Quadruple Aim Meets Digital Health: Opportunities and Challenges

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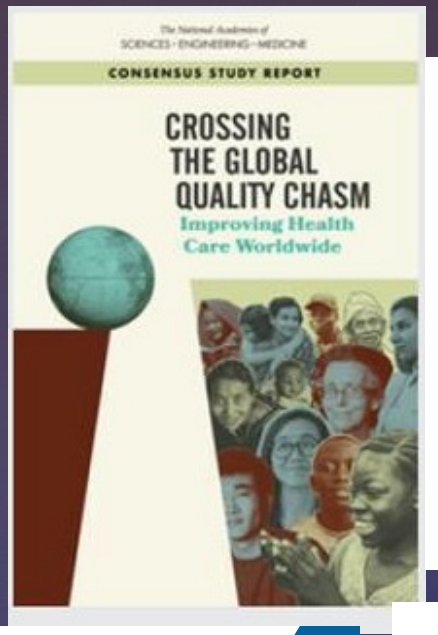
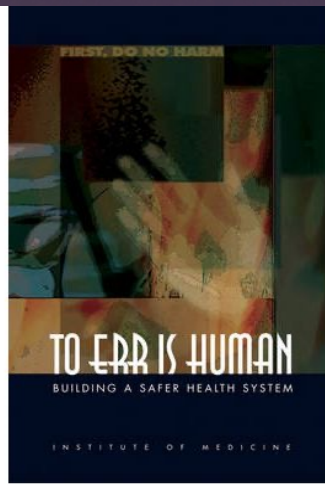
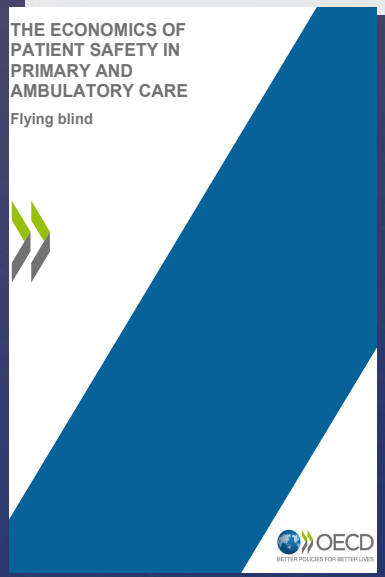
ConVerge 2 2022
FIU, Miami, Florida
October 11, 2022

Patient Safety Status-20 years on

- 1 in 10 patients harmed in hospital care/ between 5.7 and 8.4 m deaths occurring annually from poor quality care
- 14 out of every 100 patients affected by HAI
- 2% patients subject to surgical complications for the 234 million surgical operations performed every year
- 20-40% health spending wasted due to poor quality of care and safety failures
- 15% of hospital costs being due to patient harms caused by adverse events







Sources: WHO global report on evidence on patient safety 2008, WHO 10 facts for patient safety accessed 2015

Supporting the Quadruple Aim

Article

AMERICAN COLLEGE OF Medical Quality

Supporting the Quadruple Aim Using Simulation and Human Factors During COVID-19 Care

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Abstract

The health care sector has made radical changes to hospital operations and care delivery in response to the coronavirus disease (COVID-19) pandemic. This article examines pragmatic applications of simulation and human factors to support the Quadruple Aim of health system performance during the COVID-19 era. First, patient safety is enhanced through development and testing of new technologies, equipment, and protocols using laboratory-based and in situ simulation. Second, population health is strengthened through virtual platforms that deliver telehealth and remote simulation that ensure readiness for personnel to deploy to new clinical units. Third, prevention of lost revenue occurs through usability testing of equipment and computer-based simulations to predict system performance and resilience. Finally, simulation supports health worker wellness and satisfaction by identifying optimal work conditions that maximize productivity while protecting staff through preparedness training. Leveraging simulation and human factors will support a resilient and sustainable response to the pandemic in a transformed health care landscape.

Keywords

health care simulation, patient safety, Quadruple Aim, COVID-19, system preparedness

Introduction

Coronavirus disease 2019 (COVID-19) has uniquely stressed health care systems, policy makers, and health care workers throughout the world as they face the worst health and economic crises of our lifetimes. Administrators are rapidly navigating their institutions through uncertain times, providing leadership and strategic plans to manage numerous evolving systems threats. Many of these plans run counter to the accepted mantra in modern times, including intentional cancelations of profitable elective procedures and layoffs or furloughs of dedicated medical staff during the pandemic.[1]

The Triple Aim of health system reform addresses ongoing and future challenges faced by the health care sector;[2] with recent calls for expansion to a Quadruple Aim[3] to include considerations and protection for staff. These 4 interdependent goals consist of (1) enhancing patient experience and safety, (2) improving population health, (3) reducing costs and preventing loss of revenue, and (4) improving wellness and satisfaction of health care workers. The fourth Aim incorporates the increasing understanding that excellent health care is not possible without a physically and psychologically safe and healthy workforce. COVID-19 has created unique threats and unanswered challenges to each element of the Quadruple Aim (Table 1).

Human factors[4] is a scientific discipline that addresses the complex interwoven variables that affect health care workers' ability to deliver safe,

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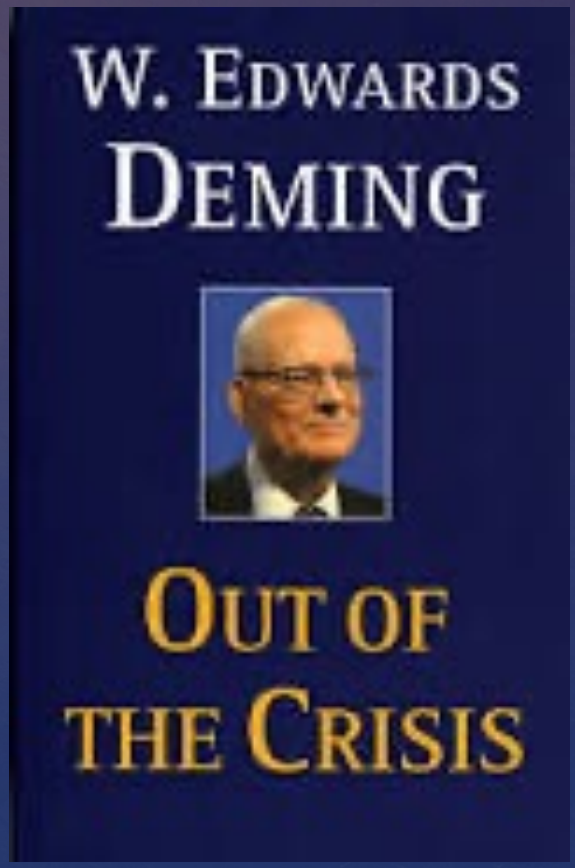
Digital Health for Profound Knowledge and Learning (Backbone of ALL industrial quality)

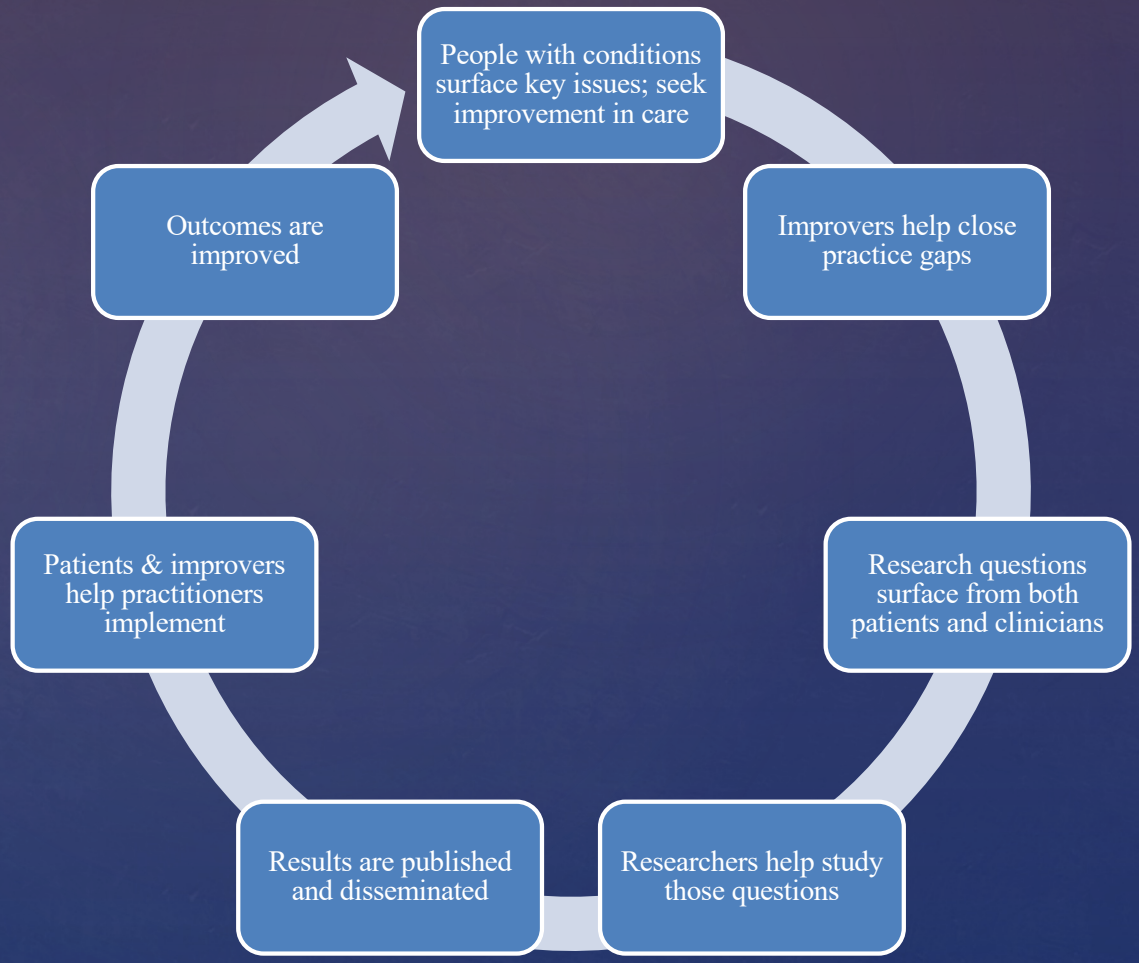
- Patient/client at the center
- Appreciation of a System
- Understanding Variation as the main cause for process and outcome failures with digital health
- Theory of Change Knowledge
- Leadership Psychology



Learning Health System Model
Roles of Tele-Health

Critical Elements:

- Focus on outcomes
- Theory of transformation
- Co-design and co-production
- Leadership engagement
- Multiple problem-solving approaches
- Research to drive action
- Emphasis on implementation



Hype or High Impact?

Hype, evidence gaps and digital divides: Telehealth blind spots in rural Australia

Health
1–19
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Abstract

Despite high unmet demand for health services across rural Australia, uptake of telehealth has been slow, piecemeal and ad hoc. We argue that widespread failure to understand telehealth as a socio-technical practice is key to understanding this slow progress. To develop this argument, we explore how technocentric approaches to telehealth have contributed to critical blind spots. First, the 'hype' associated with the technological possibilities of telehealth discourages thoughtful consideration of the unanticipated consequences when technologies are rolled out into complex social fields. Second, it contributes to critical gaps in the telehealth evidence base, and particularly a paucity of analyses focussing on the experiences of service users and patients. A third blind spot concerns the limited attention paid to the social determinants of health and digital divides in rural areas. The final blind spot we consider is an apparent reluctance to engage community stakeholders in co-designing and coproducing telehealth services. We used an iterative approach to identify studies and commentary from a range of academic fields to explain the significance of the telehealth blind spots and how they might be addressed. Insights suggest how expanding understanding of the social dimensions of telehealth could enhance its accessibility, effectiveness and responsiveness to community needs and contexts.

The Pitfalls of Telehealth — and How to Avoid Them

by Lisa S. Rotenstein and Lawrence S. Friedman

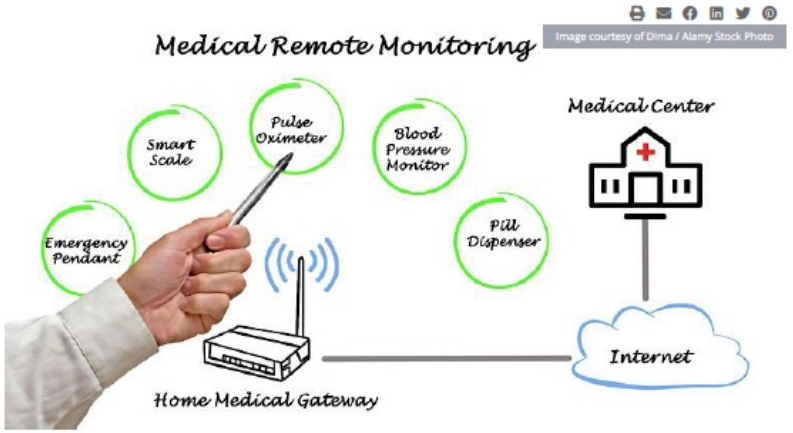
November 20, 2020

ER Productions Limited/Getty Images

Summary. Telehealth is a boon but as use has ramped up with the Covid-19 pandemic its downsides are becoming clearer. Unless providers are careful, it can exacerbate disparities in access and increase clinicians' workloads. Taking a lesson from the adoption of electronic health records, the authors recommend four ways to prevent telehealth's unintended consequences from undermining its benefits. **close**

The telehealth revolution has transformed how doctors and patients interact. At the height of the Covid-19 pandemic, between 50% and 80% of medical visits were conducted via telemedicine, up from just 1% before it. There are many benefits to this trend — increased convenience, the potential to reduce clinical overhead costs, and a new insight into patients' lives. During a telehealth visit with one colleagues, for example, a patient with diabetes picked up a can of sugary cola. In that moment, our colleague saw the barriers to this patient's diabetes control in a way she would never have during an office visit.

