Information technology in health management and its role in raising the quality of service provided by hospital workers and the extent of community acceptance of electronic transformations in the Ministry of Health

By

Omar Ahmed AlAmri *

***Specialist in Health Services and Hospitals Management, East Jeddah hospital / Jeddah**

Omar Abdullah Alshaikhi**

****Health Administration Technician, East Jeddah Hospital / Jeddah**

Nabeel Saleh Alharby***

*****Specialist in Health , Services and Hospitals Management, East Jeddah hospital / Jeddah**

Othman Ebrahem Althomali****

******Specialist in Health , Services and Hospitals Management, East Jeddah Hospital / Jeddah**

Lafe Owaid Dehiran Almutairi*****

*******Health Information technician, East Jeddah Hospital / Jeddah**

Mashhoor Abdulrahman Alharthi******

********Specialist in Health , Services and Hospitals Management, Maternity and Children specialist hospital / Jeddah**

Turki Nabil Mohammed Mously*******

*********Specialist in Health , Services and Hospitals Management, Maternity and Children Specialist Hospital / Jeddah**

Abdulrhman Ibrahim Aloufi *******

**********Social Specialist, East Jeddah Hospital / Jeddah**

Ahmad Ali Mohammed Alghamdi *********

***********Health Informatics Technician, First Health Cluster Jeddah / Al-Rabi and Al-Tawfiq Health Center / Jeddah**

Abstract The current study aimed to investigate information technology in health administration and its role in raising the quality of service provided to hospital workers and the extent of community acceptance of electronic transformations in the Ministry of Health by reviewing technological uses in health aspects and to provide a distinguished health service in hospitals with updating technological techniques in the Ministry of Health in the community receiving the service.

Keywords: Information Technology - Health Management - Quality of service -Hospital Workers - Community Acceptance - Electronic Transformations -Ministry of Health.

I. INTRODUCTION

With no current cure, individuals with CD are tasked with managing their condition, including coordinating complex procedures and regimens [6,7]. As with many chronic conditions, management can include performing multiple tasks and developing skills such as remembering to take medications on time, scheduling appointments, tracking symptoms, seeking social support, and managing nutrition and diet [8].
Though diet and nutrition have not been implicated in causing CD, certain foods can trigger an inflammatory flare-up or exacerbate symptoms for those with CD [9,10]. Moreover, individuals with CD have an increased risk of malnutrition and micronutrient deficiencies [11-14], which are contributing factors to disease morbidity [14-16]. While more research is needed, the current scientific and anecdotal evidence is reason enough for individuals with CD to take diet and nutrition seriously.

However, there is no consensus on nutritional or dietary guidelines or a standard nutritional assessment method, making diet- and nutrition-based management challenging [17]. Furthermore, there are limited resources for managing a specific dietary regimen at home [18]. One self-management strategy is to identify and eliminate foods that intensify symptoms [17], typically by adopting an elimination diet and food journaling [19]. Adherence to these methods is demanding, due to social pressures to eat at restaurants, stigma associated with food journaling, difficulty entering reliable dietary information, and difficulty maintaining the habit of journaling [19]. Additionally, stress related to managing cumbersome daily activities, including nutrition management, can contribute to the occurrence of CD symptoms [20] and affect social and emotional well-being [21]. Even without the demands of these activities, adopting an elimination diet may not be successful at mitigating CD symptoms, as there is variability within one's own metabolism and microbiome over time [4,22]. Therefore, it is increasingly important to develop personalized approaches to diet and nutrition for individuals with CD [23].

Consumer health information technology (CHIT) could address challenges with diet and nutrition management of CD. However, CHIT developed for diet and nutrition purposes only partially addresses the needs of CD management, as features need to be more nuanced to capture the complexities surrounding diet and nutrition. Although tools have been developed for CD, specifically, and IBD, more generally, the apps do not offer robust features for tracking diet and nutrition.

Current popular IBD-related apps (eg, GI [Gastrointestinal] Monitor, GI Buddy, and MyCrohnsAndColitisTeam) offer logging capabilities, trend reports, and community forums. These apps lack an integration of features, including those that monitor behaviors and disease states, track diet and nutrition, facilitate connections with providers, develop social networks, provide psychological tools, and provide accurate medical information. As a result, currently available apps lack features to deliver personalized diet and nutrition guidance, integrate this guidance into the broader context of daily CD management, and adapt management activities across a lifespan [24]. Overall, tools tend to treat diet and nutrition management as isolated from other components of management. For CHIT to be a more meaningful part of diet and nutrition management for individuals with CD, its design must be informed by a deeper understanding of these complexities and interactions.

The shortcomings of CHIT designed for CD management may be viewed through the lens of Corbin and Strauss's [6] theoretical framework of the illness trajectory. In this framework, 3 lines of work are described: (1) illness work (eg, managing medication, scheduling appointments, or tracking symptoms), (2) everyday life work (eg, bathing, eating, or doing laundry), and (3) biographical work (ie, major life events and identity formation). These lines of work often occur in tandem, mutually shape each other, and require coordination known as articulation work [6]. Articulation work is often needed to manage interactions between different tasks [6]; however, CHIT for this condition is often not designed to capture and support interactions between and within the lines of work and, therefore, minimizes the importance of these interactions. Furthermore, CHIT generally supports diet and nutrition management as a generalized, everyday routine, rather than a complex disease management task specific to those living with CD. However, the division between illness work and everyday life work does not necessarily hold for work that has overlapping components such as diet and nutrition management. It is clear that this work is a critical component of illness work, in addition to everyday life work, for individuals living with CD. During times of remission, the overlap between illness and everyday life work may be minimal. However, in times of flare-ups, the overlap could be considerable, with little to no distinction, since every meal requires consideration of the effects it could have on the condition. We refer to patient work [6,25,26] exhibiting these highly overlapping, dual characteristics as biform work. As such, CHIT design for diet and nutrition management for individuals with CD may be understood through the theoretical concepts of biform work and articulation work to explicate and support overlap and interactions, respectively. Therefore, in this study, we aimed to gain a more comprehensive view from a patient perspective of diet and nutrition management through this lens and to provide guidance for how CHIT can be designed to support this work.

Methods: Sample:

Eligible participants were over 18 years of age, diagnosed with CD, and US residents. Once eligibility was confirmed, a convenience sampling strategy was used to contact individuals to participate in the study.

Recruitment:

Participants were recruited from the online social media platform Facebook [27]. The keyword "Crohn's disease" was used to search for pages and groups that support individuals with CD. Administrators of both public and private groups were contacted prior to posting information about the study. Posts were directly submitted to pages for approval. Administrators from 9 CD groups and 11 CD pages agreed to the request. We also posted on our personal Facebook profiles. These posts contained a flyer that included information about the study purpose, a link to the recruitment survey on Survey Monkey, and compensation information (Figure 1). The recruitment survey contained questions about basic demographic information (ie, age and gender) and contact information. Compensation was a $20 gift card to a nation-wide retail chain. The recruitment survey was closed after 54 responses were received. Respondents who provided valid information and met eligibility criteria were contacted for an interview. If the respondent did not reply within 24 hours, a follow-up message was sent. Those who did not respond after 2 attempts were not contacted again.

In 2019 the US Census Bureau reported that there were over 25 million people living in the United States classified as having limited English proficiency (LEP), defined by not answering "very well" regarding their ability to speak English [1]. Not only is LEP linked to lower socioeconomic status and poverty, but it is also a known predictor of poorer health status, decreased preventive care, and less access to medical care [2,3]. The obstacles to receiving medical care for these patients are further compounded by communication barriers, facilitating poor engagement with health care providers, worse interpersonal care and patient satisfaction, and less patient education [4-6]. Because of these factors, the LEP population may be a growing marginalized group of patients with high disease burden and poor connections with the health care system [1].

Automated telephone self-management support systems are a form of health information technology (HIT) that use patient vignettes to deliver education and self-management tools to patients and interactive voice response with an option to request clinician phone calls to engage patients in their health care. Automated telephone self-management support systems have been shown to improve clinical outcomes such as systolic blood pressure (SBP), depressive symptoms, and obesity, and reduce hospital admissions and mortality for patients with heart failure [6-10]. They have also been shown to have high levels of patient engagement, even among older adults who may be unable to use other forms of HIT due to limited vision, literacy, or technology knowledge [11]. This dynamic and interactive tool offers a unique opportunity to reach marginalized populations with poor health access and promote engagement in populations such as those with LEP.

Despite long-time awareness of the existence of this population and the gaps in their care, providers are only recently beginning to develop targeted health interventions to improve access and outcomes for patients with LEP. Patient engagement, encompassing patient activation which is defined as having the motivation, knowledge, skills, and confidence to make effective decisions to manage one's health, has been shown to be associated with improved patient lifestyle choices, adherence, and chronic disease management [12-18]. Thus, finding novel ways to augment patient engagement will serve as one of many essential pathways to improve health care access and outcomes among the LEP population.

Automated telephone self-management support systems represent a group of novel interventions that can be tailored to specific patient populations. We sought to explore whether the LEP status impacted patient engagement with a language-concordant self-management program that featured automated telephone self-management support systems among participants with chronic kidney disease (CKD) randomized to the intervention arm of the Kidney Awareness Registry and Education (KARE) pilot trial. We hypothesized that patients with LEP would have higher levels of engagement than those with English proficiency given the novelty of a language-concordant intervention in an environment with a paucity of non-English self-management support materials.

Methods :Study Design:

We conducted a retrospective analysis of the KARE pilot trial to assess participant engagement with and impact of an HIT-augmented comprehensive self-management support program on change in SBP and albuminuria among patients with limited (vs adequate) English proficiency. Details of the KARE study have been previously described [19]. In brief, KARE was a 2 × 2 factorial pilot randomized controlled trial that took place in 2 primary care clinics in San Francisco's public health care delivery system. The study was funded by the National Institutes of Health in August 2011 and approved by the University of California Institutional Review Board in October 2011 (No. 11-07399). A total of 137 patients were enrolled in the trial, which was executed between 2013 and 2015. Overall results of the pilot trial have been published previously [20].

The KARE study had 2 levels of randomization. First, within each clinic, primary care practice teams consisting of several physicians (including trainees), 1 nurse, nurse practitioners, medical assistants, and behaviorists, were randomized 1:1 to 1 of 2 arms with a random number generator: access to a CKD registry versus usual care registry. Second, within 6 months of the provider-level randomization, eligible patients were recruited to a baseline visit and were randomized within each provider 1:1 to participate in a year-long comprehensive CKD self-management program.

Eligible patients included adults (≥18 years) with CKD, defined by 2 values of estimated glomerular filtration rate of 15-60 mL/min/1.73 m^2 or albuminuria (urine dipstick ≥1+ or urine albumin-to-creatinine ratio >30 mg/g) documented in the electronic health record on 2 occasions at least 90 days apart, who had contact with their primary health care team at least once within the past 2 years and spoke English, Spanish, or Cantonese. Patients who spoke Spanish or Cantonese were monolingual and did not speak English. Patients were excluded from the study if they were recipients for kidney transplantation, pregnant, or were unlikely to benefit from the self-management support program due to hearing or visual impairment, impaired cognition or severe mental illness, or a life expectancy less than 6 months.

Intervention:

The KARE interventions have been previously described in detail and found to be acceptable among providers and patients [19,21]. In brief, the provider intervention consisted of an electronic health record–enabled CKD registry tool with "in-reach" and "outreach" elements to support team-based management of CKD.

The patient intervention was a comprehensive CKD self-management support program with 3 distinct elements. The first element consisted of language-concordant, low-literacy written patient educational materials [22] couriered to patients at months 1, 4, and 8. The second element was a language-concordant and culturally tailored interactive automated telephone self-management program with 26 modules delivered every other week that provided education and self-management strategies related to topics pertinent to kidney health: basics of kidney disease and its association with hypertension; importance of participation in healthy behaviors (diet, physical activity, smoking cessation, stress reduction); avoidance of nonsteroidal anti-inflammatory medications; participation and preparation for clinic visits; complementary medication use; medication adherence; and glycemic control.

In addition to providing educational content, the automated phone calls included "quiz questions" which patients would answer with a touch-tone phone throughout the module. These questions promoted engagement with the program and allowed patients to hear additional content or request telephone calls from their health coach. The third element of the CKD self-management support program consisted of telephone-based health coaching delivered by lay bilingual health coaches trained in motivational interviewing and action planning who called patients upon their request via the interactive telephone program and on an as-needed basis. Multimedia Appendix 1 includes an example English script for 1 week's content related to use of nonsteroidal anti-inflammatory medications, as well as the corresponding health coach guide to promote the development of an action plan related to this topic.

