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Factors shaping effective utilization of health information technology in urban safety-net clinics

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Abstract

Urban safety-net clinics are considered prime targets for the adoption of health information technology innovations; however, little is known about their utilization in such safety-net settings. Current scholarship provides limited guidance on the implementation of health information technology into safety-net settings as it typically assumes that adopting institutions have sufficient basic resources. This study addresses this gap by exploring the unique challenges urban resource-poor safety-net clinics must consider when adopting and utilizing health information technology.

In-depth interviews (N = 15) were used with key stakeholders (clinic chief executive officers, medical directors, nursing directors, chief financial officers, and information technology directors) from staff at four clinics to explore (a) nonhealth information technology-related clinic needs, (b) how health information technology may provide solutions, and (c) perceptions of and experiences with health information technology. Participants identified several challenges, some of which appear amenable to health information technology solutions. Also identified were requirements for effective utilization of health information technology including physical infrastructural improvements, funding for equipment/training, creation of user groups to share health information technology knowledge/experiences, and specially tailored electronic billing guidelines. We found that despite the potential benefit that can be derived from health information technologies, the unplanned and uninformed introduction of these tools into these settings might actually create more problems than are solved.

From these data, we were able to identify a set of factors that should be considered when integrating health information technology into the existing workflows of low-resourced urban

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safety-net clinics in order to maximize their utilization and enhance the quality of health care in such settings.

Keywords

Collaborative work practices and information technology; health-care professional training; in-depth interviews; organizational change and information technology; urban safety-net clinics

Introduction

Health care involves the tight interrelation of several factors in a system. Therefore, the introduction of a new complex element, such as health information technology (HIT), can have reverberating consequences. Research shows that the adoption of health-care technologies is related to user satisfaction, rather than features and efficacy of the technology.[1,2] Ignoring organizational and sociotechnical issues in HIT deployments has led to delayed progress, cost overruns, and even failures and project abandonment.[3,4] While HIT systems have the potential to dramatically improve medical care, the adoption of these systems has generally had less success than predicted.[5–9] Despite the potential benefits, slow rates of HIT adoption can be attributed to (a) resource availability, (b) organizational disposition and capacity, (c) HIT systems design and adaptability, (d) staff perceptions of utility, and (e) unintended consequences of implementation.[9–11]

Urban safety-net clinics, the principal providers of primary care services to the uninsured and underinsured in urban areas of the United States, face such challenges in the implementation and utilization of HIT. The term “safety-net” refers to a heterogeneous and overlapping network of health-care organizations that serve a disproportionate number of uninsured and underinsured patients. Common organizational structures of clinics within the urban safety-net where this study was conducted include, but are not limited to, Federally Qualified Health Centers (FQHCs), FQHC look-alikes, free clinics, publicly funded country clinics, and privately funded community clinics. The primary differences between these categories relate to funding sources, health-care services offered, whether services are offered at low cost or for free, and clinic licensing and reporting obligations.[12] Clinics selected for this study represent a spectrum of the urban safety-net and belong to different categories, see Table 1. The findings, therefore, are significant because they indicate that clinics within the urban safety-net, regardless of type, face a similar set of issues relating to the adoption of HITs.

The communities served by the safety-net manifest the highest burden of disease and the most challenged health-care infrastructure in the United States. HIT-related improvements have great potential to improve the health outcomes and quality of life for these populations. Few studies have evaluated barriers and facilitators to the successful implementation of HIT in the urban safety-net.[13–15] Since these organizations face unique resource, staffing, and infrastructural challenges, it is critically important to assess their ability to adopt HIT and to identify potential barriers and facilitators for their effective, sustained utilization.

Attention to sociotechnical factors is particularly important for the successful diffusion and acceptance of HIT in urban underserved areas, given the “digital divide” experienced by multiethnic vulnerable patient populations.[15] The goal of this article is to evaluate how the social context of an urban safety-net clinic impacts the effective utilization of HIT. In line with a participatory and ground-up approach, we conducted qualitative interviews with key stakeholders to explore their views on noninformation technology (IT)–related needs of participating clinics and their perceptions of and experiences with HITs.