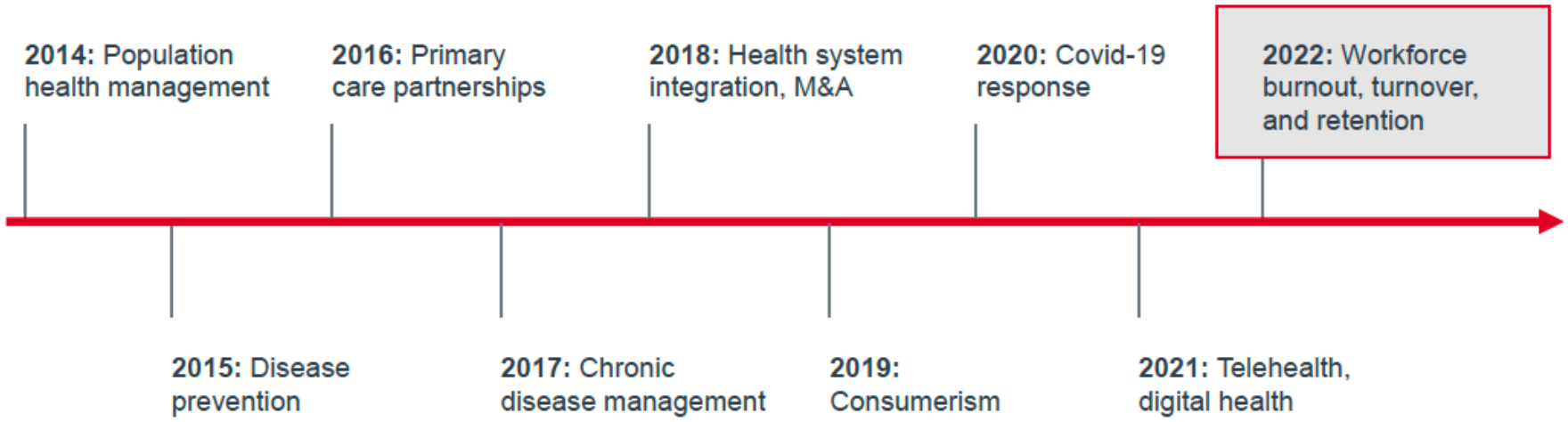
Is the Promise of Remote Patient Monitoring All Hype?



A report recently published in JAMA using Masimo's remote patient monitoring technology says otherwise.

Workforce the #1 executive priority for first time

Top CEO priority in Advisory Board's global health care surveys



Advisory Board interviews and analysis.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Question #1: What do we know about telehealth/telemedicine users?

- **Key Human Factors Principles:** Know the needs, capabilities, and environment of your users
- **Methods:** Focus groups, surveys, interviews, and personas, contextual inquiry

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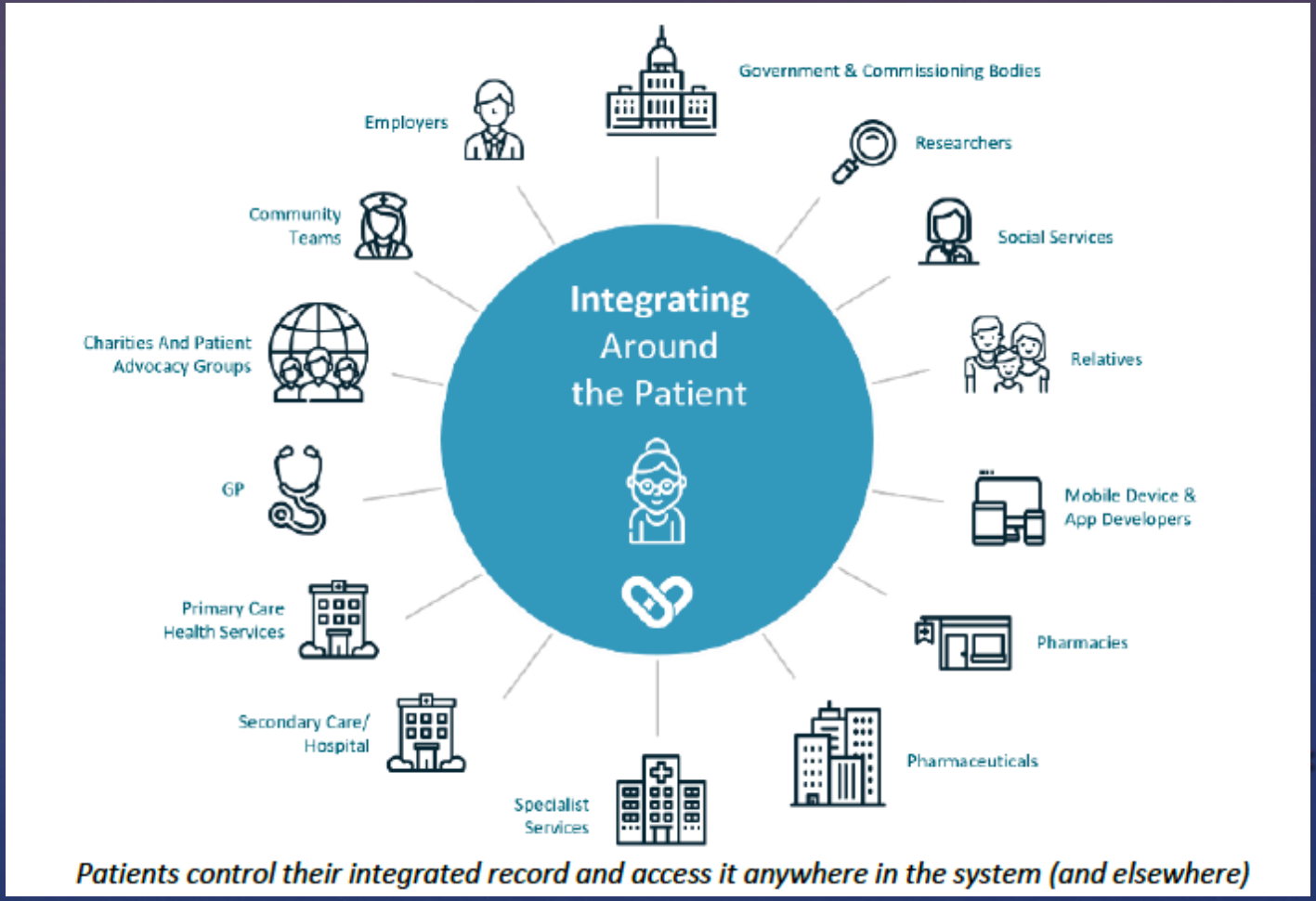
Patient Centered Design



* Patients Know Best

Co-Production of Improved Outcomes

- In co-production, professional and patient activities, as well as available resources must be coordinated and controlled in an integrated manner.
- Such a change requires rethinking the organizational architecture of healthcare systems.
- It requires organizational architectures that can enable fluid organizing across various temporarily connected "actors" -- entities capable of acting intentionally, such as individuals, groups, or organizations.
- The operation of efficient network infrastructures, i.e., creating value by facilitating informational, logistical, and financial network relationships, is essential to actor-oriented organizing.

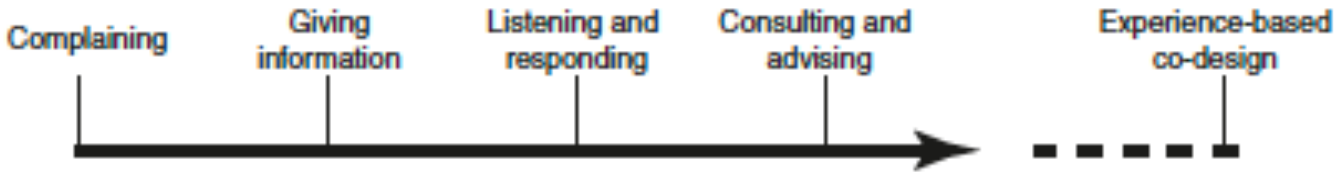
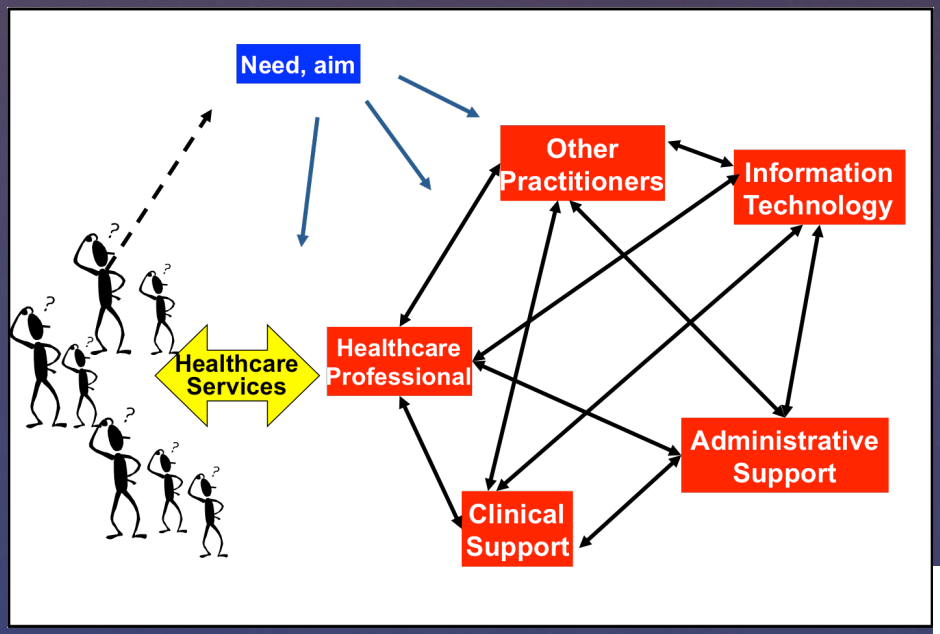


Fig. 39.3 The continuum of co-design roles of the patient. (Reprinted with permission from Bate and Robert [23])

Digital Health to support design and Implementation of Quadruple Aim Model

Clinical Microsystem Model



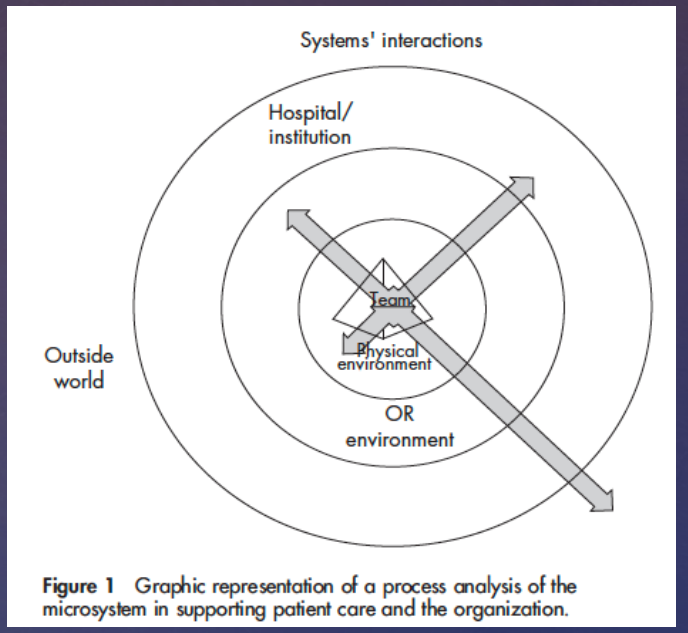


Figure 1 Graphic representation of a process analysis of the microsystem in supporting patient care and the organization.

SAFETY BY DESIGN

Understanding the complexity of redesigning care around the clinical microsystem

P Barach, J K Johnson

The microsystem is an organizing design construct in which social systems cut across traditional discipline boundaries. Because of its interdisciplinary focus, the clinical microsystem provides a conceptual and practical framework for simplifying complex organizations that deliver care. It also provides an important opportunity for organizational learning. Process mapping and microworld simulation may be especially useful for redesigning care around the microsystem concept. Process mapping, in which the core processes of the microsystem are delineated and assessed from the perspective of how the individual interacts with the system, is an important element of the continuous learning cycle of the microsystem and the healthcare organization. Microworld simulations are interactive computer based models that can be used as an experimental platform to test basic questions about decision making misperceptions, cause-effect inferences, and learning within the clinical microsystem. Together these tools offer the user and organization the ability to understand the complexity of healthcare systems and to facilitate the redesign of optimal outcomes.

Table 2 The five essential goals (''5Ps'') of the microsystem

5 Ps	What are implications for effective microsystem functioning?
Purpose	What is the purpose of the clinical microsystem and how does that purpose fit within the overall vision?
Patients	Who are the people served by the microsystem?
Professionals	Who are the staff who work together in the microsystem?
Processes	What are the caregiving and support processes the microsystem uses to provide care and services?
Patterns	What are the patterns that characterize microsystem functioning?