Study Outcomes:

The primary outcome of this secondary analysis was patient engagement with the intervention determined a priori by the following measures which have been previously defined as engagement metrics for similar interventions [23]: percentage of users who engaged with any aspect of the automated system (defined by responding to at least one automated telephone self-management support call), percentage of automated calls completed, percentage of users who completed at least 80% of calls, and percentage of patients who created at least one action plan. We also a priori identified other engagement metrics that we believed fit the CKD self-management support program, including self-reported use of educational materials during study visits, duration of participation in the automated telephone calls determined by the telephone software (longer duration suggesting greater engagement due to interactive answering of health questions, repeating patient vignettes, and call completion), and number of requests for health coach callbacks from study participants during their automated telephone call (greater number of requests suggesting greater engagement).

Secondary outcomes of this study included changes in SBP and albuminuria severity (spot urinary albumin-to-creatinine ratio) from baseline to 12 months, both ascertained at study visits. SBP was measured with a digital blood pressure monitor (model HEM-907X; Omron), using the average of 3 SBP measurements in the right arm after the patient sat quietly for 5 min.

Covariates:

At the baseline visit, patient sociodemographic data (age, gender, race/ethnicity, education, income, insurance status) were self-reported, as were comorbidity data (diabetes, coronary artery disease, hyperlipidemia). Food insecurity and health literacy were ascertained using validated screening questionnaires [24].

Statistical Analysis:

We examined baseline characteristics of KARE participants and tested for differences by LEP status using chi-square tests for categorical variables and nonparametric Kruskal–Wallis tests for continuous variables. Multivariable logistic and linear regression models were used to determine differences in engagement with the self-management support program by LEP status adjusted for age, sex, and variables that differed by LEP status (race/ethnicity, education, insurance status). Impact of the self-management support program on change in SBP at 12 months and change in albuminuria by LEP status were determined using linear mixed models accounting for clustering by provider and controlling for sociodemographic variables and baseline measures of SBP and albuminuria, respectively.

Results:

Participant Demographics:

Of the 137 KARE participants, roughly half were male (66/137, 48.2%) with a mean age of 55.3 (SD 12.2) years; 8 of 137 participants were White (5.8%), 59 Black (43.1%), 49 Hispanic (35.8%), and 20 Asian (14.6%); 1 (0.7%) participant declined to answer. Over one-third (53/137, 38.7%) of participants reported LEP with primary languages of Spanish (45/53, 85%) and Cantonese (8/53, 15%); 71 out of 137 participants were high-school educated (51.8%) and 47/137 college (34.3%) educated, with lower numbers in the LEP group, 27/53 (51%) and 7/53 (13%), respectively, compared with the English-speaking group (*P*<.001 for both). In the overall cohort, 34/137 (24.8%) participants were uninsured or covered by a health care access program to subsidize medical care for uninsured residents of San Francisco, with 21/53 (40%) participants being in the LEP group and 13/84 (15%) in the English-speaking group (*P*<.001). Over three-quarters (91/121, 75.2%) of participants who provided these data reported annual income less than US $15,000 and 72 participants (52.6%) reported food insecurity, without any differences by LEP status. All study participants had CKD, of which 38.7% (53/137) had hypertension and 51.8% (71/137) had diabetes (Table 1).

Table 1. Sociodemographic characteristics of the study patients.

Characteristics	Overall (n=137)	Non-LEP (n=84)	LEP (n=53)	*P* value
Age (years), mean (SD)	55.3 (12.2)	56.3 (10.9)	53.7 (13.9)	.22
Sex, n (%)				.11
Male	66 (48.2)	45 (53.6)	21 (39.62)	
Female	71 (51.8)	39 (61.31)	32 (60.4)	
Race/Ethnicity, n (%)				<.001
White	8 (5.8)	8 (9.6)	0 (0.0)	
Black	59 (43.1)	59 (71.1)	0 (0.0)	
Hispanic	49 (35.8)	4 (4.8)	45 (84.9)	
Asian	20 (14.6)	12 (14.5)	8 (15.1)	
Language, n (%)				<.001
English	84 (61.3)	84 (100.0)	0 (0.0)	
Spanish	45 (32.8)	0 (0.0)	45 (84.9)	
Cantonese	8 (5.8)	0 (0.0)	8 (15.1)	
Education, n (%)				<.001
Primary school	19 (13.9)	0 (0.0)	19 (35.9)	
High school/Technical education	71 (51.8)	44 (52.4)	27 (50.1)	
College	47 (34.3)	40 (47.6)	7 (13.2)	
Insurance, n (%)				<.001
None or HSF	34 (24.8)	13 (15.5)	21 (39.6)	
Medicaid	61 (44.5)	44 (52.4)	17 (32.1)	
Medicare	37 (27.0)	26 (30.9)	11 (20.8)	
Other	5 (3.6)	1(1.2)	4 (7.6)	
Income[a], n (%)				.43
<15K	91 (75.2)	56 (77.8)	35 (71.4)	
15-50K	30 (24.8)	16 (22.2)	14 (28.5)	
Food insecurity	72 (52.6)	42 (58.3)	30 (56.6)	.45
Health literate	101 (73.7)	63 (75.0)	38 (71.7)	.67
Hypertension (≥140/90 mmHg)	53 (38.7)	37 (69.8)	16 (30.2)	.11
Diabetes	71 (51.8)	39 (54.9)	32 (45.1)	.11
CKD stage, n (%)				.23
CKD stages 1 and 2	46 (33.6)	25 (29.8)	21 (39.6)	
CKD Stages 3 and 4	91 (66.4)	59 (70.2)	32 (60.4)	

[a]n=137 for all rows except income, for which n=121 (n=72 for non-LEP and n=49 for LEP).

Primary Outcomes:

Participant engagement measures pertinent to all 3 components of the CKD self-management support program included self-reported use of written education materials, development of at least one action plan, and degree of interaction with the automated telephone self-management support program. The overall use of patient education materials was 87% (47/54) and 57/74 (77%) participants developed an action plan. There were similar rates of self-reported use of educational materials among participants in the non-LEP and LEP group: 88% (30/34) and 85% (17/20), respectively (*P*=.73). Similarly, 35/47 (74%) participants in the non-LEP group and 22/27 (81%) participants in the LEP group developed at least one health-oriented action plan (*P*=.49). By contrast, engagement with the automated telephone self-management support differed by LEP status. While nearly all participants completed at least one automated telephone self-management support module (only 1 patient with English proficiency did not complete any automated telephone self-management support modules), the average completion rate of all modules was 57% among those with English proficiency and 66% among those with LEP.

In multivariable linear regression, LEP status was positively associated with a higher automated telephone self-management support module completion rate (coefficient=0.3/10% higher completion), although this was not statistically significant (*P*=.75). "High engagers" were classified as participants who completed at least 80% of automated phone calls, of which 61% (17/28) were in the non-LEP group and 39% (11/28) were in the LEP group; however, there was a nonstatistically significant difference in this regard (*P*=.70). Among participants who did complete the automated telephone self-management support calls, the mean number of health coach callbacks requested was significantly larger in the LEP group compared with the non-LEP group (16 [SD 14.8] vs 11 [SD 10.6]; *P*=.004); however, in the adjusted model this outcome did not reach statistical significance (*P*=.08). The average call duration among the LEP group was 200.6 seconds compared with 133.1 seconds in the non-LEP group, a difference which was statistically significant when adjusted for age, sex, race/ethnicity, education, and insurance status (*P*=.02; Figure 1)

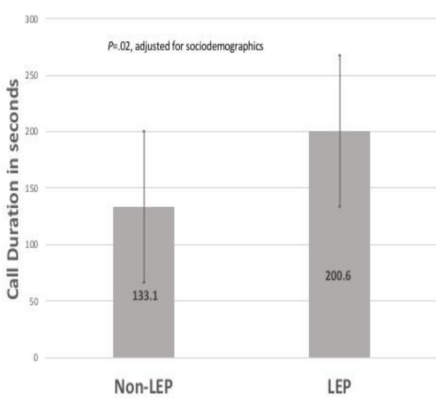


Figure 1. Mean (SD) of automated telephone self-management call duration by English proficiency. LEP: limited English proficiency.

Secondary Outcomes:

Change in SBP was nonstatistically greater in the LEP group compared with the non-LEP group among patients randomized to the self-management support intervention as well as among those randomized to usual care (*P*=.74). Adjusted estimates of SBP change among patients with LEP who received the self-management support intervention were –4.5 mmHg (SD 2.49) and among patients with LEP randomized to usual care were –4.3 mmHg (SD 2.97). Participants with English proficiency randomized to the intervention had an average adjusted estimated SBP change of –2.2 mmHg (SD 3.29), whereas those randomized to usual care did not experience any change in SBP (0.04; SD 3.26; Figure 2). Similarly, patients with LEP randomized to the self-management support intervention had a nonstatistically significant greater decrease in urine albumin-to-creatinine ratio compared with their English-speaking counterparts (–72.4 mg/dL [95% CI –208.9 to 64.1] vs –11.1 mg/dL [95% –166.9 to 144.7], *P*=.29).

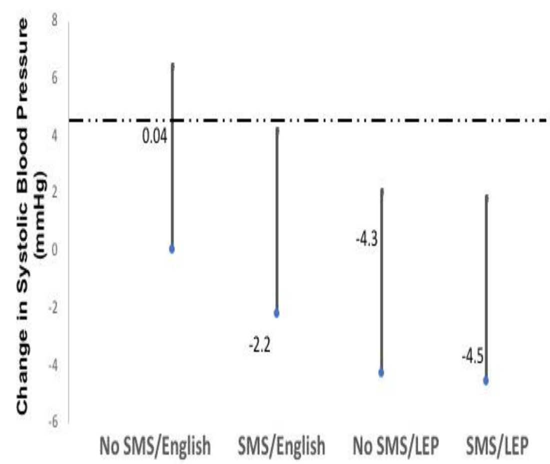


Figure 2. Estimated change in systolic blood pressure (95% CI) by intervention and English proficiency. LEP: limited English proficiency.

Discussion:

Principal Findings:

In this study of primary care patients with CKD who participated in a trial examining the impact of a comprehensive CKD self-management support program, we found that participants with LEP showed higher engagement than those with English proficiency with the HIT elements of the program by completing the automated telehealth modules more often, spending significantly longer time with each automated module, and requesting more health coach phone callbacks for further information/clarification.

The LEP status did not seem to influence engagement with the more traditional health education components of the program such as language-concordant reading materials and developing at least one action plan with a health coach. These data suggest that language-concordant HIT may offer a unique opportunity to impact the health of linguistically marginalized patients. However, despite differences in engagement, the comprehensive CKD self-management support intervention had a similar null impact on change in SBP and albuminuria among both patient groups (ie, those with English proficiency and those with LEP with kidney disease).

Patient Engagement:

Patient engagement has been shown to be associated with preventative behaviors such as participating in health screenings, regularly attending physician appointments, and improving dietary choices and exercise habits [12-18]. More highly engaged patients have also been shown to be less likely to smoke or consume illicit substances [25]. Further, among patients with chronic disease, higher engagement has been correlated with increased home monitoring, better treatment adherence, and more consistent medical follow-up [14,16,26-31]. Chronic diseases such as hypertension, diabetes, and kidney disease not only dominate in prevalence compared with acute diseases in the American population, but they also require consistent medical management, significant disease education, and higher levels of treatment adherence. Thus, the emphasis on patient engagement, activation, and education is paramount in our population.

Impact of Limited English Proficiency:

In general, LEP is associated with poorer health status, decreased access to medical care, reduced preventive health services, and poorer quality of care [2,32-36]. Patients with LEP are more likely to have poorly controlled hypertension and worse glycemic control among those with diabetes as outpatients, as well as higher infection rates and longer hospitalizations as inpatients [37-39]. In addition, patients with LEP are more likely to have lower socioeconomic status, compounding health disparities by adding the burden of poverty, limited education, and unemployment [3]. These disparities are only partially mitigated by patient-provider language concordance or interpreter use, as LEP has been shown to be an independent predictor of poorly controlled disease [32,40,41]. With over 25 million Americans having LEP, the impact of these disparities has prompted research into innovative programs to improve health status, preventive services, and patient activation within this population [1].