Methods

The present article comes out of a larger study examining awareness and perceptions of and access to HIT among clinic staff and patients in an urban safety-net setting. The senior author of this article, R.B., approached the chief executive officers (CEOs) of these clinics to introduce the study after which the primary author conducted the interviews. We collected qualitative data from 15 individual interviews with key stakeholders from four urban safety-net clinics. Interviews lasted from 39 to 90 min (average 68 min). Participants included CEOs (n = 4), medial directors (n = 4), nursing directors (n = 3), and information system directors/chief financial officers (n = 4). Interviews were conducted in English and audio-taped. Topics covered in the semi-structured interviews were guided by the aims of the study and focused on participants’ views of (a) pressing problems in clinics (not directly HIT related), (b) clinic personnel’s awareness and perceptions of HIT, (c) barriers/facilitators to the current use and/or implementation of HIT, and (d) types of problems created and solved by the current use of HIT.

Interviews were transcribed, and Atlas.ti (a qualitative software program) was used to store transcripts and manage the data. Open coding was used and data were given a code if it related to the broader aims of the study, without predetermined categories. After a number of transcripts were coded, patterns and themes began to emerge and these separate codes were grouped into broader categories and subcategories. To ensure validity and reliability, first and second authors, S.G. and B.G., coded the first four transcripts independently. This form of analyst triangulation was an avenue for discussion about interpretations of data and did not show any great discrepancy between coders. B.G. and S.G. read and examined all transcripts, and regular meetings were held to specifically discuss interpretations of emerging codes, categories, and subcategories. The analysis report generated from the coding was then reviewed and discussed by all authors.

Results

The participating clinics are located in a county renowned for the fragmented nature of its health-care safety net. In this setting, safety-net clinics are responsible for meeting the primary care needs of underinsured patients, while the county is responsible for specialty and emergent care needs. This division of care is mediated by inadequate and simplistic HIT systems that are under revision at the time of publication. The clinics in this study varied in size with the smallest (Clinic B) operating from two locations with approximately 18,321 patient encounters per year and the largest (Clinic D) operating from seven locations with

approximately 119,000 patient encounters per year. Clinics A and C were of similar size. Detailed clinic characteristics are included in Table 1.

From the data, four main factors have been identified that can both inhibit or facilitate the implementation and utilization of HIT in clinics: (a) infrastructure, (b) clinic resources, (c) HIT system, and (d) clinic personnel. Each is discussed in the following. Tables 2–5 describe the different components of individual factors, provide specific examples taken from the data, and highlight whether the factor was perceived as a barrier and/or facilitator to HIT adoption. Data from participant interviews have also been included in separate boxes.

Infrastructure

The infrastructural issues that inhibit uptake of HIT include delays for fixing infrastructure when work was required from an outside department, staff not appreciating the need for a prompt response to infrastructural issues, the need for appropriate bandwidth for programs to work, and the need for better software (see Table 2).

The urban safety-net clinics were all, to varying extents, currently using numerous unintegrated HIT systems. For example, a single clinic might have or intend to adopt varied imaging systems (e.g. picture archiving and communication system (PACS) for radiology), a general electronic medical records (EMR) system (e.g. Centricity), and several chronic disease registries (e.g. unique registries for diabetes and asthma) and to maintain a complicated set of systems for referrals. Because appropriate equipment and software had not been installed prior to implementation of these multiple systems, clinics experienced system crashes and had lost data. Clinics housed in old buildings (not designed for IT) faced additional issues since the layout may prevent full implementation of a system. One clinic identified a need for architectural improvements due to inadequate network closets (closets not large or cool enough for equipment). Furthermore, inappropriate infrastructure led to the slowing of work productivity (Box 1, Quotes 1 and 2).

Box 1

infrastructure

Examples of inappropriate infrastructure

Quote 1: I've got a lot of challenges because the building is old and the equipment was old … very archaic cabling. The standard now is at least CAT5 or fiber optic. We still had CAT3 … (IT Director, Clinic A).