Digital Health Models to Support Design of the Quadruple Aim

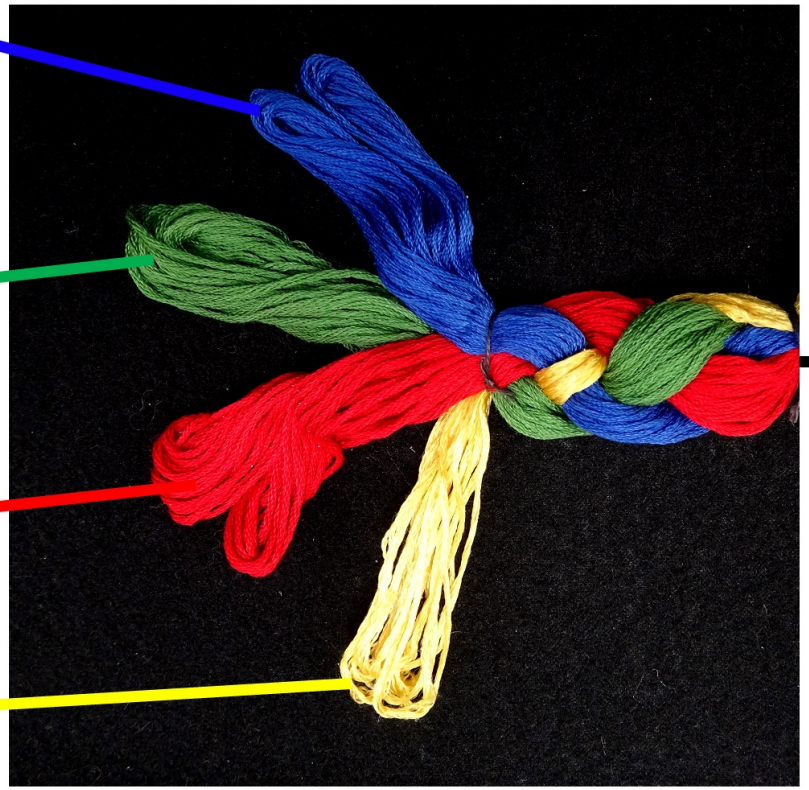
Coproduction Model

TIFKAP: aim, lived reality, social support, resources

As is system: journey, emotions, working/not-working

Science-informed practice: internal/external validity

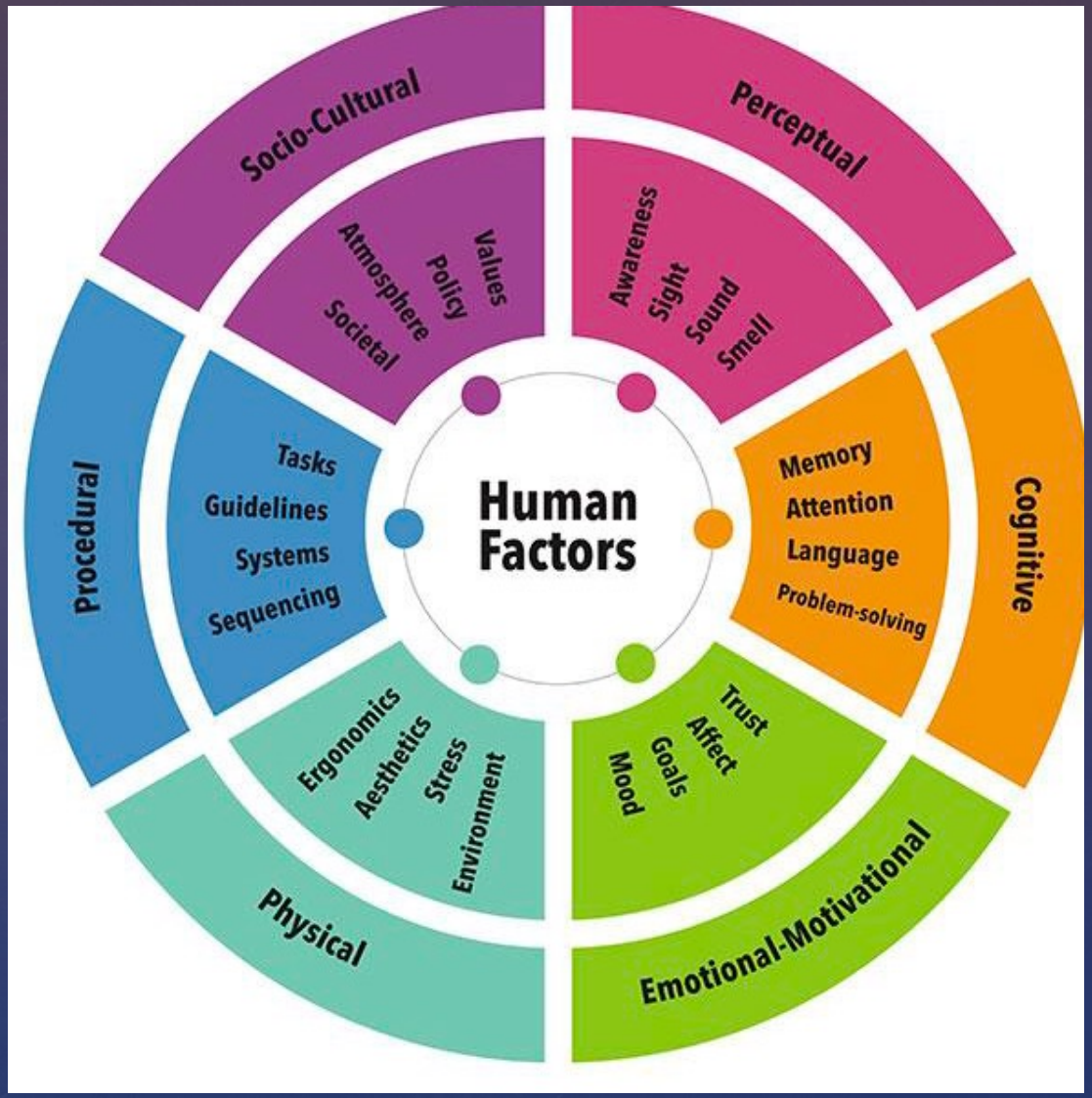
TIFKAPro: lived reality, support, resources



Coproduced healthcare service

P Batalden
3/25/19

Human Factors (Human Centered interface (HCI)) Considerations

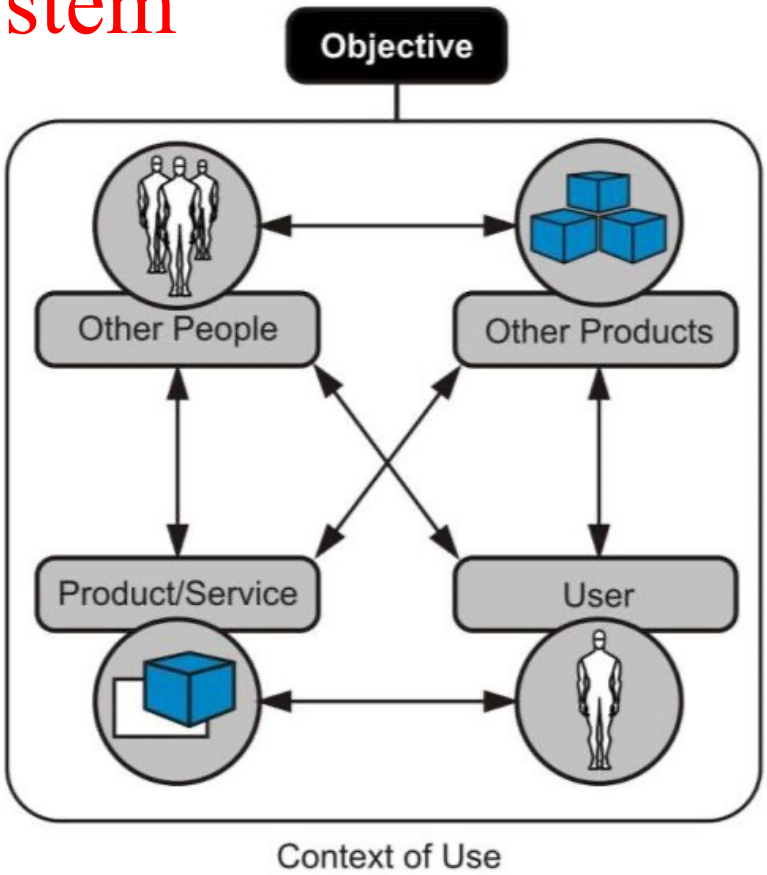


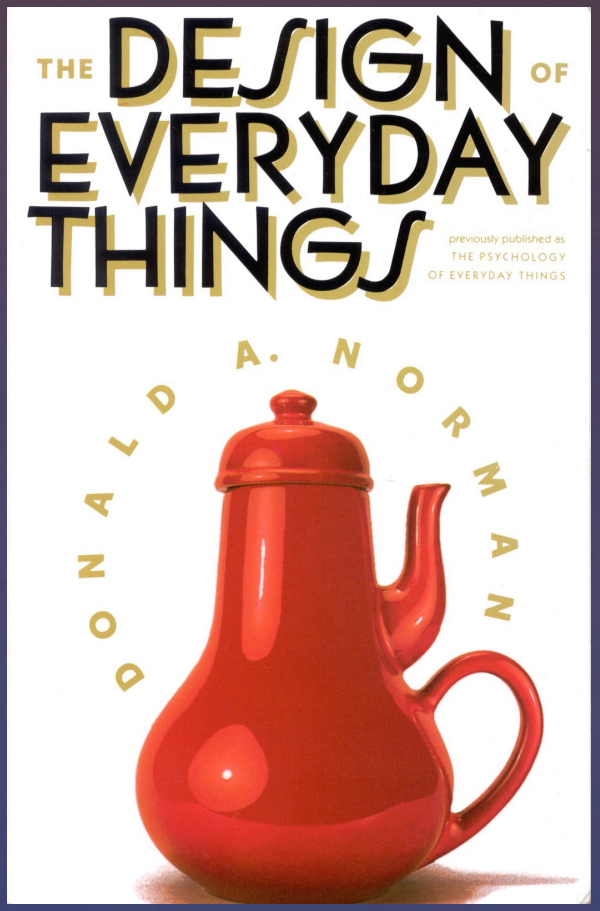
Discovery in Healthcare Ecosystem

Introduction

Apply qualitative methods for defining problems, characterizing user and patient needs, mapping workflows, storyboarding User Experience (UX) journeys and discovering actionable insights.

Evaluative methodologies include:





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Impact of Patient AND Staff-centered Designed Mobile Health App

Original Paper

Assessing the Impact of Patient-Facing Mobile Health Technology on Patient Outcomes: Retrospective Observational Cohort Study

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Abstract

Background: Despite the growth of and media hype about mobile health (mHealth), there is a paucity of literature supporting the effectiveness of widespread implementation of mHealth technologies.

Objective: This study aimed to assess whether an innovative mHealth technology system with several overlapping purposes can impact (1) clinical outcomes (ie, readmission rates, revisit rates, and length of stay) and (2) patient-centered care outcomes (ie, patient engagement, patient experience, and patient satisfaction).

Methods: We compared all patients (2059 patients) of participating orthopedic surgeons using mHealth technology with all patients of nonparticipating orthopedic surgeons (2554 patients). The analyses included Wilcoxon rank-sum tests, Kruskal-Wallis tests for continuous variables, and chi-square tests for categorical variables. Logistic regression models were performed on categorical outcomes and a gamma-distributed model for continuous variables. All models were adjusted for patient demographics and comorbidities.

Results: The inpatient readmission rates for the nonparticipating group when compared with the participating group were higher and demonstrated higher odds ratios (ORs) for 30-day inpatient readmissions (nonparticipating group 106/2636, 4.02% and

Design and Integration of Mobile Health Technology in the Treatment of Orthopaedic Surgery: A Qualitative Study

Courtenay R. Bruce[1] Patricia Harrison[1] Thomas M. Vinh[2] Agnita G. Manoharan[2] Charlie Giammattei[3] Caitlin Bliven[3] Jamie Shallcross[3] Aroub Khleif[2] Nhan Tran[2] Josh Sol[4] Kayla Gutierrez[5] Bita A. Kash[6] R. Benjamin Saldana[7] Kwan J. Park[8] Feibi Zheng[8] Shetal-Nicholas Shetal Desai[4,8] Stephen L. Jones[5,8] Barach P.[9,10] Roberta Schwartz[6]

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ACI Open 2022;6:e11–e20.

Abstract

Background The use of mobile health (mHealth) technologies has dramatically increased in the past year. A critical component in the discussion about telehealth and mHealth technologies is the importance of integrating the voices of patients, caregivers, and their clinicians.