Health Information Technology:

Automated telephone self-management support has been highlighted by the Department of Health and Human Services as a potential tool to ameliorate health care for LEP populations, and has also been studied as an intervention in high utilizer and chronic disease cohorts [42,43]. Prior studies have shown that interventions with automated telephone self-management support can reduce hospitalizations and emergency department visits, assess medication adherence, monitor patient safety events, and improve outcomes such as medication and appointment adherence, immunizations and screening, and patient safety triggers [44,45].

However, while some studies suggest improvements in clinical outcomes such as diabetes control, the literature is lacking on studies determining efficacy of automated telephone self-management support on management of many chronic diseases [44,46,47]. While many prior trials included patients from diverse backgrounds, subanalyses of differences between patients with English proficiency and LEP were always not conducted. To our knowledge, this is one of few studies to analyze the impact of an intervention including automated telephone self-management support between patients with LEP and those with English proficiency.

Conclusions:

HIT is a burgeoning field with smartphone apps, telephone interventions, and interactive electronic medical record systems rapidly modifying the delivery of health care. The results of this study indicate that language-concordant automated telephone self-management support can be used equally well by patients with LEP compared with patients with English proficiency, with potentially even higher levels of engagement. This suggests that that language-concordant telehealth interventions could be useful in mitigating communication barriers known to negatively impact health status. This is of particular importance now, given the increase in novel telehealth modalities for care delivery in the era of COVID-19, with the number of telehealth visits more than doubling in some health systems in 2020 [48]. This surge in HIT use has also emphasized the "digital divide" where marginalized populations are less likely to have access to computers or internet services, and thus unable to participate in virtual clinic visits [49]. Because of these limitations and time needed to develop infrastructure to facilitate virtual visits, telephone encounters have become a mainstay of patient care [50].

Our findings also indicate that patients with LEP may more readily engage with language-concordant telehealth interventions as opposed to language-concordant reading materials. Reasons for this difference are likely multifactorial, but may include the fact that reading materials have to account for language, literacy, and numeracy, whereas telehealth interventions (often phone or video based) can convey similar ideas with clinical vignettes and stories, without the potential pitfalls associated with low literacy, numeracy, or even limited technological knowledge (which may contribute to lack of patient portal or web-based interventions) [23]. Thus, HIT customized to account for linguistic variation should be a key consideration in the development of novel telehealth tools.

The main limitation of this study is its small sample size, limiting power to examine the impact of the self-management support program on clinical outcome by LEP status. In addition, it was conducted in a single public health care system in California. As such, the results may not be generalizable to other settings or patient populations. However, we included a diverse patient population with a high percentage of patients with LEP.

HIT interventions are rapidly evolving to address patient needs, improve health outcomes, and increase patient engagement. As these innovations are used to increasingly engage our patients, and to the extent that the LEP population continues to grow in the United States, it is important that we develop them in a way to include, not ignore, the needs of this marginalized population. Language-concordant versions of automated telehealth and HIT tools have the potential to help bridge the disparities gap for the LEP population, and represent a unique opportunity to improve health outcomes in a disproportionately disease-burdened population.

Sample Characteristics:

In total, 54 individuals filled out the survey, and, of those, 3 (6%) did not provide sufficient contact information, 27 (50%) did not respond to the follow-up, 3 (6%) were unable to interview due to medical complications, and 21 (39%) were successfully enrolled. Of the 21 participants, 16 (76%) were female, and the average age was 35 years (Table 1). Participants reported living with an official diagnosis of CD for an average of 12 years and felt that they had CD for 6 years, on average, before their official diagnosis (Figure 2).

Table 2. Participant demographic data (N = 21).

Characteristic	Participants, n (%)
Age (years)	
20-29	8 (38)
30-39	7 (33)
40-49	4 (19)
50-59	1 (5)
60-69	1 (5)
Gender	
Male	5 (24)
Female	16 (76)

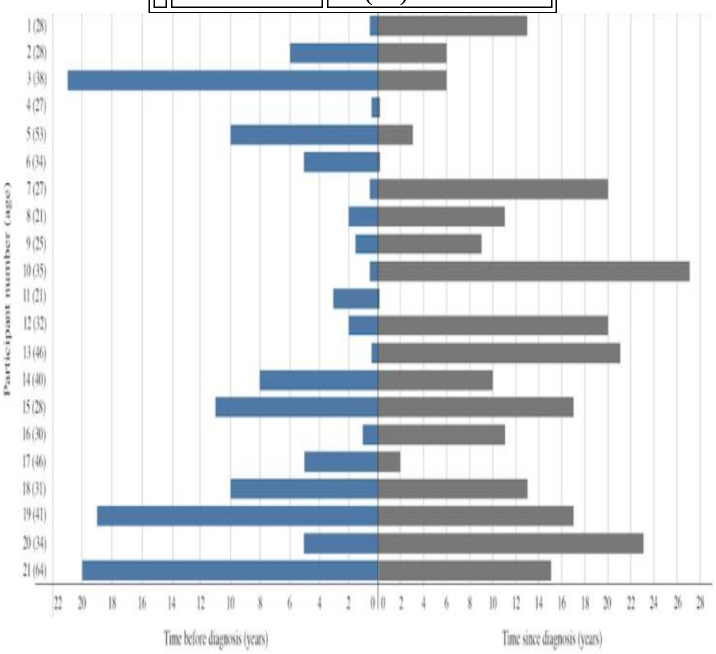


Figure 2. Participant experience with self-management of Crohn disease.

Themes: Overview of Themes:

Qualitative content analysis yielded 4 overarching themes (Table 2). The themes were oriented around diet and nutrition management as biform work and highlight the articulation work required for CD management. The first 3 themes characterize 3 dimensions of diet and nutrition management, while the fourth theme is orthogonal to the first 3, addressing how tools are used for management.

Table 3. Themes and categories identified based on interview analysis.

Theme and subthemes	Definition
Physical management	Relationship between diet and nutrition and symptoms of CD[a]
Management of medication	Relationship between diet and nutrition and prescription drugs
Management of remission	Relationship between diet and nutrition and periods with reduced symptoms
Management of flare-ups	Relationship between diet and nutrition and periods of increased symptoms
Emotional management	Relationship between diet and nutrition and the psychological aspects of living with CD
Management of social relationships	Relationship between diet and nutrition and forming and maintaining connections with people
Management of routines	Relationship between diet and nutrition and daily tasks
Management of stress	Relationship between diet and nutrition and experiences of mental and emotional strain
Information management	Relationship between diet and nutrition and information gathering
Management of information from health care professionals	Experiences with seeking and obtaining advice about diet and nutrition from trained providers
Management of information from text sources	Experiences with seeking and obtaining advice about diet and nutrition from books, websites, and other written materials
Management of information from social networks	Experiences with seeking and obtaining advice about diet and nutrition from online and offline connections
Technology-enabled management	Experience using CD management tools for diet and nutrition
Management experiences using existing tools	Experiences with using technologies to facilitate activities related to diet and nutrition
Management needs not met by existing tools	Experiences with lack of usefulness and usability of available technologies related to diet and nutrition

[a]CD: Crohn disease.

The persistence of medical errors is a major issue in healthcare delivery (Heath, 2019) despite the rapid growth in healthcare quality assurance and performance improvement efforts by healthcare systems in recent years. According to the report *To Err is Human: Building a Safer Health System* by the Institute of Medicine (IOM), as many as 98,000 hospital deaths due to medical errors occur per year (Donaldson, 2008). The Fifth Annual HealthGrades Patient Safety in American Hospitals Study (2008) estimated that from 2004 through 2006 more than 220,000 incidents and over 37,000 deaths among hospitalized Medicare patients might have been preventable (p. 6). The following year, HealthGrades, also focusing on Medicare patients during the same period, released a report that estimated as many as 171,424 lives might have been saved and 9,671 major complications might have been avoided if these patients were treated at hospitals performing at the level of Distinguished Hospitals for Clinical Excellence (HealthGrades, 2008 p. 2).

Research findings show that based on patient safety measures, patient care has significantly improved in recent years. According to data collected by the Agency for Healthcare Research and Quality (AHRQ), hospital-acquired conditions (HACs) have consistently decreased over time. Findings show that between 2014 and 2017, HACs dropped 13%, cut $7.7 billion in costs, and saved an estimated 20,500 lives. These improvements in performance built on earlier advances. Between 2010 and 2014, the healthcare industry recorded 2.1 million fewer HACs than in previous years. However, many problems still affect the safe and effective delivery of healthcare services. A Johns Hopkins report notes that "patient safety mistakes accounted for nearly 250,000 patient deaths," greater than the death toll from respiratory disease by nearly 100,000 incidents (Heath, 2019). It may be noted that even though patient safety has emerged as a key aspect of healthcare quality (Pronovost et al., 2006), many detailed quality metrics based on specific health conditions (e.g., stroke, pneumonia, and cardiac arrest), length of hospital stay, and hospital readmission rates have become popular as standardized metrics to measure healthcare quality.

While increasing quality improvement efforts is an important goal in healthcare, decreasing healthcare costs is also critical to have sustainable and equitable healthcare delivery systems. US healthcare is the most expensive per capita among the Organization for Economic Co-operation and Development (OECD) countries (Statista, 2022). In 2019, the *Journal of Operations Management* published a special issue on "delivering effective healthcare at lower cost." Supply chain management (SCM) in healthcare has been considered one area in which cost can be reduced by synchronizing the flow of information and goods throughout the entities in a chain (Chakraborty & Gonzalez, 2018). The critical effect of SCM on healthcare operations has become more apparent during the COVID-19 pandemic. Improving the quality of services available to patients and effectively managing supply chains while reducing costs are currently three pressing needs of the US healthcare system.

In this chapter, we explore quality management and the supply chain of US community hospitals to better understand quality challenges in the US healthcare delivery system. The American Hospital Association defines community hospitals as "all nonfederal, short-term general, and other special hospitals. Other special hospitals include obstetrics and gynecology; eye, ear, nose, and throat; long term acute care; rehabilitation; orthopedic; and other individually described specialty services. Community hospitals include academic medical centers or other teaching hospitals if they are nonfederal short-term hospitals" (AHA, 2022a). The chapter provides an overview of the extended healthcare supply chain of hospitals, care processes, relationships among hospital quality management practices and quality performance, a discussion about population health management and lean systems, and some insights on stressful environments and healthcare quality.

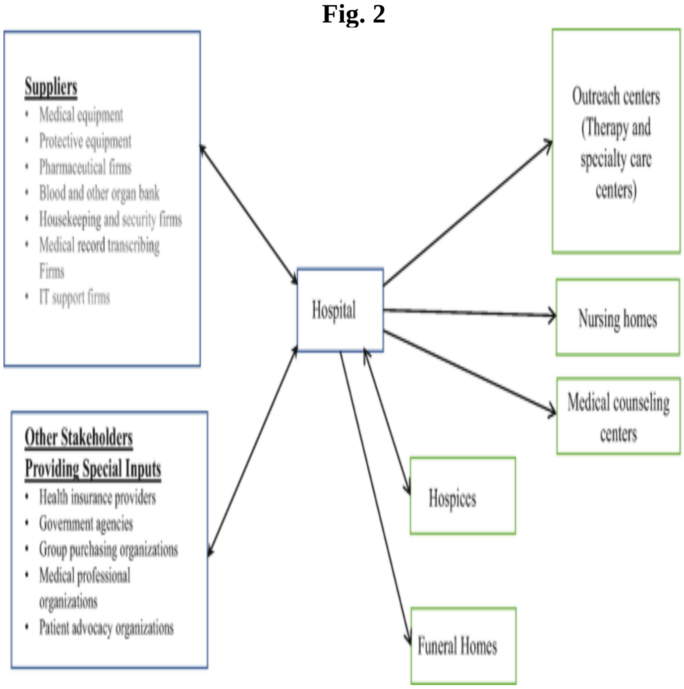
2 Background: An Overview of a Hospital's Extended Healthcare Supply Chain:

Healthcare is a complex activity that is dependent on the medical treatment processes followed to cure a patient's health condition. During diagnosis and medical treatment, knowledge that physicians rely on depends to a large extent on the philosophy of their medical school education and the specific objectives of a given hospital (i.e., whether the hospital is a teaching, physician-owned, or nonprofit hospital) (Bohmer, 2009). These considerations pose additional challenges to delivering high-quality patient care (Bohmer, 2009).