Quote 2: When I first got here, the network equipment was between 9 and 13 years old. We had hubs, which are way before even the advent of switches. So we had situations where, literally … the network would drop a few times every day. There's no way you can start an electronic medical record. (Chief Information Officer, Clinic D)

Establishing "stable ground" as a critical component of future success

Quote 3: … don't, as an organization, think that technology is gonna fix your problems … [make] sure that we do the process analysis … you get stable ground, line things up,

so that it's manageable, and that there's accountability and responsibility, and traction. (Chief Information Officer, Clinic D)

While infrastructural problems served as barriers, obtaining and improving hardware in preparation for the potential use of HIT-facilitated utilization (e.g. having wiring set up to enable computers to be used). Therefore, one IT director identified establishing "stable ground" as a critical component of future success (Box 1, Quote 3).

Clinic resources

Lack of financial and human resources were also significant barriers to HIT adoption (see Table 3). Both the need for an initial injection of funds to implement a new HIT program and funds to sustain and upgrade the use of existing HIT were important and were a consistent theme across clinics. Some safety-net clinics had to fight for funds to purchase appropriate equipment and software programs. Staff time was required to apply for funds from foundations, donors, and private individuals. Furthermore, this lack of funds inhibited hiring additional staff and the adoption of more sophisticated and up-to-date HIT systems.

Such limitations in financial resources gave rise to the related concern about the time required for HIT adoption where a possible disruption to patient care, and related disruption to clinic revenue during the early stages of HIT implementation, was anticipated. For many, time required for staff training was a resource they could not spare because of the impact on patient care (Box 2, Quote 1).

Box 2

clinic resources

Lack of time for HIT training

Quote 1: [T]here's the concern about—especially during implementation, the reduction in productivity. And I feel like that contradicts sort of our mission, which is to see patients and take care of them, so I really worry about that implementation phase, when we're going to have to close our doors to a lot of people. (CMO, Clinic D)

Billing complexity

Quote 2: It makes the administrative problem of trying to get accuracy in billing—which is very, very important—very much of a challenge here. (CEO, Clinic C)

Timely access to HIT

Quote 3: The barriers are lack of funds and the time that it takes to get something approved … certain things you can ask for this year and you might not get them till five years down the road. (IT Director, Clinic C)

Quote 4: Unfortunately, I don't think we can just get all of it to us because we are a public entity. There are so many layers you have to work through. It's not like the private sector. (Medical Director, Clinic A)

Making the funds stretch

Quote 5: If you don't know what you're doing it can cost you a lot of money, and being in a non-profit organization—How do you get the most innovative technology for the least amount possible? If you didn't know, and you do a proposal to the senior staff and say, "hey listen, I need to buy 250 licenses of Office 2007 at $300.00 each license," or do you know to go to a donor, a non-profit, and get it for $3.00 each … I've had guys do things for me that I've subcontracted, that a normal person would easily pay $125.00 an hour, but I get the same type of work, high quality, at $20.00 an hour. (IT Director, Clinic C)

Important role of user groups

Quote 6: … because health programs like ours are small they need to get into what's known as user groups, and purchase systems together. So if you had ten programs like ours, and we have a single contract with a vendor, we're gonna be able to get more response out of that vendor. You'd be able to train people in larger training groups. You'd be able to troubleshoot things by calling up your colleagues in the user group … (CEO, Clinic C)

This reduction to financial resources further compounded the already difficult billing procedures in place in these clinics, which strategically draw from several social welfare programs to cover the costs of providing services to safety-net patients. These numerous programs all come with their own rules and regulations as to which patients can receive services, what types of services can be provided, and what documentation is required. One participant likened this problem in billing complexity to a "nightmare" and that accurate billing can be affected (Box 2, Quote 2). Establishing quality control over the billing process may increase the accuracy for auditing purposes and improve overall cash flow. Another participant similarly suggested that public website-based billing guidelines could be established for clinics utilizing the same social and public health programs.