Methods This study was performed in a tertiary center in Houston consisting of 7 hospitals (1 academic and 6 community hospitals). The clinically integrated mHealth technology consisted of a mHealth education and monitoring platform that used patient-centered emails and text messages over a 50-day period from prior to orthopaedic total joint replacement surgery to posthospital discharge to provide education and health monitoring at home. Study participants included patients who were scheduled for total joint replacement surgery between July 2018 and November 2019, and their caregivers. The study involved two components: (1) focus group study ($n = 15$); split into two groups of participants who had not used the mHealth technology (α-testing during the design phase, prior to implementation); and (2) a content analysis of 377 free-text comments from patients who used the mHealth

Keywords
- mHealth technology
- mHealth interventions
- patient-facing technologies
- patient-centered care
- patient experience
- patient engagement
- patient activation
- effectiveness
- quality improvement
- patient safety

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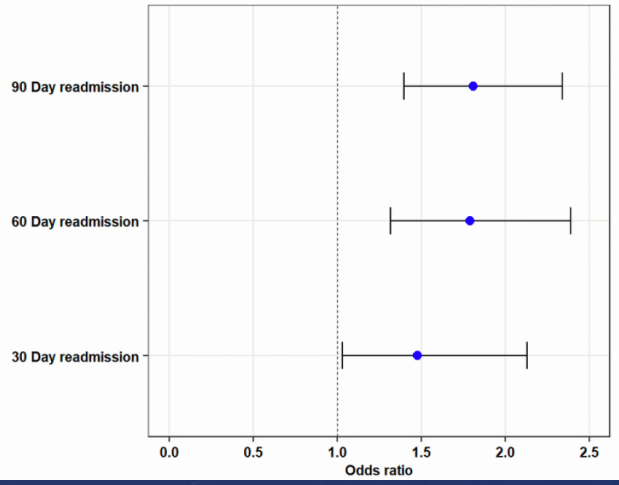
Bruce C, et al. ACI Open Vol. 6 No. 1/2022.

Figure 1. Odds ratio for participating versus nonparticipating patients. The bars represent 95% CIs and the dots represent the odds ratio.



- Bruce C, et al. Assessing the Impact of Patient-Facing Digital Technology on Patient Outcomes: A Retrospective Observational Cohort Study", *Journal of Medical Internet Research*, 2020. 8(6): doi: 10.2196/19333

The Patient Telehealth Checklist

This checklist will help you to have a better meeting with your healthcare provider. Following it will help you clearly hear and more easily benefit from the call. Your computer or phone set-up, the room where your call will take place, and how to get assistance are all important. Tell your healthcare provider immediately if you cannot clearly hear or understand what is being said. You may ask a relative, trusted friend, or someone in healthcare for help with the call.

Action	Application
Ask for written instructions for making the call.	☐ Know how to connect to the call. ☐ Learn how to fix problems.
Ask for a practice call.	☐ Make sure the call will work ahead of your scheduled appointment.
Choose a quiet place.	☐ Use a room where others are not talking and noise is minimal. ☐ Choose a room with soft materials such as carpet, fabric furniture, and curtains. ☐ Use a place out of the wind if outside.
Reduce background noise.	☐ Turn off noisy items such as televisions and fans. ☐ Mute your microphone when not speaking. ☐ Turn off or mute your cell phone if talking on a computer. ☐ Use the settings on your computer or phone to reduce background noise, if possible.
Ensure a good appearance on screen.	☐ Light your face with a lamp or window in front of you. ☐ Close curtains/blinds and turn off lamps behind you. ☐ Check that the camera is on. ☐ Position the camera at eye level. Look straight at it when speaking. ☐ Ask the healthcare provider if they can see you well.
Ensure good call audio.	☐ Speak within 3 feet of the microphone. People in a group should take turns being close to the microphone. ☐ Use a headset, earbuds, or handset if you are the only person on the call and own them.
Consider speech privacy.	☐ Close the door. ☐ Consider whether others not on the call can hear and understand you.
Ensure ability to hear and understand.	☐ Tell your healthcare provider if you cannot hear or understand them. ☐ Ask someone to help with the call, if necessary.
Consider using hearing assistance.	☐ Consider the following tools for hearing assistance: • hearing aid pairing with computer or telephone • phone assist pairing with computer or telephone • Bluetooth • Telecommunications Relay Service (TRS)
Get a record of the call.	☐ Consider using software (apps) for recording the call: • voice-to-text app • captioning • translators • make an audio recording of the call ☐ Ask your healthcare provider for a call transcript or summary notes.
Provide feedback.	☐ Tell the healthcare provider how well the call went for you. ☐ Tell the healthcare provider about ideas for improvement. ☐ Ask the person assisting you to provide feedback to the healthcare provider.

The Provider Telehealth Checklist

This checklist helps healthcare providers facilitate an effective telehealth clinical call with patients. It advises on how to be clearly heard and easily understood through optimizing the call environment, selecting appropriate telecommunications equipment, and implementing a continuous improvement process.

Action	Application
Issue written instructions for making the call.	☐ Describe how to connect to the call. ☐ Describe how to fix common problems.
Hold a test call.	☐ Assist the patient in setting up equipment, adjusting room conditions, and understanding conversation about medical matters.
Choose a quiet place.	☐ Use a room where others are not talking and noise is minimal. ☐ Choose a room with sound absorbing materials such as an acoustical tile ceiling or acoustical wall panels. ☐ Use a sheltered place out of the wind if outside.
Reduce background noise.	☐ Turn off noisy items such as televisions and fans. ☐ Mute your microphone when not speaking. ☐ Turn off or mute your cell phone if talking on a computer. ☐ Use the settings on your computer or phone to reduce background noise, if possible.
Ensure a good appearance on screen.	☐ Light your face with a lamp or window in front of you. ☐ Close curtains/blinds and turn off lamps behind you. ☐ Check that the camera is on. ☐ Position the camera at eye level. Look straight at it when speaking. ☐ Ask the patient if they can see you well.
Ensure good call audio.	☐ Speak within 3 feet of the microphone. People in a group should take turns being close to the microphone or use multiple microphones for groups if your system allows. ☐ Use a headset/earbuds/handset if you are the only person on the call. ☐ Ask the patient if they can hear you.
Ensure speech privacy.	☐ Close the door. ☐ Make sure people not associated with the call cannot understand the conversation. Comply with HIPAA speech privacy.
Ensure ability to hear and understand.	☐ Use see-through masks or clear face shields, if needed, or if not hazardous to others, remove mask so that patient can see your mouth. ☐ Periodically check that the patient can hear and understand you. ☐ Inquire whether someone can assist the patient, if beneficial to the patient.
Suggest audible assistance.	☐ Consider the following tools for audible assistance should the patient require it: • hearing aid integration with computer or phone • phone assist integration with computer or phone • Bluetooth • Telecommunications Relay Service (TRS)
Provide transcripts, summary notes, or an audio recording.	☐ Consider using software (apps) for transcribing or recording the call: • voice-to-text app • captioning • translator • make an audio recording of the call ☐ Offer the patient a call transcript or summary notes.
Administer a post-call evaluation.	☐ Ask the patient how well the call went for them. ☐ Ask the patient what you can do to improve the call.

Patient and Provider Tele-Medicine Checklists
FGI, APRC, 2021

Question #2: What do you need to know about the digital health/telemedicine system?

- **Key HF Principle**: Make choices based on data, not on sales pitches
- **Methods:** Benchmark testing, user testing, heuristic analysis, Failure Modes and Effects Analysis (FMEA), and observations in other healthcare settings

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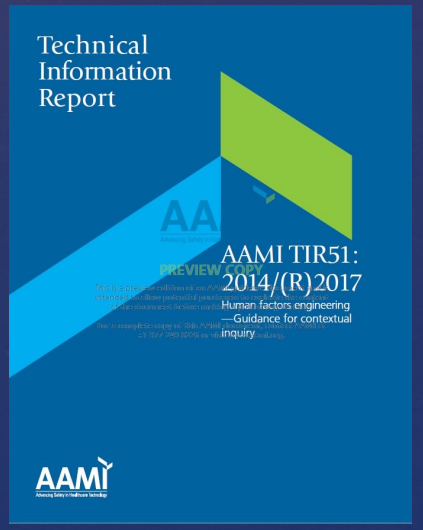

JAMA Network | Open

Original Investigation | Health Informatics

Prevalence and Sources of Duplicate Information in the Electronic Medical Record

Jackson Steinkamp, MD; Jacob J. Kantrowitz, MD, PhD; Subha Airan-Javia, MD

Abstract

IMPORTANCE Duplicated text is a well-documented hazard in electronic medical records (EMRs), leading to wasted clinician time, medical error, and burnout. This study hypothesizes that text duplication is prevalent and increases with time and EMR size and that duplicate information is shared across authors.

OBJECTIVE To examine the prevalence and scope of duplication behavior in clinical notes from a large academic health system and the factors associated with duplication.

DESIGN, SETTING, AND PARTICIPANTS This retrospective, cross-sectional analysis of note length and content duplication rates used a set of 10 adjacent word tokens (ie, a 10-gram) sliding-window approach to identify spans of text duplicated exactly from earlier notes in a patient's record for all inpatient and outpatient notes written within the University of Pennsylvania Health System from January 1, 2015, through December 31, 2020. Text duplicated from a different author vs text duplicated from the same author was quantified. Furthermore, novel text and duplicated text per author for various note types and author types, as well as per patient record by number of notes in the record, were quantified. Information scatter, another documentation hazard, was defined as the inverse of novel text per note, and the association between information duplication and information scatter was graphed. Data analysis was performed from January to March 2022.

MAIN OUTCOMES AND MEASURES Total, novel, and duplicate text by note type and note author were determined, as were the mean intra-author and inter-author duplication per note by type and author.

RESULTS There were a total of 104 456 653 notes for 1 960 689 unique patients consisting of 32 991 489 889 words; 50.1% of the total text in the record (16 523 851 210 words) was duplicated from prior text written about the same patient. The duplication fraction increased year-over-year, from 33.0% for notes written in 2015 to 54.2% for notes written in 2020. Of the text duplicated, 54.1% came from text written by the same author, whereas 45.9% was duplicated from a different author. Records with more notes had more total duplicate text, approaching 60%. Note types with high information scatter tended to have low information overload, and vice versa, suggesting a trade-off between these 2 hazards under the current documentation paradigm.

CONCLUSIONS AND RELEVANCE Duplicate text casts doubt on the veracity of all information in the medical record, making it difficult to find and verify information in day-to-day clinical work. The findings of this cross-sectional study suggest that text duplication is a systemic hazard, requiring systemic interventions to fix, and simple solutions such as banning copy-paste may have unintended consequences, such as worsening information scatter. The note paradigm should be further examined as a major cause of duplication and scatter, and alternative paradigms should be evaluated.

Key Points

Question How much duplicate content is present in electronic medical records, where does it come from, and why is it there?

Findings In this cross-sectional analysis of 104 456 653 routinely generated clinical notes, 16 523 851 210 words (50.1% of the total count of 32 991 489 889 words) were duplicated from prior documentation. Duplicate content was prevalent in notes written by physicians at all levels of training, nurses, and therapists and was evenly divided between intra-author and inter-author duplication.

Meaning The prevalence of information duplication in electronic medical records suggests that it is an adaptive behavior requiring further investigation so that improved documentation systems can be developed.

+ Supplemental content

Author affiliations and article information are listed at the end of this article.

JAMA Network Open. 2022;5(9):e2233348. doi:10.1001/jamanetworkopen.2022.33348

EMR Duplication of Information

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https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2796664

Open access Original research

BMJ Open

Impact of electronic health records on predefined safety outcomes in patients admitted to hospital: a scoping review

Christian Peter Subbe [1,2] Genevieve Tellier,[2] Paul Barach [3]

To cite: Subbe CP, Tellier G, Barach P. Impact of electronic health records on predefined safety outcomes in patients admitted to hospital: a scoping review. *BMJ Open* 2021;**11**:e047446. doi:10.1136/bmjopen-2020-047446

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2020-047446).

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ABSTRACT

Objectives Review available evidence for impact of electronic health records (EHRs) on predefined patient safety outcomes in interventional studies to identify gaps in current knowledge and design interventions for future research.

Design Scoping review to map existing evidence and identify gaps for future research.

Data sources PubMed, the Cochrane Library, EMBASE, Trial registers.

Study selection Eligibility criteria: We conducted a scoping review of bibliographic databases and the grey literature of randomised and non-randomised trials describing interventions targeting a list of fourteen predefined areas of safety. The search was limited to manuscripts published between January 2008 and December 2018 of studies in adult inpatient settings and complemented by a targeted search for studies using a sample of EHR vendors. Studies were categorised according to methodology, intervention characteristics and safety outcome.
Results from identified studies were grouped around common themes of safety measures.

Results The search yielded 583 articles of which 24 articles were included. The identified studies were largely from US academic medical centres, heterogeneous in study conduct, definitions, treatment protocols and study outcome reporting. Of the 24 included studies effective safety themes included medication reconciliation, decision support for prescribing medications, communication between teams, infection prevention and measures of EHR-specific harm. Heterogeneity of the interventions and study characteristics precluded a systematic meta-analysis. Most studies reported process measures and not patient-level safety outcomes: We found no or limited evidence in 13 of 14 predefined safety areas, with good evidence limited to medication safety.

Conclusions Published evidence for EHR impact on safety outcomes from interventional studies is limited and does not permit firm conclusions regarding the full safety impact of EHRs or support recommendations about ideal design features. The review highlights the need for greater transparency in quality assurance of existing EHRs and further research into suitable metrics and study designs.