Many healthcare experts and other stakeholders now agree that hospital SCM is crucial to improving the performance of US healthcare systems (Buttigieg et al., 2020). Although the cost of facilities, clinical support, and their administration still form the major components of total healthcare costs, 20.6% for the cost of supplies is a significant amount, and it is rising every year (AHA, 2022b). Managing supply chains effectively (and therein quality management of the healthcare supply chain as well) is critical to controlling and maintaining the quality and cost of medical supplies. In the context of healthcare, SCM includes both the internal chain (e.g., patient care unit, hospital storage, and patient) and the external chain (e.g., vendors, manufacturers, and distributors) (Denton, 2013).

Keeping patient flows in mind, a conceptual depiction of the current US healthcare supply chain is presented in Fig. 1. The upstream of a typical US hospital supply chain consists of two entities: (1) suppliers and (2) other stakeholders providing special inputs (Chakraborty & Gonzalez, 2018). Medical equipment firms provide medical and other related types of equipment (e.g., beds) required by hospitals, doctors, and nurses for treating patients. These are broadly classified into the following seven categories: storage and transport medical equipment, durable medical equipment, diagnostic medical equipment, electronic medical equipment, surgical medical equipment, acute care equipment, and procedural medical equipment. Also included in the supply chain are firms that provide furnishings and supporting materials for patients such as curtains and bed sheets and personal protective equipment (PPE) for healthcare team members. Hospital staff wear PPE to reduce the potential for injuries resulting from being exposed to workplace hazards, medical and mechanical, commonly found in hospitals. This protective equipment includes items such as shoes, safety glasses, respirators, and gloves, among other equipment. A pharmaceutical firm could be involved in developing, producing, and marketing drugs licensed for use as medications. Pharmaceutical companies are permitted to sell and distribute generic and/or brand medications and medical devices. Dosage forms include tablets and capsules, injectables, creams, ointments, inhalants, and solutions.

Fig. 2



A schematic diagram of a typical U.S. hospital's extended healthcare supply chain. (Adapted from Chakraborty and Gonzalez (2018))

Blood bank refers to the division of a hospital laboratory where blood products are stored, and compatibility testing is performed before transfusion and may also process blood donations, depending on the capabilities of the facility. The term also includes other organ banks such as eye banks, which retrieve and store eyes for corneal transplants and research, and amniotic stem cell banks, which store stem cells derived from amniotic fluid for future use. Housekeeping and security firms provide environmental services such as security services and housekeeping services that include cleaning rooms, medical equipment, and laundry. These firms also stock and keeps track of basic hospital amenities in hospital rooms, especially in the emergency rooms and intensive care units. Medical transcription is the process of converting voice-recorded reports as dictated by transcribing firms, physicians, and other healthcare professionals into text. A few specialized firms provide such transcription services to their clients. Information technology (IT) support firms typically provide some or all IT services, from computer support, IT consulting, IT outsourcing, helpdesk services, data backup, disaster recovery, application hosting, and email hosting to chief information officer–level consulting, managed services, and call centers.

Health insurance providers are firms that provide health insurance services. Health insurance protects a patient from the prohibitive cost of medical care by providing coverage for providers of specific healthcare services. The three broad types of health insurance are: consumer directed, fee-for-service (often known as "indemnity" plans), and managed care. These plans cover medical, surgical, and hospital expenses. Some cover prescription drugs and offer dental and behavioral and mental health coverage as well. Government agencies that monitor and test product safety include the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and the Department of Defense's Office of the Surgeon General. Agencies that monitor the operation of healthcare programs such as Medicare and Medicaid are authorized to audit, investigate, and inspect any facility.

A group purchasing organization (GPO) is an entity that helps healthcare providers such as hospitals, nursing homes, and other health agencies realize efficiencies by aggregating purchasing volume into bulk and using that leverage to negotiate discounts with suppliers. As measured by the total number of member hospital beds, Premier Inc., MedAssets, Vizient, Intalere, Cardinal Health, McKesson Pharmaceutical, AmerisourceBergen, HealthTrust Purchasing Group (HPG), the Department of Veterans Affairs, and Provista are some of the large GPOs. Professional associations such as the American Medical Association (AMA) help doctors by uniting physicians and medical students to work on the most important professional and public health issues. Professional fraternities are organizations whose primary purpose is to promote the interests of a particular profession and whose membership is restricted to students in that particular field of professional education or study. Common medical fraternities are Phi Beta Pi, Theta Kappa Psi, Phi Delta Epsilon, Phi Rho Sigma, and Phi Chi. Patient advocacy organizations are nonprofit organizations that provide patients a voice in improving access to and reimbursement for high-quality healthcare through regulatory and legislative reform at the state and federal levels. Examples are National Patient Advocate Foundation, HealthHIV, and the National Association for Hearing and Speech Action.

At the center of a typical US healthcare supply chain is the hospital, which is generally the primary facility for most healthcare services that any person receives, ranging from diagnostic services to surgery to continuous nursing care and advanced disease and other medical treatments. Hospitals vary from small, free-standing rural facilities to a vast, multifacility, geographically dispersed but integrated system. Some hospitals specialize in the treatment of a particular disease such as HIV/AIDS, cancer, or for particular types of procedures such as cardiology and heart surgery. Others are full-service hospitals that prioritize medical treatment for most ailments.

Next, moving to the downstream side of a typical US hospital supply chain, discharged patients who are not fully cured may need such specialized services as outreach or medical counseling centers, or they may be candidates for a nursing home. Patients that die in the hospital are sent to funeral homes. Hospices provide medical care for people with an anticipated life expectancy of 6 months or less, when a cure is no longer possible, and the focus of care shifts to symptom management and quality of life.

Outreach centers can provide both therapy and specialty care. Therapy centers provide developmental and rehabilitation services such as speech-language therapy, pediatric occupational therapy, and pediatric physical therapy services. Specialty care centers provide high-quality medical services such as radiation treatment, stem cell care centers, transplantation, and cellular therapy.

A nursing home is a residence for people who require constant nursing care and have deficiencies that render them incapable of performing the activities of daily living. Residents generally are elderly and younger adults with physical or mental disabilities. Patients in a nursing facility could also receive physical, occupational, and other rehabilitative therapies following an accident or illness. Medical counseling centers generally take a team approach to patient care in which psychiatrists and other therapists regularly collaborate on a patient's care to determine the best treatment option. Patients in medical counseling centers are primarily those who suffer from such disorders as depression, bipolar anxiety, panic attacks, obsessive-compulsive disorder (OCD), or from life-threatening diseases such as HIV or cancer. These centers typically offer a variety of services, from medication management to counseling on how to cope with a patient's affliction .

Care Processes in Patient-Centric Hospitals:

As in all service processes (Jacobs & Chase, 2020), the customer (patient in healthcare) is the focal point of hospital operations. Doctors, nurses, and all other infrastructure support systems are designed to serve the patient in the most effective and efficient manner. The infrastructure support system includes all departments and units in a hospital. Other care processes include internal stakeholders that receive the services – patients and their friends/relatives as well as those who provide the services such as physicians, nurses, and support staff.

As we will discuss in the next section, to provide high-quality patient care, all these processes need to be designed keeping quality management (QM) principles in mind. In other words, QM must be the foundation of care hospital processes .

Quality Measurement in Hospitals:

QM is defined as a holistic management philosophy that guides continuous improvement in all functions of an organization (Kaynak, 2003). In healthcare settings, in order to implement QM, hospitals need to strive for continuous improvement, beginning with the acquisition of resources to the care of patients and other stakeholders. The Malcolm Baldridge National Quality Award (currently known as the Baldrige Excellence Award) was established in 1987 (Kaynak, 1997) to encourage quality improvements in firms, and it was followed by the European Foundation Quality Award in 1988 (Nabitz et al., 2000), which also encourages quality improvements in firms. In 1998, the scope of the Malcolm Baldrige National Quality Award was expanded by the US Congress to include the healthcare industry (Baldrige, 2022). Since then, many healthcare organizations in the USA, Europe, and around the globe apply the quality improvement efforts introduced in these frameworks, even during the COVID-19 pandemic (Shah et al., 2021). The results of a study by Shah et al. (2021) show that the use of quality improvement approaches by healthcare organizations increased during the COVID-19 pandemic in England.

In this chapter, we discuss the relationships among QM practices implemented in a hospital and quality performance measures drawing from the extant literature in healthcare, particularly from the arguments in Chakraborty and Kaynak (2018), Chakraborty et al. (2021), and Kaynak and Hartley (2008).

Suggested practices also have been documented in numerous studies that have investigated the implementation of QM in healthcare organizations (see Table 1 for major studies). We identify eight QM practices in the context of hospitals – hospital quality leadership, healthcare training, healthcare teamwork, hospital quality data and reporting, patient focus, supplier quality management, hospital services design, and hospital process management. These healthcare-applicable QM practices, along with the major studies that discuss these practices, are indicated in Table 1. Although there are similarities between the practices in our framework and those shown in Malcolm Baldridge, some differences are also evident. For example, the Malcolm Baldrige healthcare criteria for 2021–2022 does not identify supplier quality management as a distinct practice of QM, although some related questions are included under strategy development. Furthermore, patient care and patient satisfaction are not clearly differentiated. Thus, we believe that the QM practices we offer are more detailed and informative than those in the Malcolm Baldridge framework.

One of the most important antecedent variables is hospital quality leadership. The structure that leaders impose on an organization and the care they take to provide daily encouragement to all levels of staff are crucial to the successful implementation of quality in an organization. Different resources are necessary for training people in the use of new principles and tools and creating a work environment in which employees are engaged with changes in the organization and its work culture (Kaynak, 2003). Stable processes are essential to maximizing patient satisfaction and success in the marketplace, a principle a quality leader recognizes (Smith, 2018). It is the hospital leadership's responsibility to implement practices that will improve the quality of patient care.

Hospital leaders' awareness of all risks associated with improper patient care procedures and ensuring that staff at all levels understand these risks and how to mitigate them is essential to the creation of an environment in which patient safety initiatives can take hold (Saint et al., 2010). A critical practice of both QM and SCM is the interaction with customers (Robinson & Malhotra, 2005), and the development of strong relationships with patients or customers, and customer (patient) focus is a function of quality leadership. Creating policies and designing structures that create a work environment in which the attention of employees – physicians, nurses, and healthcare teams – is focused on serving the customer is a crucial function of hospital leadership.

Patient feedback surveys could be used to promote patient involvement thereby improving quality of care. Patient satisfaction can be improved if quality leaders make consistent effort to focus on and assess patient needs (Asif et al. 2019). Effective management of relationships with key suppliers is essential to SCM, especially in life-threatening situations such as those encountered often in hospitals. It is hospital leaders' responsibility to ensure an elevated level of integration when designing healthcare services not only within the hospital but also across the hospital supply chain. Hospital administrators manage a wide range of suppliers serving all functions in a hospital, and effective leadership can promote mutually beneficial relations with these suppliers by emphasizing quality and delivery performance over price when developing, selecting, and certifying them for quality of supplied materials or items.

Moreover, both hospitals and their suppliers can benefit from facilitating the exchange of proprietary and competitive information.

Training increases staff engagement with the attention to quality-related issues. Healthcare staff need to be trained on the collection and use of quality data, but training alone will not sustain an improvement effort. Staff must receive quality data in a timely manner and use it effectively. Training in quality-related issues that emphasizes problem-solving in teams, effective communication, and statistical process control transform healthcare employees into creative problem solvers (Moore et al., 2018), which, in turn, enables staff members at every level to understand patients' needs, identify their requirements, and communicate effectively with them (Moore et al., 2018).

A team may be defined as a collection of three or more people in an organization whose members take pride in their collective identity and collaborate on one or more common tasks. Teamwork is defined as the action of a group working together with a common, well-defined objective. In hospitals that have implemented electronic health record (EHR) system, high-quality data on patients that is timely and accurate is available to the healthcare team members, which in turn will improve the teamwork and the effectiveness of the team as a whole (Graetz et al., 2015; O'Malley et al., 2015).