Another challenge was timely access to HIT. For some clinics, successful HIT utilization was inhibited when the county bureaucracy was slow to provide access to necessary systems and resources (Box 2, Quotes 3 and 4). Clinic administrators also had to be creative in making funds stretch and access cost-effective technologies and services, given such systemic limitations by drawing upon nonmonetary resources (Box 2, Quote 5).

Finally, some participants noted hidden potentials within the safety-net environment that could be leveraged more effectively. For example, they pointed to the important role that user groups could play in providing collaborative support in the use of HIT (Box 2, Quote 6). One clinic, with access to necessary funds, employed a consulting group during the implementation of their EMR that greatly facilitated the process and allowed them to learn valuable strategies.

HIT system

System-related barriers included glitches in new technology, slow systems, nonuser friendly technology, and an unintegrated patchwork of HIT (see Table 4).

One participant highlighted the problematic nature of having glitches in their Patient Electronic Care System (PECS) (Box 3, Quote 1). Slow and inferior systems (compared to other HIT systems on the market) had a negative effect on clinic efficiency, compromising the "buy-in" necessary from clinic personnel to embrace HIT (Box 3, Quotes 2 and 3). Fragmented programs were an additional barrier, since many HIT programs were not interfaced and staff often had to navigate in and out of different programs (Box 3, Quote 4).

Box 3

HIT systems

Problematic nature of glitches in the system

Quote 1: We have PECS. We were using it for a short time, and our mainframe crashed or something. So we lost all of our data that we had been implementing. (Medical Director, Clinic B)

Slow and inferior systems compromising staff "buy-in"

Quote 2: Well, the No. 1 [challenge] is [that] a better Practice Management System would help us—is the No. 1 thing. Ours is not one of the more modern ones, and it's kind of old and clunky—this is a bad environment to be an old and clunky. (CEO, Clinic C)

Quote 3: The computer technology that we use to register our patients here … it's very archaic. It's very labor intensive, and it's not user friendly … The amount of time the patient sits at the window while a clerk is trying to register them—it's just preposterous. (Nursing Director, Clinic A)

Problem of fragmented programs

Quote 4: It's all technology, but each person has to go into ten screens with ten user codes and ten passwords … Nothing is interfaced. (Medical Director, Clinic A)

A fragmented system led to uncoordinated care. Some participants wanted a system that enabled communication across care settings to reduce duplication of patient services and increase patient safety. While interfacing systems with hospitals and laboratories was possible, sometimes this process was slow. Additionally, some clinics experienced a sense of "in betweenness," whereby they had access to some HIT programs but did not have the benefit of full access.

Clinic personnel

Participants pointed to the important role of all clinic personnel in the successful implementation of HIT (see Table 5). Some staff members were reportedly reluctant to use computers, perhaps due to lack of familiarity and comfort with the tool. Some perceived that HIT increased workload and preferred handwriting rather than inputting. The challenge of an older generation using computers was also noted, with one participant postulating that some older providers associated data input and computer use with clerical work.

Gaining acceptance from staff can be an obstacle to implement HIT, and the need for "buy-in" is crucial for successful implementation. For example, one participant admitted her own

initial reluctance to use a diabetes registry and how it was not until she was able to identify the benefits of using the registry, and thus prove its usefulness, that she was convinced of its usefulness (Box 4, Quote 1). This type of "buy-in" is critical at all levels (administrators, providers, and other clinic personnel) and was identified by a number of participants as a key factor to facilitate the smooth implementation of HIT. One participant also noted the need for a "cheerleader"—someone who would lead the process and encourage other personnel in its use. Other ways to encourage "buy-in" included demonstrating that a new HIT program was efficient and enabling staff to see the benefits to either the health of patients or their workload (Box 4, Quote 2). That some providers preferred handwriting orders to be input by nurses and medical assistants suggested that HIT was perceived to challenge the existing traditional hierarchies (Box 4, Quote 3).