Strengths and limitations of this study

- ► Scoping review to identify the gaps in research on assessing the impact of electronic health records) on patient safety.
- ► Only interventional clinical studies were included.
- ► Limitation of search to terms from a previously validated authoritative search strategy.
- ► Exclusion of observational and feasibility studies.

INTRODUCTION

Caring for patients with complex conditions safely and competently mandates having access to the right information at the right time.[1] Ineffective sharing of information between providers and patients seriously impedes the quality and safety of patient care and is a leading cause of adverse events in hospital.[2] Harm from medical care is common, has a significant associated morbidity and mortality and affects the mental health of staff as well as the financial performance of institutions.[3] A small number of categories of patient harm account for the bulk of adverse events.[4] Most interventions aimed at reducing harm have included introducing a digital health record while restructuring the patient documentation and communication.[5]

It is widely accepted wisdom that the introduction of comprehensive systems for documentation and communication such as electronic health records (EHRs) should improve the safer delivery of care. Mortality improves after implementation of EHRs in smaller non-teaching hospitals.[6] The number of reported adverse events changes after implementation of EHRs with 'meaningful usage' functionality[7] but it is unclear whether changes are due to improved practice or changed event reporting. There are technical standards for EHR implementation and metrics for meaningful usage have focused on technical and efficiency aspects but not safety outcomes.[8] There is hence the need to review the existing evidence for this specific aspect of care at a time of increasing spread of EHRs.

No regulations or requirements mandating that EMRs be designed using formal human factors principles

Results The search yielded 583 articles of which 24 articles were included. The identified studies were largely from academic medical centres, heterogeneous in study conduct, definitions, treatment protocols and study outcome reporting.

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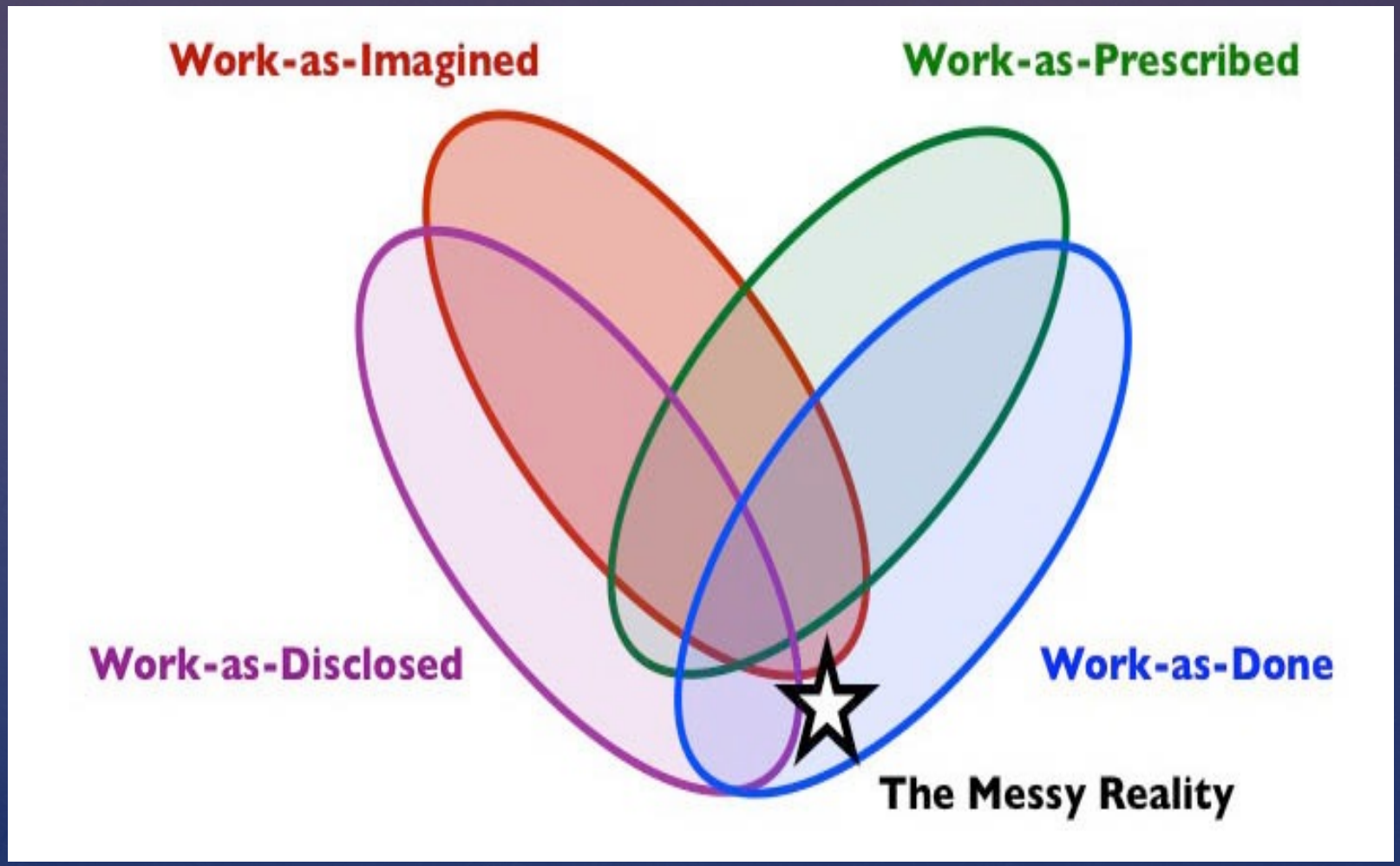
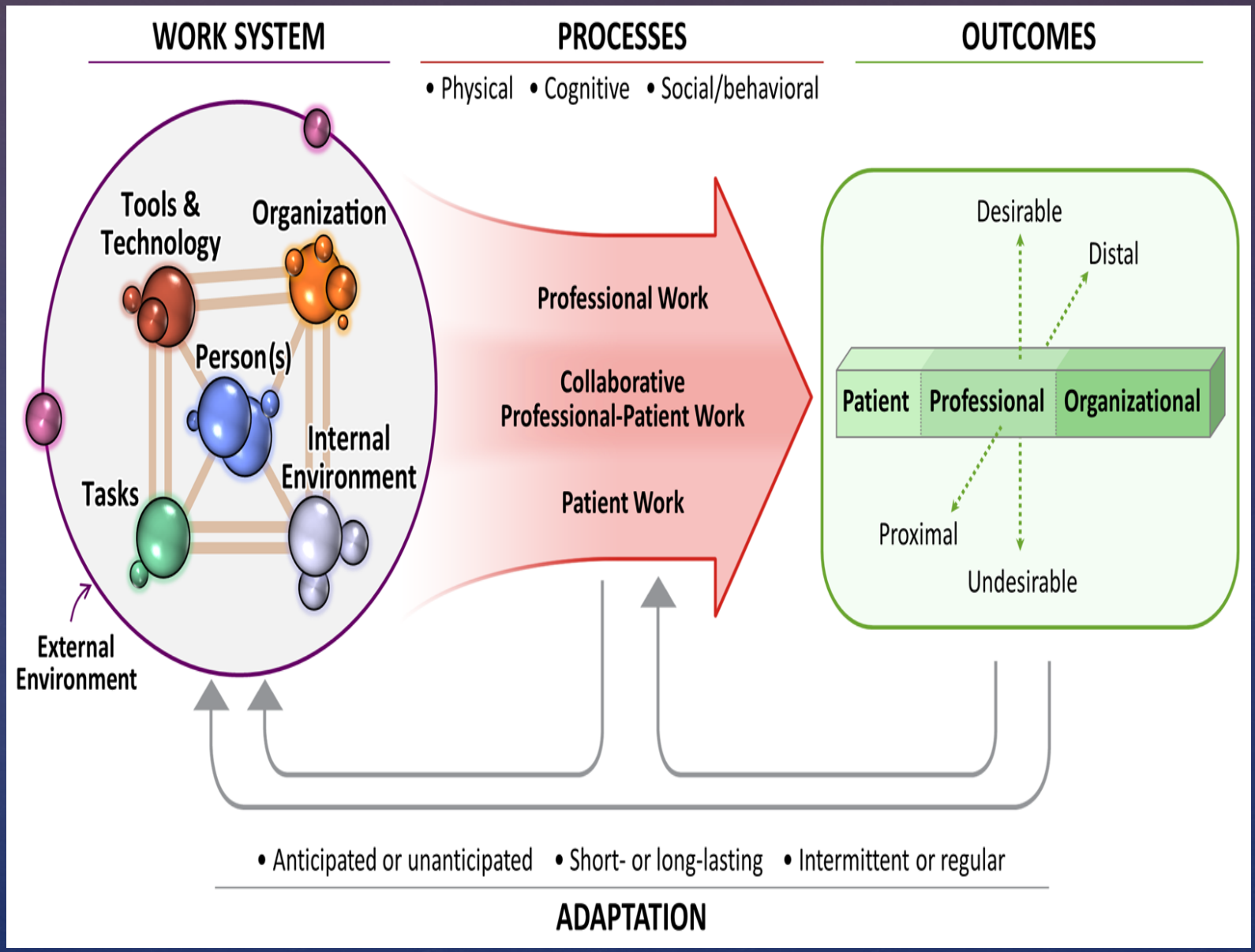
Workflow Redesign:
Work as Done vs Work as Imagined



Impact of Tele-Health on Human Factors



After Carayon P, et al.

Interactive Instruments & Stimuli

- Projective Mapping
- Enables users to visually describe their definitive moments, typical experiences, needs and aspirations in the context of their day-to-day experiences.

Hagen S and Barach P. 2022

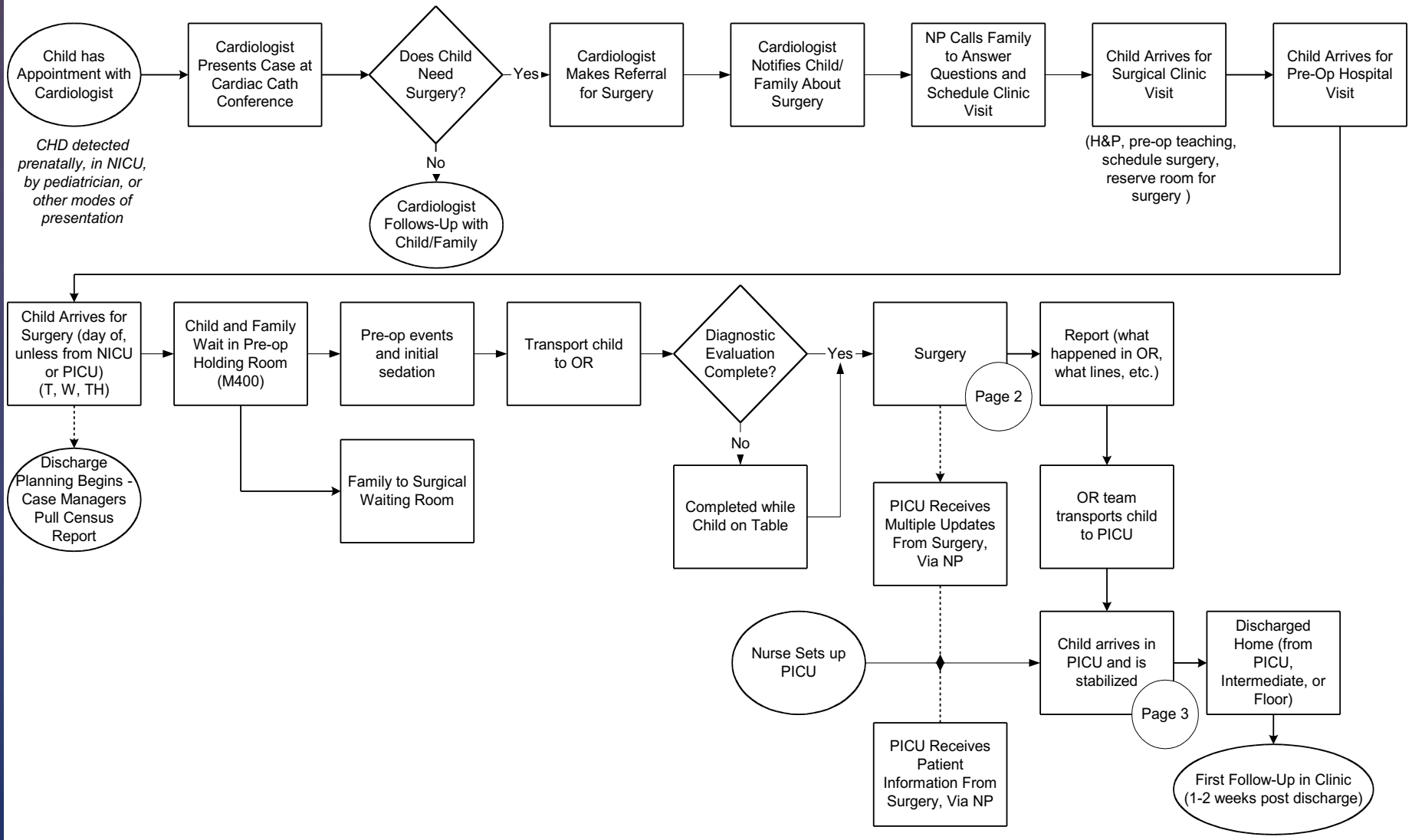
Process Mapping and Analysis

- Create process maps from observations, interviews, and focus group data to depict the hospital-specific and community specific processes and affordances.
- Process mapping describes what an individual is required to do to achieve the goal, in terms of cognitive processes, actions, or both.
- Improving outcomes requires understanding the underlying processes and the maps identify potential areas that require additional implementation efforts.