Whether it is in manufacturing or in services, the collection and analysis of quality information is important for successful implementation of QM practices. Also key to SCM is the sharing of information among supply chain members (Kaynak & Hartley, 2008). The use of quality data and reporting in hospitals is necessary for improving supplier quality management, as it allows buyers to monitor and assess the performance of suppliers, which is also improved by measuring their performance and providing feedback (Gonete et al., 2021). Quality data disseminated throughout a hospital in a timely manner is also a crucial factor when designing hospital services, for it facilitates the feedback from healthcare teams during the service design stage. Timely and effective use of quality data impacts a hospital's process management. Healthcare staff members are alerted quickly to process changes so they can fix problems before undesirable and inferior services become a problem.

Kaynak's (Kaynak, 2003) study suggests that supplier quality management is effective because of its direct relationship with service design and process management. Successful relationships could emerge whereby, for example, suppliers become engaged early in the design services of a new electronic data interchange (EDI) program at a hospital's pharmacy encouraging them to offer suggestions regarding the type, quantity, and frequency of the medical supplies that the hospital could order from the supplier, which would ultimately enhance the quality of patient care (Priestman et al., 2019). Under SCM, suppliers are integrated (Robinson & Malhotra, 2005) because improved quality of supplies positively affects process management by eliminating or reducing variation in healthcare services (Hughes, 2008).

Effective supplier management shrinks inventory and reduces waste in the supply chain (cf. Kaynak & Hartley, 2008), which reduces inventory costs, a goal of SCM. Improving quality by collaborating with suppliers also reduces the need for safety stock inventory. If the number of suppliers can be reduced, organizations can work more closely with those retained. As Chakraborty and Gonzalez (2018) explain, supplier quality management plays a critical role in a hospital's continuous quality improvement effort (McLaughlin et al., 2004). Successful and sustained quality improvement initiatives require that hospitals develop long-term and mutually beneficial partnerships with key suppliers to reduce inventory while still meeting service quality standards for patient care (Dahlgaard et al., 2011).

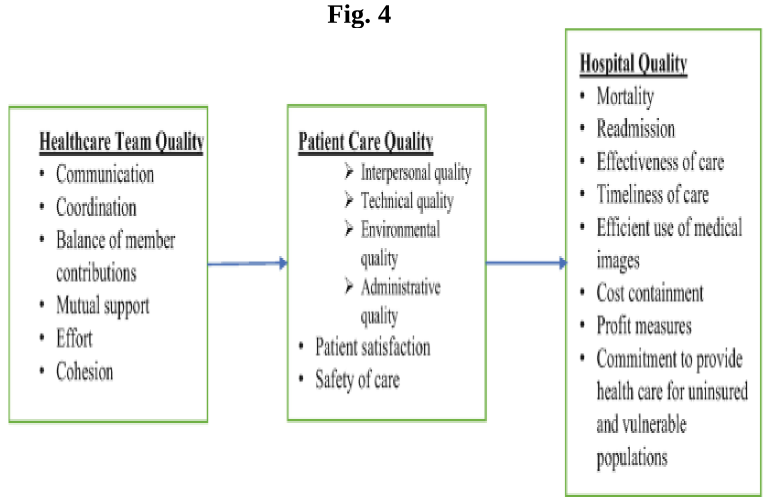
It is during service design that the processes employed in a firm and within its supply chain are established. Kaynak and Hartley (2008) empirically validated the proposition that effective product design is related to efficient process management, and this relationship applies to hospitals as well.

If hospitals are to realize the full benefits, hospital leaders must recognize that QM practices are interdependent and need to be implemented as a system. The ultimate objective of implementing QM is to improve outcomes for at all three major stakeholders**:** the patients, who need care; the healthcare team, which provides the treatment most likely to make the patients better; and the hospital, which needs to enhance its reputation so that it will attract new patients and enable its healthcare teams to thrive (Chakraborty & Gonzalez, 2018). Next, we describe these outcomes in detail.

5 Quality Outcomes in Hospitals:

Nerenz and Neil (2001) suggest that scholars should integrate a range of aspects of healthcare performance: quality of care, utilization, cost, efficiency of hospital resources, patient satisfaction, and reports of care and financial performance. We offer a conceptual framework for quality measurement in hospitals (Fig. 2) that unifies three dimensions of the healthcare system: the team, the patient, and the hospital. Our framework emphasizes the fact that quality healthcare teamwork is positively related to patient care quality (PCQ), and PCQ is positively related to hospital quality performance. In the rest of this section, we discuss each dimension of quality measures in hospitals.

Fig. 4



A framework for quality measurement in hospitals. (Adapted from Chakraborty and Kaynak (2018)). Copyright © American Society for Quality, reprinted by permission of Taylor & Francis Ltd, http://www.tandfonline.com on behalf of American Society for Quality

Healthcare Teamwork Quality:

In healthcare, a patient's medical treatment and cure generally involves work of a resolute healthcare team. *Healthcare teamwork quality* is defined as the ability of the members of a healthcare team to collaborate well with each other to achieve their team objective(s).

Care teams are the norm in all areas of healthcare delivery. For example, members of small surgical teams are able to quickly learn from each other due to workload sharing and team helping, especially when task complexity is very high (Vashdi et al., 2013). Healthcare teams generally use physician empathy and nurse emotional involvement to positively influence the interpersonal relationships that they are able to establish with their patients. They typically take an active interest in their patients' medical condition, empathize with their suffering, communicate clearly to the patient and kin about their medical condition, and work together to rapidly improve health outcomes. Members of a healthcare team try to avoid medical errors, check schedules and room/equipment availability in advance of patients' medical procedures, take steps to prevent infections in hospitals, and keep the patients' care at the forefront of their decision-making. In addition, they generally follow hospital procedures or established workarounds, take all necessary precautions related to hygiene, and ensure that all physical elements of the hospital including the beds and other medical and surgical equipment are thoroughly cleaned and disinfected before use on any patient (Carling et al., 2008).

Overall, there are three major advantages of working in integrated healthcare teams – increased task effectiveness, which improves the patients' health and thereby their satisfaction with care; improved morale and mental well-being of the healthcare team members; and team viability which indicates the degree to which a team will function effectively over time. Based on the above discussion, we suggest that the measurement of the quality of teamwork is essential, not only to improve the quality of patient care, but also to help maintain healthcare team viability and keep them going on to serve patients. In summary, healthcare teams play a pivotal role in providing patient care and in continuously improving PCQ. Teamwork is one of the QM practices (Kaynak & Hartley, 2008) and its relation to healthcare team quality.

Patient Care Quality:

PCQ may be defined as the excellence of medical care received by admitted patients in hospitals (Nelson & Niederberger, 1990). In extant literature, many studies have focused on identifying the determinants of PCQ both in hospital and clinical settings. Based on a synthesis of the multidimensional nature of patient care quality discussed in extant literature, Chakraborty and Kaynak (2018) identify the following four facets – *interpersonal, technical, environmental,* and *administrative quality*.

Interpersonal quality refers to the relationship developed and the dyadic interplay that occurs between the patient and the healthcare team (Sweeney et al., 2015) that comprise doctors, nurses, and support staff working together as a group to care for admitted patients in most hospitals. It includes issues such as whether healthcare teams treat their patients with respect, healthcare team members listen to what patients have to say, members give personalized attention to patients, and whether team members are willing to answer questions that the patient or their kin may have.

Technical quality identifies with the expertise, professionalism, and competency of the healthcare team in delivering treatment. It takes into account whether patients are administered the correct medical treatment that is required to cure their ailment, tests (e.g., X-rays and lab tests) are ordered on patients only when required, healthcare team members are qualified, and whether they carry out their tasks competently.

Environmental quality includes hospital atmosphere such as cleanliness and order and tangibles like hospital bed and required equipment for patient health needs. Whether the design of the hospital is patient friendly, the lighting at the hospital is appropriate, the temperature at the hospital is pleasant, and whether the furniture at the hospital is comfortable are issues considered in this PCQ facet.

Administrative quality alludes to the support provided by the administrative and support staff that facilitates the medical treatment while adding value to the patient. Considerations such as whether the internal hospital services (e.g., pathology) work well, waiting time at the hospital is minimal, the hospital provides patients with a range of patient support services, and whether the hospital records and documentation (e.g., billing) are error free are in the domain of this PCQ facet.

Hospital Quality Performance:

Hospital quality performance is defined as a comprehensive reflection of how well the hospital is performing on a wide variety of quality-related parameters. Many scholars have already investigated the impact of QM practices on a firm's quality performance (Fynes & Voss, 2001). Hospital quality performance intends to capture all aspects of quality of the medical treatment processes and other products and services that are used in providing patient care which affect the hospital's overall quality performance.

Hospital quality performance measurement has been a continuing concern for quite a few years now, albeit it may be known by different names such as overall hospital star rating and may be calculated differently by many organizations. On one hand, it could be fairly sophisticated as using ten Hospital Quality Alliance (HQA) performance indicators to calculate a summary performance score for each of the three clinical conditions – acute mesenteric ischemia acute myocardial infarction (AMI) or heart attack, congestive heart failure (CHF), and pneumonia (Jha et al., 2007). On the other, it could be as simple as averaging all hospital star ratings given by patients or their kin on websites like Healthgrades, RateMDs, Vitals, and Yelp.

As a third example, the overall hospital star ratings introduced by the Centers for Medicare and Medicaid Services (CMS) could be considered. The current (2016) CMS overall hospital rating follows a detailed methodology using 57 items from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey grouped into seven subcategories. HCAHPS is the patient satisfaction survey required by CMS for all hospitals in the USA (Cahill & Wang, 2012).

In Table 4, we offer a detailed research design for quality measurement. For each dimension, we also identify a few existing and enhanced instruments that can be used in hospitals that involved in quality measurement. One of the pillars of our quality measurement framework is the patient (either admitted into the hospital or visiting the outpatient clinic). Along with the patient(s), the other key stakeholder is the patient's relatives and friends, who stays with the patient/visits the hospital during the period of admission or accompanies the patient to the outpatient clinics. PCQ can be measured by tapping the patient's health record(s) from the EHR system (Middleton et al., 2013) and their perceptions of the quality of care that he/she experienced in the hospital using the HCAHPS survey questionnaire. EHR is the software platform extensively used in US hospitals by the nurses, staff, and physicians to electronically record all patient information beginning with their name and demographics to their body temperature, medication history, medical procedures, allergies, and several other relevant medical information. The HCAHPS survey, administered mostly by independent survey contractors and sometimes by hospital staff to patients in the hospital, is currently used by CMS to collect patient data on PCQ and several other aspects of hospital operations for its own annual reporting to the US Congress. Systemic analyses of patient complaints could help healthcare researchers find recurring themes among patients' complaints for each hospital, and the recurring themes among similar hospitals across the USA, which could be considered as areas of enhancement of the HCAHPS survey. These gaps or areas of improvement could also prove to be directly helpful for the hospitals in their effort to improve PCQ.

Most hospitals have three primary responsible stakeholders who work in teams and interact very closely with the patient – the physician, the nurse, and the healthcare staff – who could be playing one or more of the following roles: physician assistant, dietician, pharmacist, therapist/rehabilitation specialist, or hospital administrative/support personnel. We refer to these three stakeholders collectively as the healthcare team.

Measuring teamwork quality is important because it not only affects PCQ on one hand but is important for the healthcare team members' viability and mental well-being on the other. All hospitals need to routinely measure how effectively their team members interact and work on providing patient care (Poulton & West, 1993, 1999). In addition, human resource utilization should also be checked using the hourly work schedule for all team members to ensure that all team members are optimally utilized. For the in-house team surveys, hospitals could randomly select one or more of their healthcare teams who come into direct contact with patients. Further, data on the number of patients handled by the healthcare team in a month and the number of hours worked each day by every team member could be used from hospital records to gauge team success.

We suggest that the focus of a quality measurement framework should be to measure all aspects of PCQ including its four dimensions – interpersonal, technical, environmental, and administrative quality. Patient satisfaction with the medical treatment is also important because ultimately the patient must not only recover fully from the disease/ailment but must also be satisfied with the treatment and its associated costs. Patient perception and satisfaction data for every hospital could be mined from four common websites (e.g., Healthgrades, RateMDs, Vitals, and Yelp) to obtain customer complaint themes and all the individual data for the hospital collected in a month to be grouped to ultimately enhance/augment the HCHAPS survey domains.