Box 4

clinic personnel

Buy-in" from staff is crucial for successful implementation

Quote 1: … I thought I could track all that stuff in my head a little bit, but I wasn't doing very well … I was sure I was taking good care of my diabetic patients, and I didn't really need this thing superimposed on it, and it was just something new. And then when the data started coming back it was really, really impressive, really impressive. (Chief Medical Officer, Clinic D)

Importance of demonstrating the benefits of HIT to staff

Quote 2: [The other clinic] doctors seeing the two physicians that were doing this as the test … saw them practicing [and] started coming up to them saying "I want in. I wanna do this with my patients." … and [these other doctors] saw that those [test] physicians were seeing results with their patients that were diabetics that they weren't seeing, and that we were providing additional support to our nursing staff and through classes and other things, and then we just kept adding one doctor at a time [every month]. (CEO, Clinic D)

Perception that HIT challenges existing traditional hierarchies

Quote 3: So no [doctor] has said, "This takes too much time." … [They say] "I'm not doing that, now. I rather just write it." Change is hard. The old ways, writing your orders, and this is what the nurse is supposed to [do]. The nurses I think are more accepting of the new technology than some of the providers. (Nursing Director, Clinic C)

Need for approachable IT personnel

Quote 4: You have to make technology cool. Hey, I use it, and I'm cool, so you want to use it or not. Right? That's how I look at it is, just try to make it fun. Don't make it so intimidating … you've gotta be a people person, and people will buy in to it … A lot of times, the IT guys are known to be arrogant; they're known to be introverts, and out of touch–can't relate to them, more intimidating. I'm too good for you, don't talk to me. When you look at my staff, everybody's so humble … (Information Systems Director, Clinic C)

Resistance from organizational leaders may inhibit implementation of new HIT

Quote 5: I find that with a lot of leaders, unless they're really into Information Technology, they have a block … one CEO I had that said if it's not broke why fix it. He had not a clue and didn't want to and admittedly stated that. (Information Systems Director, Clinic A)

Quote 6: They say it's important to have an IT person at senior management level … So now, we have a core group of six or seven senior managers that meet every week. And I'm there … So I can … advocate for doing things the right way … Traditionally, most of the IT guys are just lackeys of—usually under finance. (Chief Information Officer, Clinic D)

Reliable IT staff are essential when implementing new HITs

Quote 7: If we're going to start to rely on information technology, our information technology has to be reliable. For that to happen, we need to have somebody who is able to quickly get it back up and running. I'm nervous about using more IT if we don't have that support of a person who knows what they're doing to fix it when it's broken. (Medical Director, Clinic B)

Importance of consistent IT support and computer literacy of staff

Quote 8: We started to implement [an EMR] … I think it failed for several reasons. I think probably one, because the physician's assistant who was there really was not enthusiastic about it, or computer literate enough to do it. And also we didn't have, we don't really have an IT person. So whenever there was a problem, it was a big problem because we didn't have a person that was able to address the problem. (Medical Director, Clinic B)

Importance of ongoing IT support and training

Quote 9: I would love to have a Practice Management trainer to hold workshops [every Friday] and do mandatory training for staff every time a new feature was coming out. We can have a classroom with computers that people can come in, and then we can do training on the screen. (Information Systems Director, Clinic C)

The demeanor of IT personnel and their presence in upper management was identified as an important factor. One Information System Director noted that supportive and approachable IT personnel would encourage the use of IT in a nonintimidating and helpful manner (Box 4, Quote 4). While resistance from staff could be problematic, so too was resistance at the leadership level. If an organizational leader lacks understanding about IT capability or is resistant to change, then this could inhibit implementation of new HIT while having an IT Director at senior management level allows greater scope and opportunity for obtaining the necessary funds for implementation and use of HIT (Box 4, Quotes 5 and 6).

While there was a need for more staff in general, there was a specific need for IT staff when new HITs were implemented. Having a shortage of IT staff was a barrier to the use of HIT because these systems require skilled labor to maintain (Box 4, Quote 7). Lack of consistent IT support coupled with discomfort with computer use—whether caused by low computer

literacy or negative attitudes about the use of such tools—led to failures in implementation (Box 4, Quote 8). Finally, training was an important aspect to the successful implementation and ongoing use of HIT programs. Not only was training itself important, but also the ability to have *ongoing* IT support and training (Box 4, Quote 9).