Process Mapping-Patient Journey Mapping

Pediatric Cardiovascular Surgical Care

Our aim is to improve the process of cardiovascular surgical care, starting with the child's referral for surgery and ending with the child's first post-discharge follow-up visit.

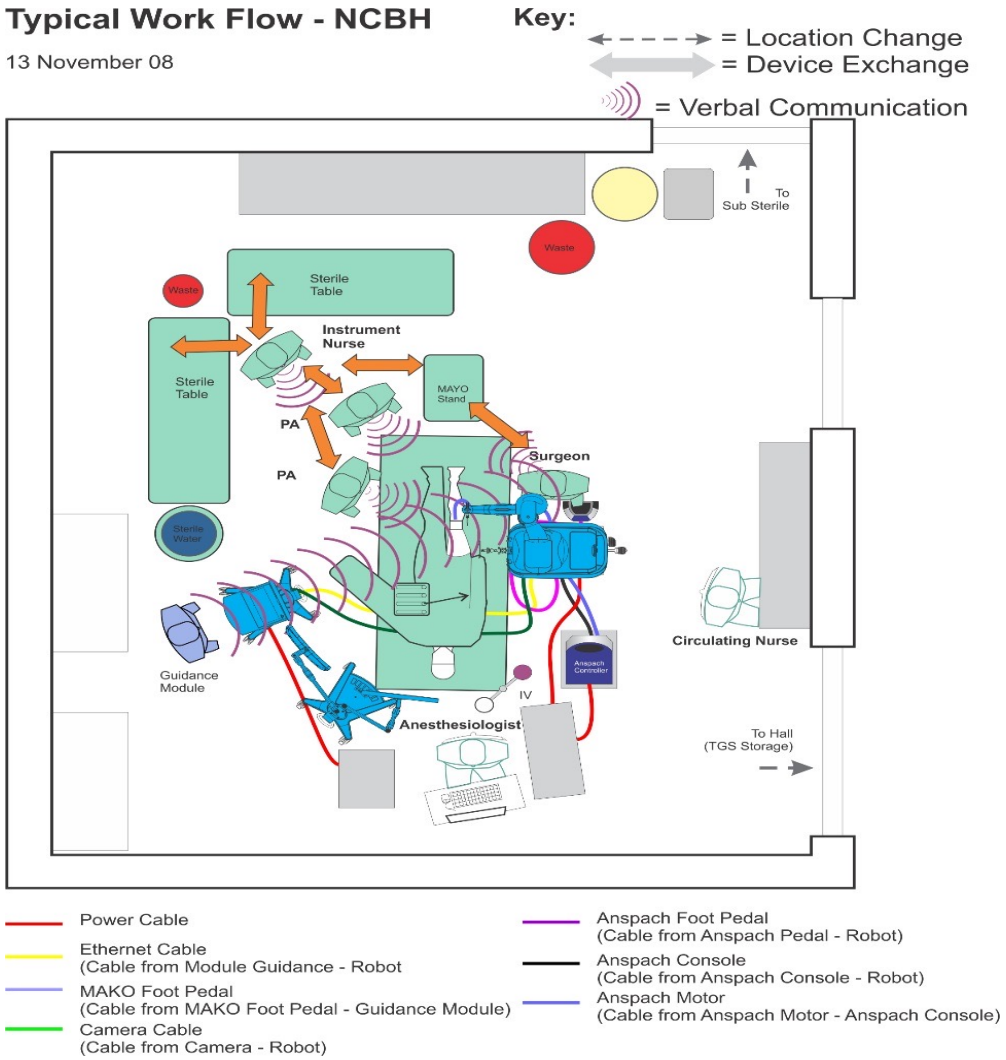


Draft 4-2-04

Barach P. Anesthesia and Analgesia, 2007

Patient Mapping

- Process Mapping/SIPOC
- Time/Motion Studies
- Team Dynamics
- Site Layouts

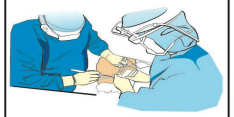


Hagen S and Barach P. 2022

Popovich, E, Wiggins, H, Barach P. Lean and Six Sigma Management: Building a Foundation for Optimal Patient Care Using Patient Flow Physics. In: Sollecito, W and Johnson, J (eds). Continuous Quality Improvement in Health Care: Theory, Implementations, and Applications. pp.143-174, 5th edition. Jones and Bartlett, 2019, ISBN 978-1-284-12695-4.

Common Mapping Metrics

- Steps from user's perspective
- Tasks within each step
- Technique variables
- Task time
- Step time
- Stage time
- Emotional association with task
- Device used in each step
- People involved during each step
- Challenges for each step
- Mitigations for each step
- Implications for each step

Procedure / Step	16 Groin Incision	17 Femoral Cannulation	18 Chest Incision
			
Time	00:21:38 (R) 00:15:35 (M)	00:09:33 (R) 00:12:33 (M)	00:15:40 (R) 00:15:49 (M)
Emotion			
Users Primary / Secondary			
Tasks	**Palpate to locate vessel** **Incise tissue** - expose target vessels **Suspend vessels** **Use red rubber tube to protect tissue from retraction sutures**	**Seldinger technique** **Start venous side move to arterial line** **Wet to wet connection** - keep air out of line **Secure with suture**	**Dissect soft tissue** **Disarticulate ribs (R)** **Relief cuts on ribs (R)** **Resect ribs (M)**
Tools	• Scalpel • Bovie • Retractor, Wheatlander • Retractor, Z type • Forceps, Kelly • Hemostats • Forceps, straight • Scissors • Needle holder • Sponge • Yankauer • Suture (sheathed w/tubing)	• Access needle • Introducer/dilator • Guidewires • Y connector • Venous cannulae • Arterial cannulae • Suture	• Scalpel • Bovie • Sponge • Foley retractors • Bone cutter, double action (R) • Bone Saw (M) • Retractor • Wheatlander retractor • Yankauer
Challenges	Deep access due to fat Age related decline in material properties of vasculature	Vascular spasm Age related decline in material properties of vasculature Loss of blood during exchanges	**Field of View (FOV)** - minimize incision size and number/size of instruments in the wound
Mitigations	Technique intensive disection	Technique intensive introduction of devices into the vasculature Adaption of additional dilators for more gradual transitions	Use smaller, low profile instruments than those used in full sternotomy Place vents and retracting sutures through peripheral punctures/ports
Implications	Limits access for cannulation	Develop introducer devices and wires that optimize transitions Moving to the other leg or chest for access site Air in line	Reduced FOV compromises access during steps: (19, 20, 21, 22, 23, 27, 29, 30, 31, 33, 35) Additional OR time in subsequent steps

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Question #3: How can we integrate what we know about users and digital health/telemedicine technology when implementing new digital telehealth/telemedicine programs?

- Which telemedicine technology is right for your patients?
- How should we introduce telemedicine system to your users?
- What level of support should we give to patients and other users, such as training and education resources?

- **Key HF principles:** Fit the tech to the person, not the person to the tech
- **Methods:** Pilot testing, task analysis, and reporting mechanisms

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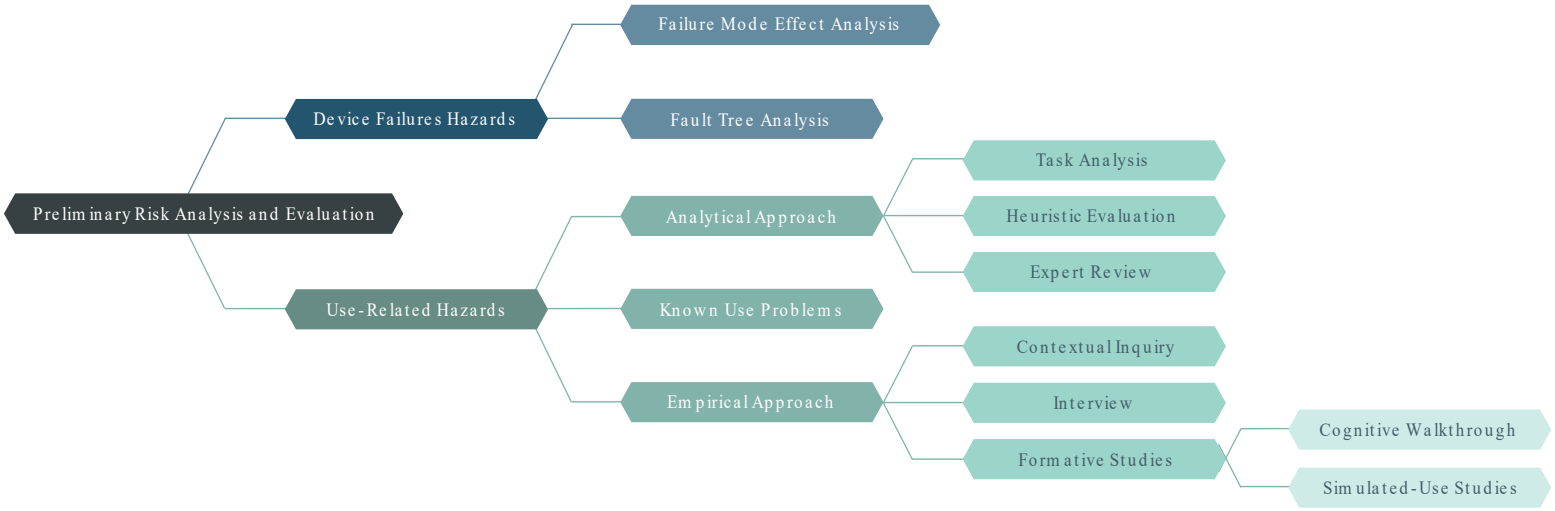
Use-related Risk Assessment



Medical Devices: Human Factors Design and FDA Regulation

July 1, 2008 - Leslie Proctor

July / August 2008

Medical Devices

Human Factors Design and FDA Regulation

By Michael Rie, MD, FACP; and Paul Barach, MD, MPH

Original Article

AMERICAN COLLEGE OF Medical Quality

Improved FMEA Methods for Proactive Health Care Risk Assessment of the Effectiveness and Efficiency of COVID-19 Remote Patient Telemonitoring

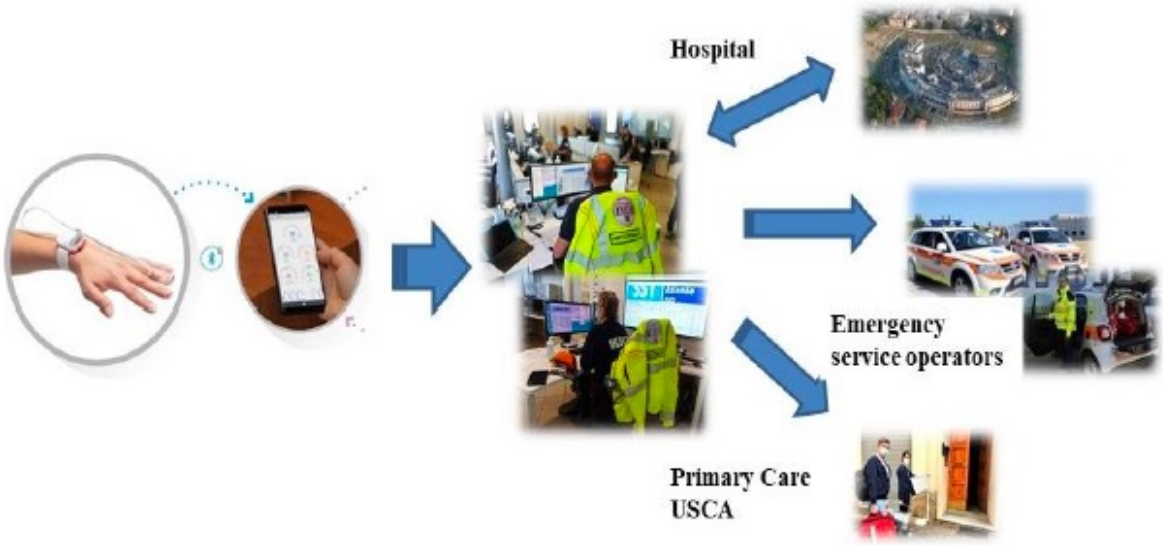


Figure 1 overview of the study and monitoring process

Paretti C, Barach P, Tartaglia R. American J of Quality, 2022.

Question #4: What else to consider about monitoring and sustaining existing or newly implemented tele health/telemedicine programs?

- What aspects of telemedicine should we be monitoring? What is being implemented well?
- What happens when things go wrong?
- How can we support staff and patients 6 to 12 months down the road?