Finally, we advocate that the focus of measuring hospital quality performance should be based on the care provided in the hospital. In this context, a lot of existing detailed hospital-level averaged data already tracked by CMS and published in the *Hospital Compare* website could be used. A few examples of detailed metrics currently used in hospitals include the following: (1) the 30-day risk-standardized mortality rates for each of the three ailments – acute myocardial infarction (heart attack), heart failure, and pneumonia, and (2) the 30-day risk-standardized readmission rates after each of the four medical procedures – acute myocardial infarction (heart attack), heart failure, pneumonia, and hip/knee surgery.

There are five other key stakeholders that routinely interact and collaborate with CMS and a few others that occasionally interact with CMS in quality measurement and management efforts as and when required. The Joint Commission and the state quality improvement organizations (QIO) are two important stakeholders. The Office of the National Coordinator (ONC) for Health Information Technology (IT), the federal body responsible for coordinating nationwide efforts to implement electronic exchange of health information using the national healthIT.gov network, is a third stakeholder. Similarly, the American Medical Association (AMA) which helps physicians help patients by uniting doctors and medical students nationwide to work on the most important issues and medical universities that teach/train all budding physicians, nurses, and other healthcare staff are two other important stakeholders in quality measurement because together they guide all physicians, nurses, and medical research teams with the care issues and help determine the evolving medical standards. For a broader discussion of the different systems that help a hospital measure its overall quality, see Chakraborty and Kaynak (2018) .

Emerging Concerns, Existing Research, and Future Directions:

Population Health Management (PHM) and Lean Systems:

Population health management (PHM) has emerged as an important strategy to address the triple aim of enhancing the individual care experience, reducing healthcare costs per capita, and improving health. Although PHM initiatives are being adopted widely, the term is used somewhat loosely – population health, population medicine, community health, public health, and disease management – and the components of PHM vary across different healthcare organizations (Kaynak et al., 2017). As commented upon by Vic Zuccarello (2015) in this 2015.

Health Affairs Forefront blog by David Kindig, "population health" is "the health outcomes of a group of individuals, including the distribution of such outcomes within the group." It is an approach to health that aims to improve the health of an entire human population (Kindig & Stoddart, 2003) whereas PHM is "the technical field of endeavor which utilizes a variety of individual, organizational and cultural interventions to help improve the morbidity patterns (i.e., the illness and injury burden) and the healthcare use behavior of defined populations" (Coughlin et al., 2006). Hospitals utilize PHM tools (e.g., data dashboards, registries, and care coordination) to not only manage their patient population but also to meet healthcare quality targets and participate in value-based care initiatives.

Effective implementation of PHM requires continuous improvement, leadership, and teamwork – the topics we have addressed in this chapter – as well as lean systems. Implementing lean systems has its own challenges. Even before the COVID-19 pandemic hit, lean or just-in-time (JIT) system was not overwhelmingly popular among healthcare providers and hospital leaders. The reason for practitioner reluctance is simple: becoming and continuing to be lean is not easy and many do not end up as successful and some give up midway once their leadership changes. A quick search showed that lean is not widely implemented in either US (Po et al., 2019) or in European hospitals (Marsilio et al., 2022).

Among the 288 public hospitals that responded to the survey, 54.2% reported that they had adopted lean. The average length of time of lean implementation was 4.58 years. The mean number of units in which lean was implemented was 11.9 out of 29 possible hospital units, with the emergency department (ED) being the unit in which lean was most frequently implemented (Po et al., 2019).

However, there are also successful implementation accounts of lean systems. For example, Washington Hospital looks at the value added and waste from the patient's perspective to focus on the patient experience. Their lean management system is based on two concepts: continuous improvement and respect for people (Washington Hospital, 2016).

Needless to say, further research is essential to better understand PHM and its implementation in hospital settings. Currently, the focus seems to be on the clinical management of subgroups of patients by health systems and payers. Future research can focus on performance measures at each level (e.g., geographic population, an entire community) and for every stakeholder, in a way that it can support the strategies of hospitals or groups of hospitals to improve population health in their service area. Directly addressing social determinants of health and paying for these strategies can be other fruitful research topics as only 20% of health is determined by healthcare utilization, the rest is due to income, housing, social isolation, and the environment (Gottlieb et al., 2019) .

Managing Stressful Environments in Healthcare:

As we discussed in the beginning of this chapter, although the jury is out about the specific number of deaths due to medical errors, everyone agrees that patient safety and healthcare quality must be improved to reduce preventable deaths. One reason for medical errors is the occupational stress that "U.S health care clinicians, clinical students and trainees" (p. 1) are experiencing, with burnout rates at approximately 50% (Marchalik et al., 2020). The recent COVID-19 crisis and shootings in hospitals have certainly been adding to the healthcare workers' stress level. Increased burnout rates among healthcare workers have three major implications: (1) a healthcare workforce shortage due to stressful working conditions; (2) low job satisfaction, high absenteeism, and high turnover; and (3) a decline in patient care and hospital quality performance (National Academies, 2019).

A review of the extant literature indicates that healthcare organizations can create an environment in which healthcare staff can feel their jobs are meaningful. "Meaningful work refers to work that is experienced as worthwhile, significant, purposeful, important, and valuable to oneself or others" (Cf. Kimakwa et al., 2021; Allan, 2017; Pratt and Ashforth 2003), which can reduce occupational stress. A study of meaningful work in healthcare can be conceptualized as antecedents of meaningful work as inputs, meaningful work as process, improved employee well-being as output, and patient care quality as outcome. Antecedents of meaningful work include leadership (e.g., Arnold et al., 2007), information technology (to reduce administration work) (e.g., National Academies, 2019), worker empowerment, worker development/learning environment (e.g., Albuquerque et al., 2014), and safe work environment (e.g., Linzer et al., 2009). In other words, the antecedents are the facilitators of meaningfulness. We posit that the outputs of meaningful work are reduced burnout reflected on increased job satisfaction, reduced turnover, and increased work effort, leading to the outcomes – patient care quality and hospital quality performance.

The experience of NYC Health + Hospitals during the COVID-19 pandemic makes it clear that there is a need for further research to fully understand the antecedents of meaningful work and the factors that influence employee well-being given its potential impact on healthcare quality. The leadership at NYC Health + Hospitals was able to use information technology, worker development, and learning tools to create a supportive staff environment during the most stressful part of the COVID-19 pandemic (Salway et al., 2020). Efficient staff redeployment and onboarding processes together with distinct types of support certainly helped the public healthcare delivery system of NYC to manage workforce burnout as well as possible .

Summary and Conclusion:

The COVID-19 pandemic has made it more evident than ever that healthcare systems should continuously improve to be able to provide excellent, equitable care to everyone at reasonable cost (Chakraborty et al., 2021). Hospitals play a critical role in the healthcare ecosystem and – as our discussion in this chapter reveals – continuous improvement, quality leadership, teamwork, and supplier relations are key factors in managing healthcare quality. The supply chain of a hospital is extensive and complex, and the patient is the focal point of its operations. Physicians, nurses, and all other infrastructure support systems are designed to serve the patient in the most effective and efficient manner.

The provision of high-quality patient care requires a supply chain that keeps quality management principles at the front and center of all hospital processes. Quality management practices that are essential in the context of hospitals include hospital quality leadership, healthcare training, healthcare teamwork, hospital quality data and reporting, patient focus, supplier quality management, hospital services design, and hospital process management. Hospital quality leadership is the crucial factor for the successful implementation of quality initiatives and efforts in these organizations. Effective leaders can leverage resources, increase staff engagement, and stabilize processes to move a hospital through its own quality improvement journey. Quality healthcare teamwork is positively related to patient care quality which, in turn, is positively related to hospital quality performance.

An emerging area of work is how population health management can be used as a strategy to enhance the patient care experience, reduce healthcare costs, and improve health. Hospitals can use population health management tools such as data dashboards, registries, and care coordination to manage patient populations more effectively, achieve healthcare quality targets, and participate in value-based care initiatives. The effective implementation of these ideas requires a continuous improvement mindset, leadership, teamwork, and lean systems. Being lean is not easy to accomplish and maintain, but successful lean management systems incorporate continuous improvement at their core.

Lastly, occupational stress and burnout should not be ignored. Burnout in healthcare leads to workforce shortages, low job satisfaction, high absenteeism, increased turnover, and declines in hospital quality performance. Healthcare organizations need to create environments where healthcare staff members feel safe and that their jobs are meaningful to reduce occupational stress and improve healthcare quality.

The World Health Organization (WHO) estimated that at least half of the world's population cannot obtain essential health services due to a global shortage of health workers. One solution to help address this gap to train community health workers (CHWs) in low-and middle-income countries [1].

Ethiopia launched the Health Extension Program (HEP) in 2003. Health Extension Workers (HEWs) are female, trained, government-employed, and salaried frontline CHWs that implement the HEP packages. Close to 40,000 HEWs implement 18 packages of health promotion, disease prevention, and basic curative health services at the community level [2]. The HEP enabled Ethiopia to achieve significant improvements in maternal and child health, control and prevention of communicable diseases, hygiene and sanitation practices, and health care-seeking behavior [3].

A paper-based community health information system (CHIS) was designed for HEWs to capture, track, and report data about HEP services. The CHIS used by HEWs uses a family folder, a file folder that helps capture information about the household environment, socio-demographic profile, and services received in individualized cards for each family member. Using a tickler file system, a system of file arrangement enabling sequential arrangement of family folders based on appointment dates, HEWs identify defaulters and monitor individuals' health. Health managers at different levels access the HEP data from the family folder and use it for planning, monitoring, and decision-making [4, 5].

While the CHIS has shown good report and content completeness, indicator calculation, and data display, it has problems with data accuracy and use for decision-making [6]. Generally, poor data quality is the main challenge of the health information system in Ethiopia [7, 8]. Possible explanations include the use of a paper-based system, the high cost of printing and distributing formats, the tediousness of recording and reporting formats, and user errors while recording and compiling reports [9, 10]. On average, Ethiopia spends 5,073,996.00 USD each year on reprinting health management information system formats, despite poor data quality [10]. In addition, the family folders are bulky and vulnerable to damage from rain when carried from house to house. Therefore, HEWs resort to recording in registers and transferring the data to family folders at a later time, predisposing the system to errors and poor data quality [11]. In addition, the HEP generated large amounts of data, which became manually unmanageable [4]. The family folder system also faced the challenge of redundant data elements. Time spent collecting and harmonizing redundant or non-transferable data was time that could otherwise be spent serving the community [11].

To address such challenges, Ethiopia identified information revolution (IR) as a priority agenda in its second Health Sector Transformation Plan (HSTP II) and has been implementing it since 2016. The IR, based on a strong foundation of governance, emphasizes the digitization of health information and the promotion of data use culture within the health system. In line with the IR, Ethiopia designed, developed, and implemented different digital tools, including the electronic community health information system (eCHIS) [12]. The eCHIS is a mobile-based application that works online and offline. The application is used by HEWs for household registration, service delivery, data recording, and reporting. It also facilitates referral communications between HEWs and health center staff [13]. Despite a high initial investment cost, eCHIS saves money in the long run [14], provides electronic decision support [15], facilitates faster referrals and patient tracking, minimizes duplication in recording and reporting, improves the quality of data, and enhances communication between providers, leading to improved service quality and health outcomes [16, 17]. Data accuracy, integrity, and decision-making at the community level tend to improve when using electronic CHIS (eCHIS) compared to paper-based CHIS [18]. The WHO also recommends the use of digital tools by health workers [19].

However, the benefits of digital health technology strongly depend on its acceptance and use among its end-users [20, 21]. This study assessed the acceptability and use of eCHIS among health workers in Ethiopia.

Main body text: Methods:Study design, area, and period:

A retrospective cross-sectional observational study was conducted from May 15–29, 2022, in six regions of Ethiopia (Amhara, Harari, Oromia, Sidama, South Nations Nationalities and Peoples, and Southwest Ethiopia). The study was conducted among HEWs randomly selected from a representative sample of health posts in the six regions.

Study population and eligibility criteria:

HEWs working in health posts that implemented eCHIS for at least 3 months, aged 18 years or older and who consented to participate were included in the study. HEWs who worked for less than 6 months and were not available during the data collection time were excluded from the study.

Sample size:

The sample size was calculated using a single population proportion formula [22].

n=[(z,2,*,p,*,q),+,ME,2,/,[ME,2,+,z,2,*,p,*,q,/,N]]/*d

Whereas:

- n = the required sample size
- z = 1.96 at 95% confidence level
- ME = margin of error = 0.05
- p = the anticipated proportion of HEWs in the selected HPs with the attribute of interest = 50%. This assumption was made to maximize the sample size due to lack of prior studies.
- q = 1-p
- N = population size (5000)
- d = design effect =1.5

Accordingly, the calculated sample size was 537. With a 10% non-response rate, the final sample size was 591 health posts.