Discussion

The introduction of new HITs into urban safety-net health clinics is not necessarily a seamless process or unilaterally beneficial. Instead, the integration of a single HIT requires a painful reshuffling of scarce clinic resources and success is affected by a variety of context-specific factors. Given this limitation of resources, we argue for a conservative and pragmatic approach that does not automatically assume that new technology produces benefits. In fact, we argue that HIT adoption without consideration of whether “stable ground” (i.e. the infrastructural capacity) has been established within the clinic can actually create problems. This can similarly be extrapolated to whether or not clinic staff, at all levels from the lowest to leadership, “buy-in” to the need for a particular technology. Therefore, the approach we recommend balances the intelligent adoption of HIT with the careful investment of clinic resources, both monetary and nonmonetary, necessary for the tool’s successful utilization given a clinic’s unique context. It is important to note that these benefits and resources, however, are not always amenable to systematic calculation, but are complex technological, social, and environmental issues unique to each organization.

In the safety-net setting, supported primarily by public funds and social programs for the uninsured and underinsured vulnerable patient populations, the lack of monetary resources is the most significant barrier to the effective implementation of new, beneficial HITs. A primary resource that clinics have to address this limitation is their social network and knowledge capital, as both are constituted within and across similarly situated clinics. In order to maximize their potential, however, these nonmonetary resources must be cultivated. Concrete ways to do this, as suggested by participants in this study, include the development of donor networks both for in-kind and monetary donations, the formation of user groups across clinics to share experiences and troubleshoot common problems, establishing electronic billing guidelines to increase clinic revenues, and the use of frontline adopters to act as exemplars. These social factors can be used to facilitate staff buy-in and motivate active engagement with the newly implemented technologies. These social resources can be used by the clinic to potentially offset the limited financial and staff resources.

The results indicate that it would be less useful to develop recommendations as to which HIT systems should be universally implemented, given the variations among urban safety-net clinics. However, as listed in Table 6, they do recommend a set of considerations that such organizations should address in making the decision to adopt HIT. Based upon our findings, we believe that clinics that are able to evaluate and address these considerations will be better positioned to identify, successfully adopt, and maximally utilize specific HIT tools. Urban safety-net clinics must use their resources wisely to eke out the most benefit for the least cost. For key clinic stakeholders, the future possibility of benefits related to current HIT adoption must be balanced against the high costs and risk of failure. Simply put,

resources invested in HITs that do not “fit” into the clinic or that “fail” represent immediate lost opportunities to deliver direct care to patient populations in desperate need.

After our interviews were completed, the Health Information Technology for Economic and Clinical Health Act (HITECH), US federal legislation that gave incentives to health-care providers to achieve specified improvements in care delivery, was passed in 2009. For example, HITECH offers funding for provider organizations transitioning into new HIT systems to offset the costs. Many urban safety-net clinics in the municipality where this study took place received HITECH funding that will aid in the successful adoption of HIT. Specifically, many clinics received physical infrastructure grants, which allow for updating wiring systems and the creation of new storage spaces like computer closets. However, such efforts have been piecemeal and indirectly address clinics’ HIT needs. Comprehensive HIT implementation continues to be a challenging goal for these clinics to meet, based on informal conversations with clinic staff.

Another aspect of the HITECH act that has the potential to most directly affect the implementation of HIT among urban safety-net clinics is the establishment of Regional Extension Centers (RECs) to assist providers in adopting qualified electronic health records (EHRs) and making meaningful use of such additions. RECs could function to effectively address implementation of HIT in urban safety-net settings by paying attention to the factors identified in this article. Our recommendations in this article are echoed in the blogosphere in suggested REC improvements by commentators including having RECs provide small practices with “top-drawer IT consultants to guide them in EMR adoption,” “rich web resources,” and “HIT education courses.”[16] In further informal conversations with our interviewees at the clinics, they noted that our findings from this study, such as the checklist of considerations for HIT adoption in safety-net settings, continue to be critically important, notwithstanding the existence of RECs.