- **Key HF principles**: Understanding work-as-imagined often differs from work-as-done
- **Methods**: Pre- and post-testing, contextual inquiry, and safety and hazard reporting

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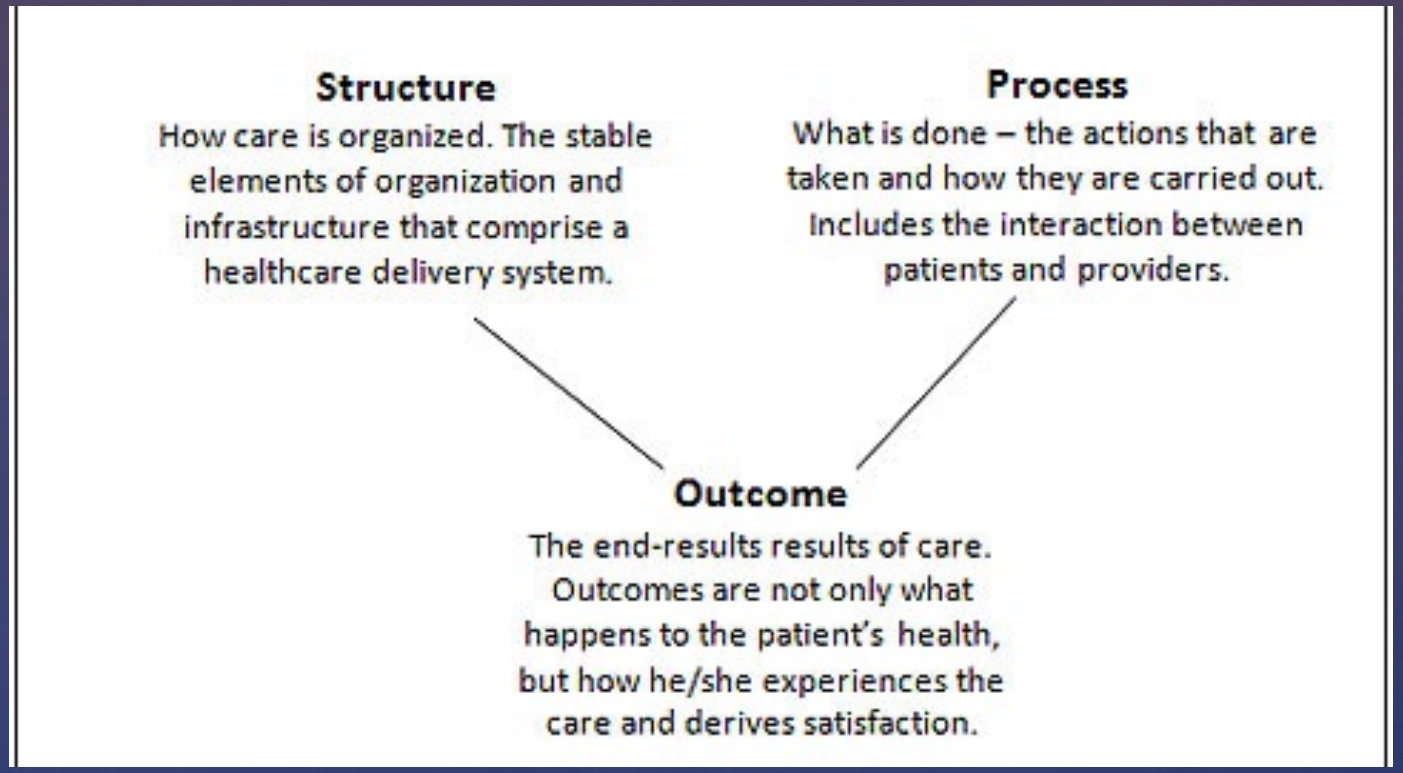
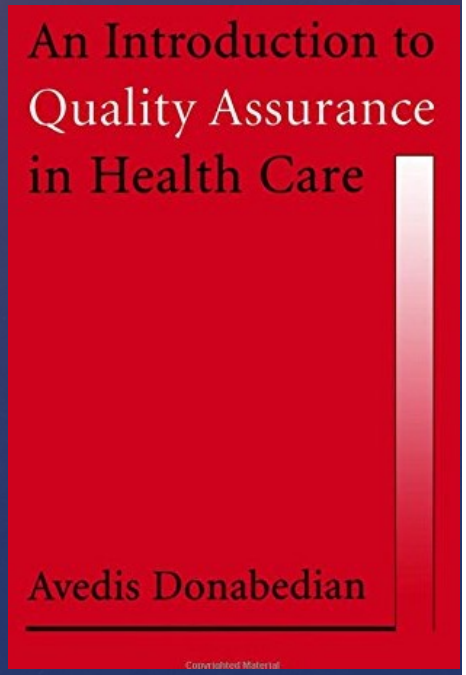
What to Improve – Donabedian Model



Donabedian 1966



Evaluating policy and service interventions: framework to guide selection and interpretation of study end points

Richard J Lilford,[1] Peter J Chilton,[1] Karla Hemming,[1] Alan J Girling,[1] Celia A Taylor,[2] Paul Barach[3]

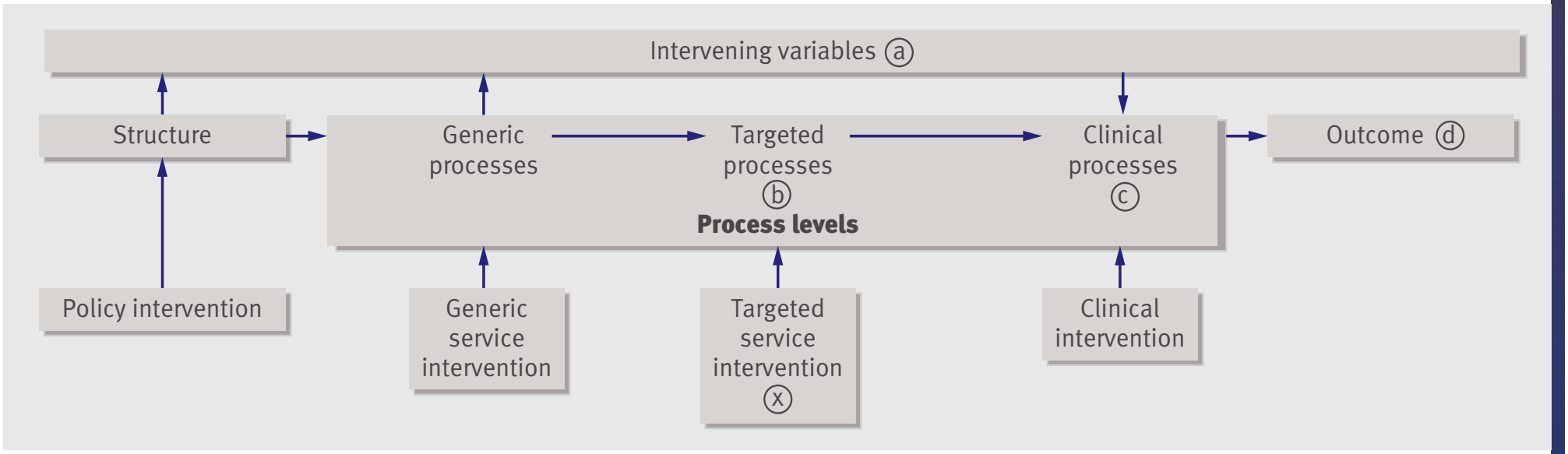


Fig 1 | **Modified Donabedian causal chain. Interventions at structural (policy) and generic service level can achieve effects through intervening variables (such as motivation and staff-patient contact time) further down the chain. For example, an intervention at (x) produces effects (good or bad) downstream at (a), (b), (c), and (d)**

BMJ 2010;341:c4413 doi: 10.1136/bmj.c4413

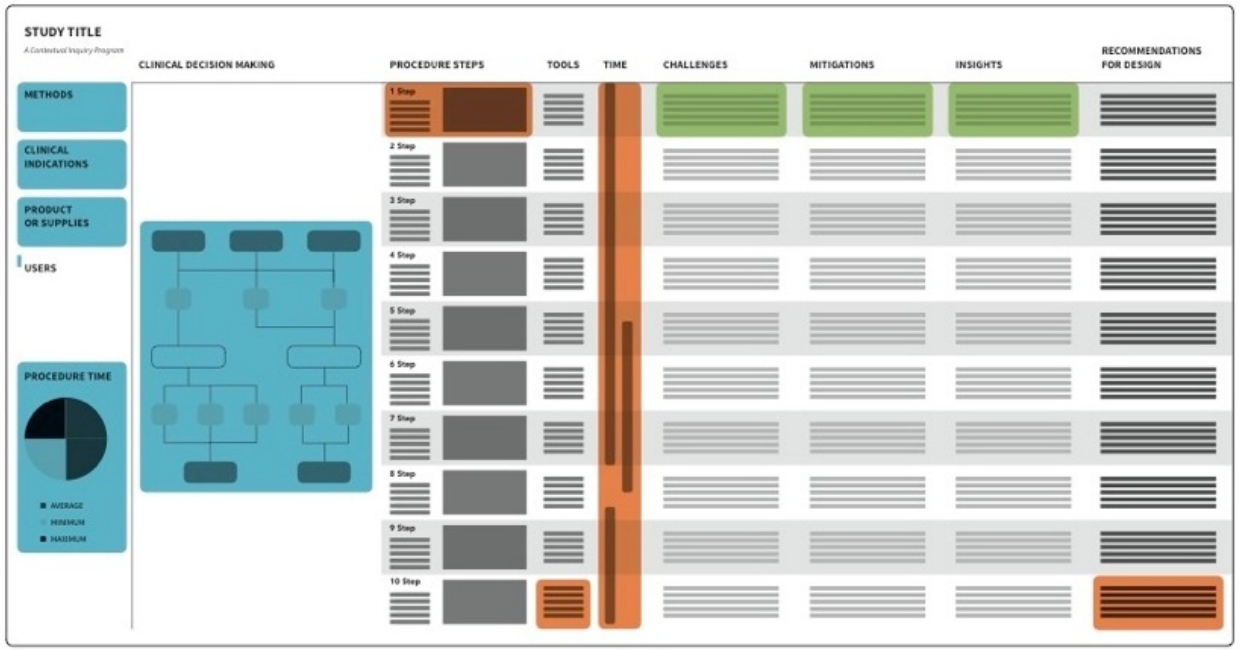
Telemedicine Devices Discovery Process

Strategic Charter

- Inform Recommended Practices
- Visualize Concept/Strategies
- Innovation Plans/ Road Maps
- Product Life Cycles/ Longitudinal Studies

Project Deliverables

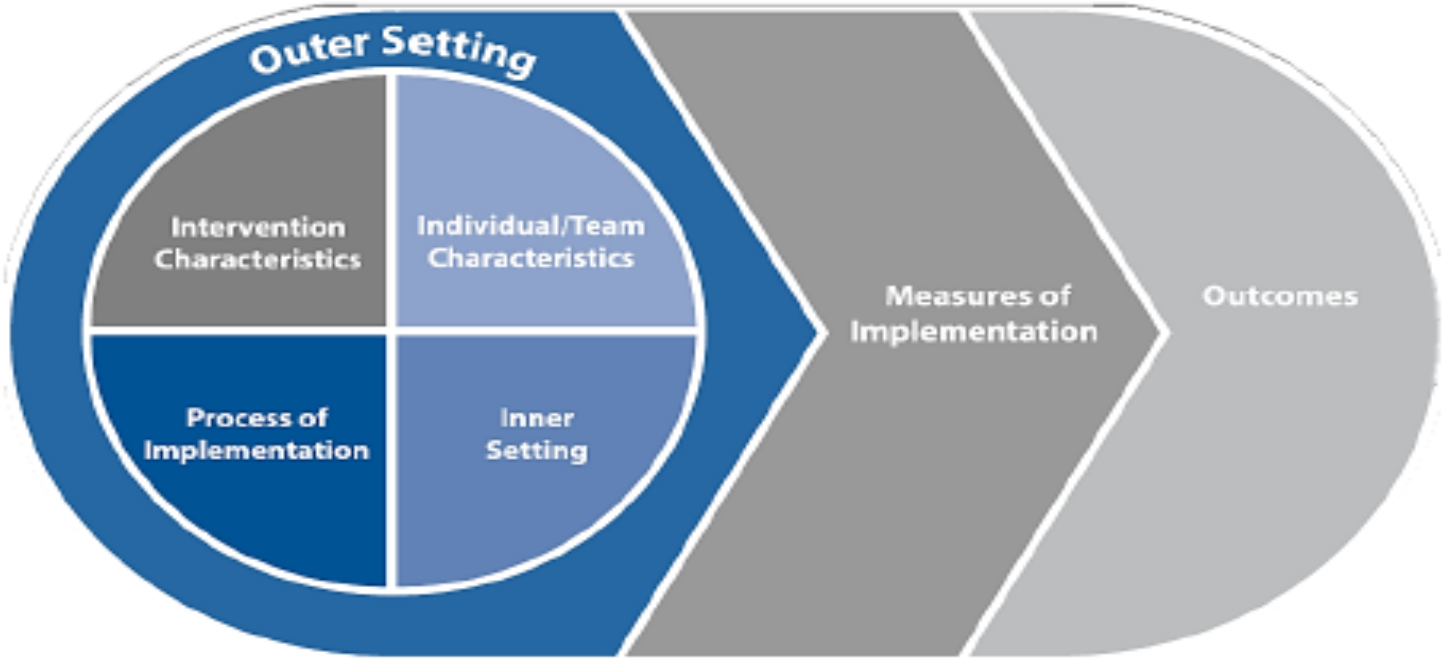
- Market Requirements
- User Interface Requirements
- User Needs
- Workflow Analysis/Time-motion
- Design Proposals/Briefs
- Persona Profiles
- Procedure/Journey/UX Maps
- Continuum of Care Studies
- Use-related Hazards Analysis
- Design Proposals/Briefs