Sampling techniques and procedures:

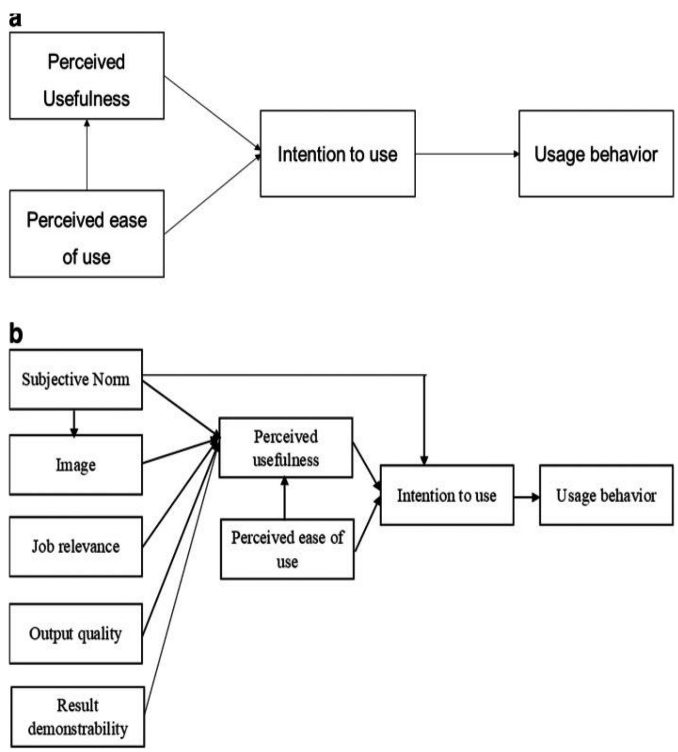
A multistage stratified random sampling technique was used to select the study subjects. First, a sampling frame of HPs that have implemented eCHIS for at least 3 months was prepared. The list was stratified by region, zone, and woreda (district). The average number of HPs that implemented eCHIS per woreda was calculated from the remaining list, which was 24. Then, the sample size was divided by this number to get the number of woredas that should be sampled to meet the sample size requirement (591/24, which equaled 25). The 25 woredas were selected from the six regions proportional to their cluster size (number of woredas per region). Once the number of woredas to be sampled from each region was determined, a table of random numbers was generated to select the 25 woredas from the six regions (Amhara 5, Harari 1, Oromia 11, Sidama 2, South Nations Nationalities and Peoples 4, and Southwest Ethiopia 2). All the health posts in the selected woredas were included in the study, and a lottery method was used to select one of the two HEWs available at the selected health posts.

Data collection tools:

The Revised Technology Acceptance Model (TAM2) questionnaire was adapted to the local context and used in this study**.** The questionnaire has nine constructs, each of which is measured on a five-point Likert scale.

The TAM, based on the Theory of Reasoned Action, theorizes that an individual's behavioral intention to use (ITU) a system (acceptability) is determined by two beliefs: perceived usefulness (PU), the extent to which a person believes that using the system will enhance his or her job performance, and perceived ease of use (PEU), the extent to which a person believes that using the system will be free of effort. According to TAM, PU is also influenced by PEU [23] (Fig. 1a).

Fig. 5.



a Technology acceptance model (TAM) developed by Fred Davis, 1985. **b** The revised Technology Acceptance Model Two (TAM2), 2000

Using TAM as the starting point, TAM2 incorporates additional theoretical constructs spanning social influence processes (subjective norm and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) in settings where the usage of technology is mandatory. The TAM2 model has been found to be an effective model for explaining technology use intention and behavior before and during implementation [24]. Below are the definitions of the constructs used in the revised TAM2 model (Fig. 1b):

Social influence processes:

- Subjective norm (SUN): a person's perception that most people who are important to him or her think he or she should or should not perform the behavior in question.
    - a

      Image (Imj): is the degree to which the use of technology is perceived to enhance one's status in one's social system.

Cognitive instrumental processes:

- Job relevance (JR): An individual's perception regarding the degree to which the target system is applicable to his or her job.
    - a

      Output quality (OQ): The degree to which those tasks match end users' job goals.

    - b

      Result demonstrability (RD): The tangibility of the results of using the technology.

Measurement:

Items for all latent and some observed variables were measured using a five-point Likert scale: strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, and strongly agree = 5. The items were asked in affirmative statements, to which respondents replied. As scoring increased from 1 to 5, it denoted a higher score in the latent and observed variables. Some items were reverse-coded to maintain this assumption.

Latent variables measurement:

Perceived usefulness (PU) was measured using nine items. Each of the items measured different aspects of perception about eCHIS usefulness. Similarly, perceived ease of use (PEU) was measured using six items and ITU using four items. In this study, an ITU score of agree or strongly agree was used as an indicator of eCHIS acceptability.

Observed variable measurement:

Use (usage behavior) was measured with the question: How often do you use eCHIS in your routine work? The response categories were coded as 1. Always, 2. Frequently, 3. Sometimes, 4. Occasionally, and 5. Never. In this study, use was defined as the percent of HEWs that reported used eCHIS either always or frequently in their routine work.

Variables of the study:

The revised TAM2 model summarizes the endogenous and exogenous variables of the study. According to structural equation modeling (SEM) terminology, all boxes in the model to which an arrow is pointing are endogenous variables. All boxes with only arrows pointing away are exogenous variables.

Data collection procedures:

The data collection tool was prepared in English and translated into Amharic and Afan Oromo languages. The translated tools were back-translated by another independent translator to check for consistency. A face-to-face interview technique was used to collect the data. A GPS-enabled Open Data Kit (ODK) was used to collect the data electronically. Experienced data collectors and supervisors were recruited and trained for 2 days. The questionnaire was checked for consistency and completeness every day during the data collection period.

Data processing and analysis:

The data were transferred to SPSS version 25. Data cleaning was done by running frequencies and descriptive statistics. Exploratory descriptive statistics were used to understand the nature of the data. Analysis of Moment Structure (AMOS), add-in software to SPSS, was used to develop the model. A SEM was applied to test and estimate path coefficients and factor loadings. The average item score, range, and percentage of favorable item scores (4 and 5 in the Likert scale) were calculated. Increasing item scores indicate increases in the value of the underlying constructs.

Internal consistency of items was checked for the latent variables. Items with a corrected item-to-total correlation of less than 0.30 and alpha if an item deleted greater than the overall alpha were used as criteria to delete items. The dimensionality of the items was tested using principal component analysis (PCA). For all significance tests, adjustments for multiple comparisons were made using the Bonferroni Correction Method for all significant path coefficients [25].

The regression weights (β coefficients or path coefficients) and factor loadings were determined using maximum likelihood estimation (model estimation). Evaluation of model fit was made using multiple fit indices: Chi-square, Goodness of fit index (GFI), Confirmatory fit index (CFI), and values > 90 and a root mean square error of approximation (RMSEA) of value < 0.08 as cut-off points.

Quality assurance mechanisms:

The validity of the study was ensured during data collection, entry, and analysis. Use of a standard questionnaire and electronic data collection system, translation and back translation of the data collection instruments, use of experienced data collectors, training of data collectors and supervisors, ensuring confidentiality and privacy of respondents, running descriptive statistics and frequencies, and use of advanced analysis techniques were the steps taken to ensure the quality of the study.

Results:

Characteristics of HEWs:

A total of 587 HEWs from 587 HPs in the six regions across Ethiopia were included in the study, giving a response rate of 99.3%.

The mean (+SD) age of the HEWs was 27.9 (±4.2) years. More than three-fourths (78.7%) of the HEWs were married, and the majority of them, 404 (68.8%), lived in rural areas. About two-thirds (66.6%) were trained at Level IV with a median (±IQR) year of experience of 10.0 (±9.0) years. Almost all (94.2%) HEWs received training on eCHIS. More than 70% of the HPs included in the study had two or more HEWs. Close to 80% of the HPs served 3000 or more populations in their respective catchment areas (Table 1).

Table 6.

Socio-demographic characteristics of the HEWs, Ethiopia, June 2022

Variable	Category	Frequency	Percent
Age (in years)	20–28	367	62.5
	29–37	210	35.8
	38–46	10	1.7
Marital status	Never married	118	20.1
	Married	462	78.7
	Single (Divorced/Widowed)	7	1.2
Residence	Urban	183	31.2
	Rural	404	68.8
Education	Level I	13	2.2
	Level II	5	.9
	Level III	178	30.3
	Level IV	391	66.6
Experience (in years)	< 5	166	28.3
	5–10	137	23.3
	> 10	284	48.4
eCHIS training	Yes	553	94.2
	No	34	5.8
Number of HEWs at HPs	1	150	25.6
	2	305	52.0
	3 and above	132	22.4
Population served by HPs	< 3000	131	22.3
	3000–5000	180	30.7
	5001–7000	158	26.9
	> 7000	118	20.1

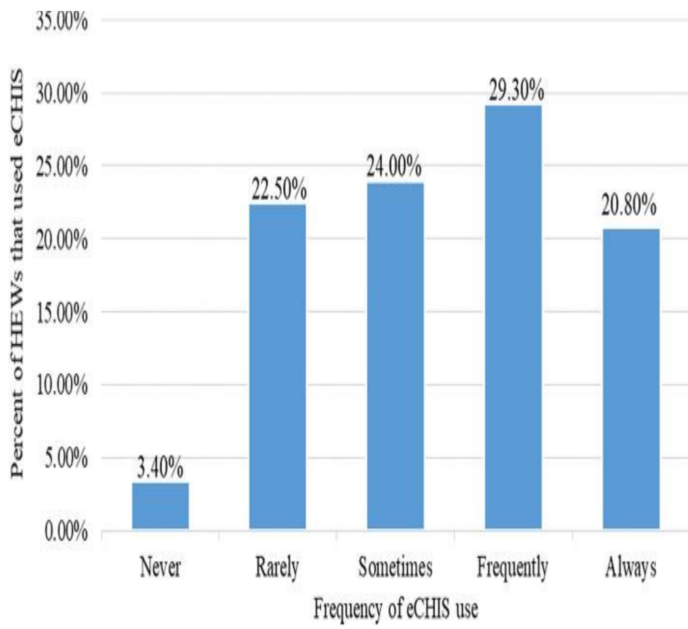
eCHIS acceptability:

The mean score of items used to measure acceptability ranged from 4.36 to 4.41 out of 5. Similarly, the acceptability of eCHIS ranged from 94.4 to 97.4%.

eCHIS use:

Despite near universal acceptance of eCHIS among HEWs**,** only half, 50.1%, of the HEWs use eCHIS in their routine work (Fig. 2).

Fig. 6.



Frequency of eCHIS use among HEWs in Ethiopia, June 2022

Determinants of acceptability and eCHIS use:

Model fitting:

Initial model fitting for TAM2 did not meet cutoff points for the selected fit indices; Chi-square, GFI, CFI, and RMSEA were 4.331, 0.799, 0.799, and 0.075, respectively. Even though some improvements in the model fit indices were shown when freeing reasonable restrictions between the error terms and some latent variables, the fit indices did not meet cutoff points. Hence, the TAM2 did not replicate the sample data very well.

The TAM2 model is used in settings where the use of technology is mandatory. However, this is not the case in the current situation of eCHIS implementation, as HEWs are required to use both manual and electronic CHIS at the same time. Hence, the influence of external factors like social influence processes and cognitive instrument processes was ignored, and the TAM model was tested as a competing model.

Accordingly, the TAM model demonstrated acceptable fitness for the sample data with the following values for the model fit indices: Chi-square = 3.177, GFI = 0.922, CFI = 0.935, RAMSEA = 0.06.

Measurement model:

All except one item loaded on a single construct. Cronbach's alpha if item deleted improved the alpha value for perceived usefulness from 0.847 to 0.879 when item nine (the advantage of eCHIS outweighs the disadvantage) was deleted from the measurement model. For the remaining constructs, there was no improvement in Cronbach's alpha when an item was deleted. Accordingly, Cronbach's alpha coefficients for PU, PEU, and ITU were 0.879, 0.838, and 0.863, respectively.

