their use of EHRs and clinical efficiencies; the leaders joined a collaborative group and subsequently, through their leadership, were able to assimilate EHR usage, including using several advanced features, in their practice (Baird et al., 2017). These leadership examples were motivated by further compliance with the federal requirements of meaningful use (Baird et al., 2017; Ballard et al., 2007).

In both instances, the leadership engagement yielded a multi-prong approach to increase EHR use associated with specific goals (Baird et al., 2017; Ballard et al., 2007). Momenipour

and Pennathur (2019) caution organizations, however, to be thoughtful about the EHR documentation requirements supporting organization goals and federal requirements as this leadership directive has empirically proven that clinicians can inadvertently spend more time charting than caring for patients.

Another literature trend focuses on the adoption of an EHR and its impact on quality. Several studies emphasize quality as related to the use of the EHR. One study deploys an empirical survey to assess variables that influence a provider's performance or quality use of the EHR (Salleh et al., 2021). Salleh et al.'s (2021) study evaluated:

- System quality, referring to IT infrastructure and technical support;
- EHR data quality, referring to ease of use and data availability;
- Service quality, referring to the vendor and technical partner's support; and
- Knowledge quality, referring to how well clinicians convert clinical data in the EHR to tactics to avoid medical errors, address clinical preventative medicine, or efficiently diagnose and treat a patient.

Knowledge quality presents the most significant variable in improving effective use of EHRs and serving as an indicator of provider performance. Following knowledge quality, system and record quality predict practical use and performance. Finally, service quality also predicted performance but was not significantly related to the effective use of EHRs (Salleh et al., 2021). Knowledge quality is empirically denoted in other studies, too; for example, studies on clinical preventive services documented improvement in addressing preventative medicine with patients by presenting the required or recommended preventative medicine information in an organized way, with clinical alerts (Ballard et al., 2007; Shih et al., 2011). Another study, which also adds

emphasis on EHR adoption, exemplified the importance of EHR knowledge quality. Knowledge quality resulted in providers modifying their workflows to allow data entry of past values and the new values for comparison and reconciliation (Baird et al., 2017). Prior literature also notes that the use of comprehensive, system based, integrated EHR's also validated a higher quality of care, including reducing readmissions and decreased adverse outcomes, such as complications (Deily, Hu et al., 2013; Tsai et al., 2020). Another study notes that EHR implementation does not necessarily translate into high-quality care but time, plus continued technical support and education combined, produce high-quality results (Ryan et al., 2013). This finding aligns with a retrospective study Alammari et al. (2021) evaluated EHR capabilities, such as providers' abilities to maintain an active problem list and viewing lab results, etc. for four screening-oriented quality measures, such as tobacco use, blood pressure screening, obesity screening, and obesity education (Alammari et al., 2021). The results included a significant finding for blood pressure screening, obesity screening, and obesity education, but not a significant correlation between the EHR capabilities and tobacco screening (Alammari et al., 2021). Finally, a comprehensive data analysis focused on the impact of EHRs on mortality for many clinical conditions identified mixed results compared to prior literature (Seblega et al., 2015). Only one infection, pneumonia, was significantly correlated with the implementation of clinical IT (Seblega et al., 2015). Seblega et al. (2015) acknowledged that other studies revealed no correlation between pneumonia mortality and adopting clinical IT (Seblega et al., 2015).

Additional literature articulates EHR adoption on cost. One study compared the per member per month (PMPM) claims data of four years for 806 clinicians to 18 months post EHR implementation (Adler-Milstein et al., 2013). These clinicians participated in a collaborative project. They identified a 3% PMPM cost decrease. Plus, the study also revealed a significant

reduction in redundant radiology and lab testing (Adler-Milstein et al., 2013). Tsai et al.'s (2020) comprehensive systematic literature review found other cost savings, such as reducing transcription and paper costs (Tsai et al., 2020).

2.5.3 Environment

Prior literature also discusses the influence of regulatory requirements or the possibility of increased reimbursement as motivators for expanding adoption of EHR and health care IT (Baird et al., 2017; Holmgren et al., 2021; Momenipour & Pennathur, 2019; Ryan et al., 2013; Shih et al., 2011; Tsai et al., 2020; Wright et al., 2012). Regulatory requirements—such as Meaningful Use and accreditation organizations—included Patient-Centered Medical Home, actively encouraging EHR design that supports clinical preventative services and use of advanced features, consequently motivating research, and adoption (Baird et al., 2017; Holmgren et al., 2021; Ryan et al., 2013; Shih et al., 2011). The study conducted by Momenipour and Pennathur (2019) was unmotivated by regulatory requirements. The findings suggest organizations should be cautious about designing EHR's specifically around the regulatory and organization mandatory requirements. As a result, they may yield undesired outcomes (Momenipour & Pennathur, 2019). Another study by Wright et al. (2012) was motivated by the meaningful use objective of maintaining the patients' problem lists. This meaningful use metric, which had low compliance, was the motivation behind evaluating the use of alerts to increase compliance (Wright et al., 2012). Of interest, many of the studies and the study participants include organizations or health care provider groups who are participating with larger networks or multi-organization collaboratives (Adler-Milstein et al., 2013; Baird et al., 2017; Ballard et al., 2007; Momenipour & Pennathur, 2019; Ryan et al., 2013).

External or inherent influences shape users' values, perceptions, and motivation, all of which influence adopting EHR health care technology (Alanazi et al., 2020; Baird et al., 2017; Choi, 2020). Choi's (2020) research specifically explored clinicians' motivations for quality and efficient computerized physician order entry (CPOE) usage with users' perceptions of system benefits as a moderator. The results indicate that doctors' and nurses' perceptions of EHR system benefits mediate their motivation for efficiency on their CPOE usage. In contrast, when evaluating quality and its impact on CPOE usage, system benefits perception only mediates for nurses (Choi, 2020). The study concludes that doctors perceive they provide high-quality care from their training and implicit knowledge versus an EHR. Using a standardized workflow derived from EHRs' limits on their abilities to personalize patients' care (Choi, 2020). Similarly, Baird et al.'s (2017) research findings support literature on reflective learning, noting that values play a part in assimilation. However, a distinction of this study denoted that reflective learning, in conjunction with the technology user's discounts, may or may not change behavior (Baird et al., 2017). In certain instances, such as maintaining efficiency, the values confirmed the behavior, and no behavior modification occurred in conjunction with reflective learning (Baird et al., 2017). Finally, Alanazi et al. (2020) conducted a systematic literature review that echoed the findings of both Baird et al. (2017) and Choi (2020). The premise for the research is how health care users' perceptions influence EHR adoption. Like Choi's (2020) research, Alanazi et al.'s (2020) study denoted the influence of systems benefits on health care providers' perceptions, as well as the impact of challenges and risks and personal factors, like those concluded by Choi with regards to the health care clinicians' training related to their motivation for quality. The health care clinicians' perceived benefits lead to an increased usage of the EHR (Alanazi et al., 2020). Like Baird et al. (2017), the identified negative perceptions include concerns over

workload increases or inefficiencies, thus making them less likely to pursue adoption (Alanazi et al., 2020). Additionally, like Baird et al. (2017), health care perceptions are influenced by individuals or past experiences that impact EHR adoption (Alanazi et al., 2020).