Hagen S and Barach P. 2022

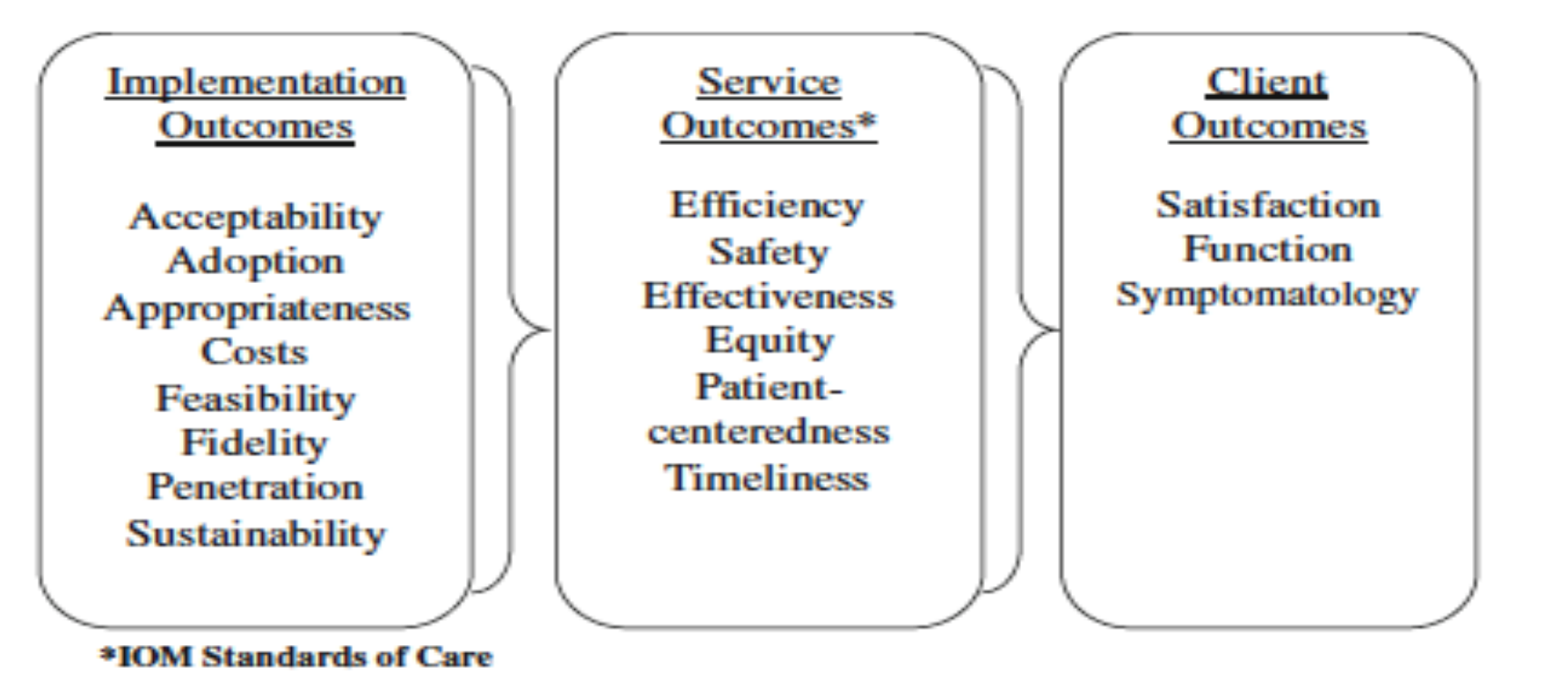
Framework for Implementation

Figure 1. Consolidated Framework for Implementation Research, modified for studying Process Redesign (CFIR-PR)[8]



Damschroder LJ, Aron DC, Keith RE, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science* 2009;4:50-50. doi: 10.1186/1748-5908-4-50.

Implementation, Service and Patient Outcomes



Learning Health Systems

Received: 4 May 2022 | Revised: 1 August 2022 | Accepted: 8 August 2022
DOI: 10.1002/lrh2.10337

RESEARCH REPORT

Learning Health Systems

Transitioning from learning healthcare systems to learning health communities: Building decision-making competencies during COVID-19

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Email: rohit.ramaswamy@cchmc.org

Abstract

Introduction: The persisting and evolving COVID-19 pandemic has made apparent that no singular policy of mitigation at a regional, national or global level has achieved satisfactory and universally acceptable results. In the United States, carefully planned and executed pandemic policies have been neither effective nor popular and COVID-19 risk management decisions have been relegated to individual citizens and communities. In this paper, we argue that a more effective approach is to equip and strengthen community coalitions to become *local learning health communities* (LLHCs) that use data over time to make adaptive decisions that can optimize the equity and well-being in their communities.

Methods: We used data from the North Carolina (NC) county and zip code levels from May to August 2020 to demonstrate how a LLHC could use statistical process control (SPC) charts and simple statistical analysis to make local decisions about how to respond to COVID-19.

Results: We found many patterns of COVID-19 progression at the local (county and zip code) levels during the same time period within the state that were completely different from the aggregate NC state level data used for policy making.

Conclusions: Systematic approaches to learning from local data to support effective decisions have promise well beyond the current pandemic. These tools can help address other complex public health issues, and advance outcomes and equity. Building this capacity requires investment in data infrastructure and the strengthening of data competencies in community coalitions to better interpret data with limited need for advanced statistical expertise. Additional incentives that build trust, support data transparency, encourage truth-telling and promote meaningful teamwork are also critical. These must be carefully designed, contextually appropriate and multifaceted to motivate citizens to create and sustain an effective learning system that works for their communities.

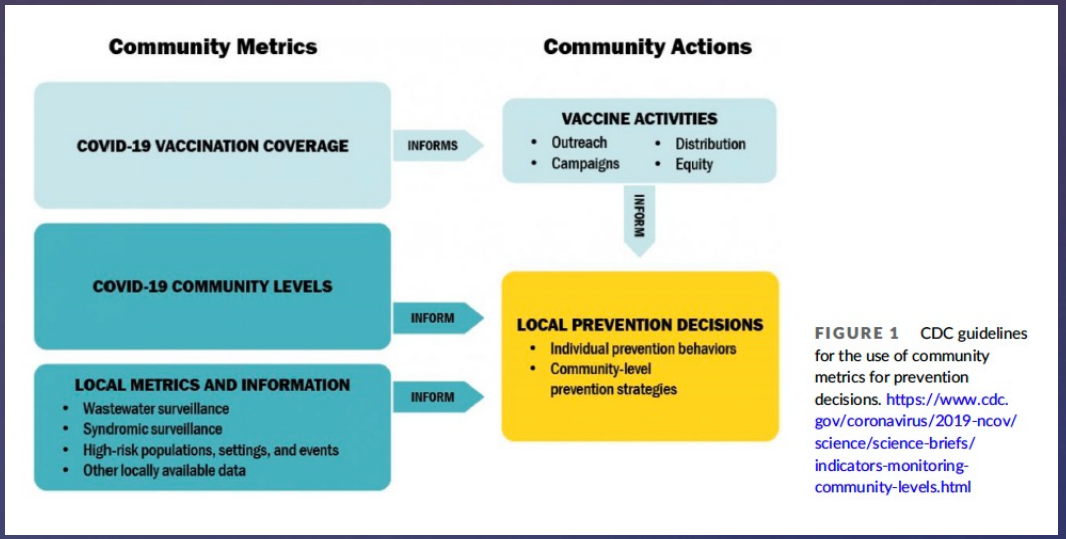

FIGURE 1 CDC guidelines for the use of community metrics for prevention decisions. https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/indicators-monitoring-community-levels.html

Digital Health/Telehealth drives Population Health

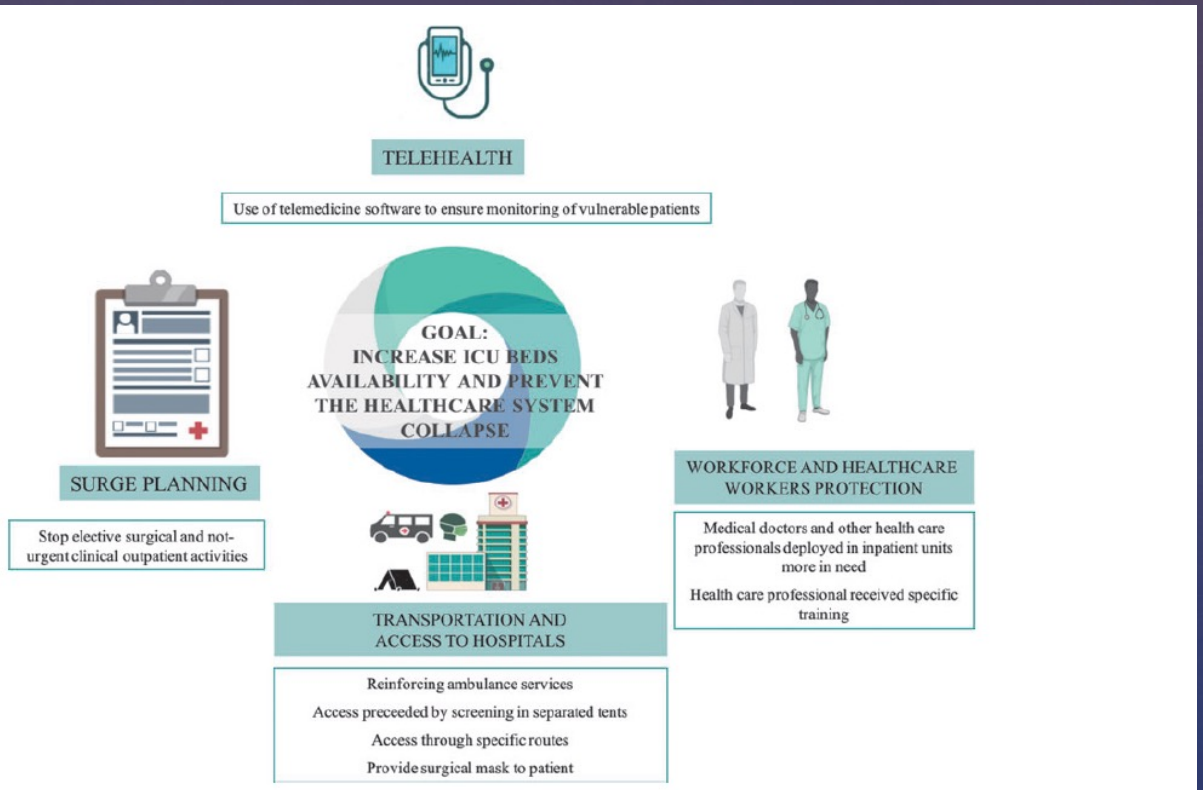

FIG. 2. Summary of Modena Taskforce logistics and operations.

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Population Health Strategies to Support Hospital and Intensive Care Unit Resiliency During the COVID-19 Pandemic: The Italian Experience

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Abstract

Italy was one of the countries most affected by the number of people infected and dead during the first COVID-19 wave. The authors describe the rapid rollout of a population health clinical and organizational response in preparedness and capabilities to support the first wave of the COVID-19 pandemic in the Italian province of Modena. The authors review the processes, the challenges faced, and describe how excess demand for hospital services was successfully mitigated and thus overwhelming the healthcare services avoided the collapse of the local health care system. An analysis of bed occupancy in the region predicted during the first weeks of the epidemic. The SEIR model estimated the number of infected people under different containment measures. Community resources were mobilized to reduce provincial hospitals' burden of care. A population health approach, based on a radical reorganization of the workflow and emergency patient management, was implemented. The bed saturation of the Modena Healthcare Agency was measured by an ad hoc, newly implemented intensive care unit (ICU) bed occupancy and COVID-19 centralized governance dashboard. ICU bed occupancy increased by 114%, avoiding saturation of the Modena Healthcare Agency system. The Emilia-Romagna region achieved a higher rate of ICU bed availability at 2.15 ICU beds per 10,000 inhabitants as compared with community 1 ICU bed availability prior to the pandemic. Rapid and radical local reorganization of regional efforts helped inform the successful development and implementation of strategic choices within the hospital and the community to prevent the saturation of key facilities.

Keywords: COVID-19, intensive care units, community engagement, epidemic, public health strategies, health care management

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Lessons Learned from Telemedicine/ Remote Patient Monitoring

- Patients will trust TM/RPM and need to truly see the benefit of TM/RPM for their care at the time of enrollment.
- Patients need to understand the associated costs, if any. Every effort should be made to clarify these issues prior to implementation in a transparent and truthful manner.
- The benefits and goals of TM/RPM should be established up front as a design feature not a bug to design out.
- The technology should be matched to the patient. It is best to offer a variety of interface options. Different patients have different engagement expectations, connectivity and device needs, and different options need to be available to increase sustained uptake.
- Patients should be allowed to disengage and re-engage, based on the evolution of their clinical conditions without penalty or censure.
- Multiple communication avenues should be offered to patients and patient understanding of these methods should be assured and verified. Some patients will prefer phone calls. Some will prefer telehealth visits. Some will prefer in-app messaging or texts.
- Regardless of the method preferred, maintaining communication should be a key objective.

Gandy K, et al. The benefit and future of remote patient monitoring, IEEE, 2021.