Confirmatory factor analysis was also done with maximum likelihood estimation to test the significance of the hypothesized measurement model. The items used to measure the constructs were all significant at a *p*-value < 0.05 (Table 2).

Table 7.

Standardized estimates of the factor loadings of the measurement model for PU, PEU and ITU, June 2022

Code	Constructs and items	Factor loading
	Perceived Usefulness (PU)	
PU1	eCHIS enables me to accomplish tasks more quickly	0.642*
PU2	eCHIS has improved the quality of the service that I provide	0.673*
PU3	eCHIS has made it easier to provide health extension services	0.708*
PU4	eCHIS has improved my productivity	0.685*
PU5	I find eCHIS to be useful for my job	0.736*
PU6	Use of eCHIS increases the effectiveness of performing a task	0.731*
PU7	Using eCHIS gives me access to information I need for my work	0.686*
PU8	eCHIS provides me information for my purpose	0.694*
	Perceived Ease of Use (PEU)	
PEU1	My interaction with eCHIS in doing my task is clear & understandable	0.648*
PEU2	Overall, eCHIS is easy to use	0.736*
PEU3	Work with eCHIS was easy for me	0.748*
PEU4	The use of eCHIS for my daily duty does not confuse me	0.724*
PEU5	eCHIS is easy to navigate	0.702*
PEU6	Using eCHIS enables me to have more accurate information	0.517*
	Intention to Use (ITU)	
ITU1	I intend to continue to use eCHIS for my routine duty to perform my job	0.787*
ITU2	I intend to frequently use eCHIS for my routine duty to perform my job	0.807*
ITU3	Assuming I will have continued access to eCHIS for my routine duty, I will continue to use it	0.821*
ITU4	Given that I have access to eCHIS for my routine duty, I predict that I would adopt it	0.721*

Open in a new tab

*$p < 0.001$

Structural model:

The standardized path coefficients show the direction and magnitude of the association between two variables. Accordingly, ITU showed a direct and positive association with usage behavior ($\beta4 = 0.297$, $p < 0.001$). However, the strength of the association is weak, supporting the intention-use gap. Both PEU and PU showed direct and positive associations with ITU ($\beta2 = 0.340$, $p < 0.001$, $\beta3 = 0.415$, $p < 0.001$, respectively). PEU also demonstrated a significant indirect effect on ITU through its direct and positive effect on PU ($\beta1 = 0.698$, $p < 0.001$) (Table 3, Fig. 3).

Table 8.

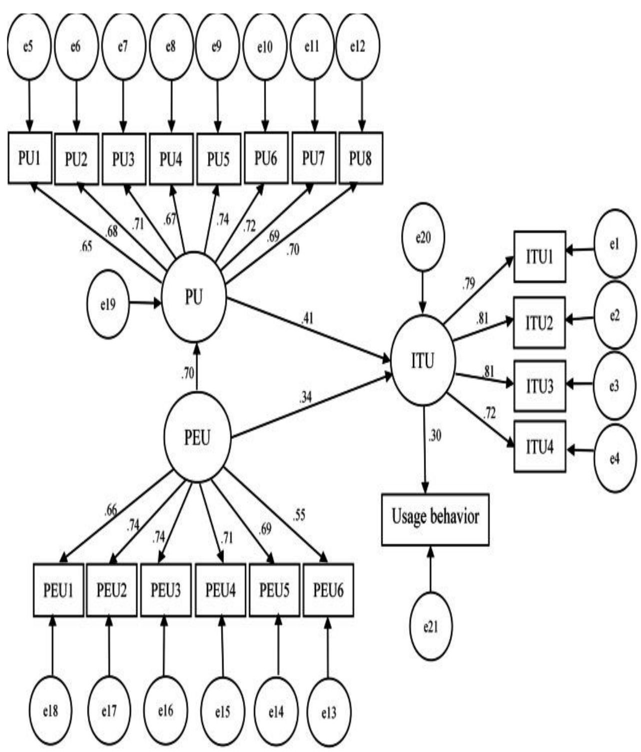
Standardized estimated parameters for the structural model, June 2022

Paths	Parameters	Standardized estimates
PEU→PU	β_1	0.698*
PEU→ITU	β_2	0.340*
PU→ITU	β_3	0.415*
ITU→Usage behavior	β_4	0.297*

Open in a new tab

*$p < 0.001$

Fig. 7.



The final TAM model with standardized estimates, June 2022

Discussion:

This study assessed the acceptability and use of eCHIS and their determinants among community health workers in Ethiopia. This study revealed a near universal acceptability of eCHIS among HEWs. This result is in accordance with studies conducted in South Africa, Uganda, and Myanmar that reported high acceptability of digital health technologies among rural healthcare workers. Simplification of work, cost reduction, and improvement in data quality and health outcomes were reported as reasons for high acceptance by these studies [26–29].

Despite high acceptability, only half of the HEWs were using eCHIS in their routine work, demonstrating a huge acceptability-use gap. This is consistent with other studies conducted on technology acceptance among health workers in similar healthcare settings in South Africa, Uganda, Kenya, Ghana, and Brazil [26–28, 30–35]. This suggests that the high acceptability of digital technologies may not necessarily lead to high usage behavior due to barriers between acceptance and use. A study in the same setting indicated that lack of technology infrastructure, poor quality of training, lack of prior exposure to technology, workload and policy gaps hindered the use of eCHIS [36]. A well-planned and coordinated effort by the government and its partners is needed to improve use and be able to harvest the benefits from eCHIS implementation. Accordingly, careful identification and tackling of eCHIS barriers is needed, for which the MOH in Ethiopia recently developed a national eCHIS implementation strategy. The plan included major strategic shifts such as revising the eCHIS training approach, changing the eCHIS implementation design, making some policy adjustments, and strengthening the ICT infrastructure [37].

In this study, ITU (acceptability) was directly and positively, but weakly, associated with use. The weak association supports the acceptability-use gap reported in this study. A weak correlation between acceptability and use was also reported in another study that applied TAM [38]. This indicates the need to explore the barriers that hinder effective translation of use intention to actual use.

PEU showed a direct and positive effect on ITU. PEU also demonstrated a significant indirect effect on ITU through its direct and positive effect on PU. Both PEU and PU are reported to predict the acceptability of using new technology and have been used in various studies to assess technology acceptance. Similar effects were observed in various studies conducted in developing and developed countries that applied TAM to investigate technology acceptance and use [39–45]. These results may imply that, in healthcare settings, technologies that provide relevant benefits and are easy to use can be effortlessly adopted by health workers to improve their productivity. Thus, sustained effort in the development of more user-friendly eCHIS applications and hands-on training to enhance the adaptability and skills of users may lead to high acceptability and use of technology by health workers.

In this study, the concept of TAM2 was applied by considering variables that include social influence processes and cognitive instrumental processes. Nevertheless, the application of TAM2 was not replicated by the sample data.

The current non-mandatory use of eCHIS by HEWs in Ethiopia may explain the lack of influence of these variables on technology acceptance and use. Hence, the effects of these variables on healthcare workers' acceptance of new technology cannot be ruled out at this stage of eCHIS implementation. Rather, further studies should be conducted in areas where technology use is mandatory.

Strengths and limitations:

The study used a standard questionnaire to measure technology acceptability in varied contexts. In addition, data quality assurance techniques were used to generate quality data from the study. The use of advanced analysis techniques is another strength of the study. However, the study has some limitations too. This study employed a cross-sectional design. Therefore, causal links may not be established despite the use of SEM. Despite the limitations, the findings of this study advance the knowledge of eCHIS in settings where such digital technologies are used to improve the quality of service and patient outcomes.

Conclusion:

Generally, the acceptability of eCHIS is very high. However, its use for routine service delivery is considerably low. Perceived usefulness had a direct and positive effect on acceptability, while perceived ease of use had both direct and indirect positive effects on eCHIS acceptability. Acceptability had a direct and positive effect on the use of eCHIS. The acceptance-use gap may be attributed to various bottlenecks at different levels in the healthcare system. Hence an integrated and coordinated approach is required to close the acceptance-use gap by investigating and addressing use barriers.

Acknowledgements:

We are grateful to USAID for funding this study and to the staff at MOH, the University of Gondar, and Jimma, Haramaya, and Hawassa Universities for their contribution during the data collection, analysis, and preparation of the draft report. All woreda health officials also deserve our acknowledgement for their cooperation during data collection. We also thank all the HEWs that participated in the study.

References:

AHA. (2022a). Fast facts on U.S. hospitals, 2022. Retrieved: https://www.aha.org/system/files/media/file/2022/01/fast-facts-on-US-hospitals-2022.pdf

AHA. (2022b). Massive growth in expenses and rising inflation fuel continued financial challenges for America's hospitals and health systems. Retrieved: https://www.aha.org/system/files/media/file/2022/04/2022-Hospital-Expenses-Increase-Report-One-Pager.pdf

Baldrige. (2022). Health care: Our impact: What we do: The Foundation for the Malcolm Baldrige National Quality Award. Retrieved July 9, 2022: https://baldrigefoundation.org/what-we-do/our-impact/health-care.html

Bogale TN, Teklehaimanot SM, Fufa Debela T, Enyew DB, Nigusse Bedada A, Dufera Kebebew S, Nigusie Weldeab A, Wolde Daka D, Willems HJ, Bekele TA. Barriers, facilitators and motivators of electronic community health information system use among health workers in Ethiopia. Front Digit Health. 2023;5:1162239. doi: 10.3389/fdgth.2023.1162239. [DOI] [PMC free article] [PubMed] [Google Scholar]

Buttigieg, S. C., Bezzina, F., Xuereb, A., & Dey, P. K. (2020). Healthcare supply chain management: Application in the Maltese healthcare system. Health Services Management Research, 33(2), 55–65. https://doi.org/10.1177/0951484819871003

Chakraborty, S., Kaynak, H., & Pagán, J. A. (2021). Bridging hospital quality leadership to patient care quality. International Journal of Production Economics, 233, 108010. https://doi.org/10.1016/j.ijpe.2020.108010

Chang LW, Njie-carr V, Kalenge S, Kelly JF, Bollinger RC, Alamo-Talisuna S. AIDS care: psychological and socio-medical aspects of AIDS/HIV perceptions and acceptability of mHealth interventions for improving patient care at a community-based HIV/AIDS clinic in Uganda: a mixed methods study. AIDS Care. 2013;25(7):874–880. doi: 10.1080/09540121.2013.774315. [DOI] [PMC free article] [PubMed] [Google Scholar]

Gonete, T. Z., Yazachew, L., & Endehabtu, B. F. (2021). Improving data quality and information utilization at Metema Primary Hospital, Amhara National Regional State, Northwest Ethiopia 2018: Capstone project. Health Informatics Journal, 27(3), 14604582211043160. https://doi.org/10.1177/14604582211043160

Jacobs, F. R., & Chase, R. B. (2020). Operations and supply chain management (16th ed.). McGraw-Hill Education.

Kimakwa, S., Gonzalez, J. A., & Kaynak, H. (2021). Social entrepreneur servant leadership and social venture performance: How are they related? Journal of Business Ethics. https://doi.org/10.1007/s10551-021-04986-y

Marchalik, D., Goldman, C., Alger, J., Rodriguez, A., Catomeris, A., Lynch, J. H., Padmore, J., Mete, M., & Krasnow, R. (2020). The impact of gender and institutional factors on depression and suicidality in urology residents. Canadian Journal of Urology, 27(6), 10471–10479.

Marsilio, M., Pisarra, M., Rubio, K., & Shortell, S. (2022). Lean adoption, implementation, and outcomes in public hospitals: Benchmarking the US and Italy health systems. BMC Health Services Research, 22(1), 122. https://doi.org/10.1186/s12913-022-07473-w

Ministry of Health. Federal democratic republic of Ethiopia: Electronic Community Health Information System (eCHIS) National Strategic Plan 2022-2025. [Report]. 2022.

Statista. (2022). Health spending per capita by country. Per capita health expenditure in selected countries 2019. Retrieved July 8, 2022: https://www.statista.com/statistics/236541/per-capita-health-expenditure-by-country/

Zaka, A., Shamloo, S. E., Fiorente, P., & Tafuri, A. (2020). COVID-19 pandemic as a watershed moment: A call for systematic psychological health care for frontline medical staff. Journal of Health Psychology, 25(7), 883–887. https://doi.org/10.1177/1359105320925148