Finally, our findings have implications for the burgeoning field of implementation science and theory. When assessing the implementation of innovations, researchers in this area emphasize similar key factors ranging from individual actors to the inside and outside environments of the organization as important foci of study.[17–20] For example, in their consolidated framework for advancing implementation, Damschroder et al.[18] identify five major domains that are critical to implementation of innovations based on their review of published implementation science theories in health services research. These domains include individual health-care professionals; inside the health-care organizations—culture, structure, and resources; outside the health-care organizations—the broader political and economic environment; characteristics of the innovation; and the process of implementation. Whether looking at the individual level, the organizational level, or the environmental level, our findings are consistent with such implementation science research. For example, the factors we have identified in our checklist of considerations for HIT adoption can be categorized into similar domains and are critical to the successful implementation of HIT in urban safety-net health-care settings.

Conclusion

This study has provided important insight into the current use and continuing need for HIT in urban safety-net clinics as perceived by key stakeholders. While it is limited in its scope and localized nature, the research is nevertheless valuable in illuminating key barriers and potential facilitators for the adoption of HITs in similar settings. Furthermore, their experiences and perspectives help identify and describe relevant issues to consider in the integration of HIT such as infrastructure, clinic resources, HIT systems, and clinic personnel that can act as both barriers and facilitators to HIT implementation and use in these facilities.

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Table 1

Clinic characteristics.

Clinic	Clinic A	Clinic B	Clinic C	Clinic D
Type (FQHC/other)	County clinic	FQHC look alike	FQHC	FQHC/free clinic/university affiliated
Year founded	1976	1977	1972	1970
Number of locations	1	2	1	7
Annual operating budget	US$51,669,000		US$27,412,399	US$18,165,120
Number of patient encounters	113,328	18,321	98,588	118,946
Percent uninsured or underinsured patients	94%	84%	94%	83%
Percent of patients Latino	53%	92%	40%	63%
Percent of patients African-American	45%	5%	55%	10%
Number of providers (FTE)	33.5	3.5	17.1	20.3
Number of IT staff (FTE)	2	1	4.2	6

FQHC: Federally Qualified Health Centers; FTE: Full Time Equivalent; IT: information technology.

Table 2

Infrastructure factors.

Infrastructure factors	Examples	Result (barrier/facilitator)
Architectural deficiency	1. Physical infrastructure inadequate to accommodate technology (e.g. network closets and small exam rooms not designed for computers)	Barrier: unable to install and upkeep equipment such as EHRs
Equipment constraints	1. Old network equipment (e.g. hubs versus switches)	Barrier: network and system crash resulting in lost time and data
	2. Old wiring and inadequate cabling (e.g. telephone wiring and lack of data jacks)	
Delay in repair and updating infrastructure	1. Delay with respect to physical infrastructure (e.g. slow to remodel and staff not understanding need for prompt response to infrastructural issues)	Barrier: HIT systems unusable or so slow as to be virtually ineffective
	2. Delay with respect to technological infrastructure (e.g. CAT 3 versus CAT 5/fiber optic standard)	
Establishing stable ground	1. Updated wiring and cabling	Facilitator: Systems can be inserted into clinic setting with few technical problems
	2. Creation of space for technology within the physical building	

EHR: electronic health record; HIT: health information technology.

Table 3

Clinic resource factors.

Clinic resource factors		Examples	Result (barrier/facilitator)
Financial	Lack of funds	1. Lack of funds for purchase of appropriate equipment	Barrier: Clinics make do with inferior HIT systems
		2. Lack of funds prevents hiring of additional staff needed to run sophisticated HIT systems	Barrier: inefficient usage of new system adopted
	Fundraising and donations	1. Clinic CEOs seek out donations of funds	Facilitator: allows clinics to offset some costs
		2. Clinic IT directors seek out donations of technology	
Human resources	Lack of time for HIT training	1. Time taken from clinic activities when setting up and training staff on new HIT systems	Barrier: disruption to patient care when staff in training
		2. Slower processing of billing when establishing new HIT system	Barrier: disruption to clinic revenue with new HIT
	Timely access to HIT	1. Lack of funds for public sector clinics	Barrier: bureaucratic impediments to the adoption of new technology
		2. Time required to obtain approval for acquisition of new technology	
	Billing complexity	1. Numerous and changing social programs and eligibility criteria confusing for clinic staff	Barrier: Inaccurate billing reduces cash flow and suggests fraud
		2. Development of HIT to increase billing accuracy and cash flow	Facilitator: More resources available to clinic and successful HIT facilitates staff buy-in
	Collaborations within and across clinics	1. Group negotiation of vendor contracts	Facilitators: clinics negotiate reduced rates
		2. Clinic user groups for sharing of best practices and staff training	Facilitator: clinics share resources and troubleshoot common problems
		3. Development of a website describing billing guidelines for social programs funding safety-net health-care services	
	Consultants	Use of consultants to target appropriate HIT systems	Facilitator: intelligent adoption of HIT system for clinic that can afford consultants

IT: information technology; HIT: health information technology; CEO: Chief Executive Officer.

Table 4

HIT system-related factors.

HIT system-related factors	Examples	Result (barrier/facilitator)
Glitches in new technology	1. System bugs and crashes	Barrier: staff time to fix HIT system glitches
	2. Staff uncomfortable dealing with problematic technology	Barrier: staff "buy-in" reduced
System speed	1. Applications run very slowly	Barrier: compromises clinic efficiency and reduces staff "buy-in"
	2. Patient information difficult for staff to access	
Nonuser friendly systems	1. Lengthy patient registration time	Barrier: labor intensive systems reduce staff buy-in
	2. Claims checking difficult	
Unintegrated patchwork of HIT	1. Lack of interfacing among HIT	Barrier: increased difficulty coordinating patient care
	2. Tracking patient prescriptions difficult	

HIT: health information technology.

Table 5

Clinic personnel-related factors.

Personnel-related factors	Examples	Result (barrier/facilitator)
Resistance from staff	1. Resistance to or discomfort with electronic tools and computers	Barriers: staff buy-in reduced
	2. Inadequate training opportunities for staff	
Resistance from leadership	1. Organizational leaders not knowledgeable about HIT capabilities	Barrier: leadership does not understand the need for HIT and IT supports
	2. No IT personnel in leadership position	
Social hierarchies within organization	1. Senior staff members or care providers who refuse to use computers	Barrier: resistance to change and problematic transition to new technology
	2. Older providers associate HIT-related typing with clerical work	
Insufficient and “nonuser friendly” IT personnel	1. Insufficient staff devoted to IT support	Barrier: IT support inaccessible
	2. Perception of IT personnel as inaccessible	Facilitator: train IT personnel to reach out to other clinic staff
Highlighting effectiveness of technology	1. Highlight the value of HIT systems at clinic level (e.g. better patient outcomes for doctors using electronic disease registry)	Facilitator: creates buy-in organically among staff
	2. Have technology-savvy staff lead the way as first adopters and encourage others	

IT: information technology; HIT: health information technology.

Table 6

Checklist of considerations for HIT adoption in urban safety-net clinic settings.

a.	Availability of funds/resources, earmarked for purchase and implementation of HIT
b.	Necessary prerequisite modifications of basic physical/technological clinic infrastructure
c.	Organizational prioritization of resources for ongoing HIT training
d.	Collaborations across similarly situated clinics to develop and pool resources
e.	User-friendliness and integrability of new HIT into existing systems
f.	Organizational restructuring to facilitate HIT (e.g. IT personnel in leadership positions)
g.	Accessible and qualified IT support staff
h.	Identification of frontline adopters within varying levels of clinic staff (cheerleaders)

IT: information technology; HIT: health information technology.