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The Current Status of Telehealth and Distance Learning in Palau

Tyler Thorne BA; Maiya Smith BS; Gregory Dever MD

Abstract

In 2017 the Republic of Palau installed fiber optic cables, allowing access to high speed internet for the first time and the capacity for growth in telehealth. Given Palau's poor access to specialists and resources, telehealth has the potential to radically change health care delivery. Currently, the status of telehealth in Palau is unknown. This study describes telehealth resources utilized at the Ministry of Health in Palau and potential future directions for telehealth. Thirty-four people, mostly health professionals at the Belau National Hospital in Palau were interviewed, including physicians, information technology personnel, public health department staff, department managers of allied health, and telehealth experts in the Pacific. Standardized questions and surveys were conducted in-person during July 2019. All departments utilized some form of telehealth. Common needs for the advancement of telehealth included: a telehealth champion, a resource facilitator, successful distance learning for auxiliary staff, dedicated telehealth space, technological help, and better telehealth communication with rural clinics. Survey respondents indicated that they would like to use some sort of distance learning, most commonly for professional betterment (86%) and upskilling of staff (86%). There are numerous distance learning and telehealth opportunities available, yet recurrent barriers to these opportunities were noted across all departments. The barriers identified in the current study and recommendations to overcome them may be applicable to other Pacific nations who face similar challenges.

Keywords

Telehealth, telemedicine, rural, under-resourced communities, Pacific Islands

Abbreviations and Acronyms

CMU = Carnegie Mellon University
MOH = Ministry of Health
NGO = Non-governmental Organization
PBTRC = Pacific Basin Telehealth Resource Center
POLHN = Pacific Open Learning Health Net
PCC = Palau Community College
Project ECHO = Project Extension for Community Healthcare Outcomes
Shriners = Shriners Hospital for Children
TCGC = Technology and Consulting in the Global Community
TAMC = Tripler Army Medical Center

Introduction

Pacific Island countries face multiple health care crises: 7 of the top 10 diabetes-prevalent countries in the world reside in these island nations; infectious disease outbreaks, such as the recent measles outbreak in Samoa, have caused hundreds of deaths; and the percentage of people with noncommunicable diseases is rising substantially.[1–3] These issues are further complicated by the geographic isolation of these island countries and the medical provider shortage across the Pacific.[4,5]

Telehealth may be a solution; it has proven to reduce costs, increase access to care in remote areas, and promote evidence-based practices.[6,7] Telehealth is a broad term that refers to a range of technologies and services that provide patient care and improve health care delivery. Under this umbrella term, there is telemedicine, which the provision of clinical health care services through telecommunication technology, and distance learning, which can include continuing education, degree programs, or learning through pre-recorded or live audio/video.[8] In countries with limited resources, telehealth can help meet the rising demands of non-communicable diseases and mental health disorders among the community.[9]

In December 2017, the Republic of Palau installed undersea fiber optic cables, allowing the country to access high speed internet for the first time. With this advancement, came the potential for growth in telehealth initiatives.[10] Telehealth may improve health care delivery to the 18 000 citizens, primarily located on 8 principal islands, spread over 700 miles of ocean. As of 2014, there are 25 physicians in the fields of internal medicine, pediatrics, obstetrics, and surgery. All of the medical staff are located at Belau National Hospital. This is the only hospital in the country, affiliated with several small satellite clinics located across the island of Koror and other islands.[11] Given this centralization, patients must travel to Koror for care or wait until a physician is scheduled to staff the nearest satellite clinic. For cases that require specialty care, Palau relies on volunteer physicians who travel to the country, referral programs to Taiwan, Philippines, Shriners Hospital for Children (Shriners), or agreements for specialty surgery cases at Tripler Army Medical Center (TAMC). The latter 2 are both located in Honolulu, Hawai'i, over 4500 miles away. In a country as geographically isolated as Palau, with poor access to specialists and resources, telehealth has the potential to radically change how healthcare is delivered.

Currently, there is no collective database or knowledge of the use of telehealth or distance learning in Palau. This study explores the experiences that providers in Palau have with telehealth, examines Palau's telehealth needs, and explores future directions. The barriers identified and recommendations made may be applicable to other countries facing similar challenges, particularly in the Pacific.

Methods

The authors conducted semi-structured interviews with 34 interviewees during June and July 2019. In-person interviews

were conducted in Palau with 12 physicians and representatives from physical therapy, nursing, behavioral health, public health, laboratory sciences, radiology, and the Palau Community College (PCC). Medical providers were all from the Ministry of Health (MOH) at the Belau National Hospital in Koror, Palau. Participants were selected based on positions held in the MOH, such as department chairs or heads of programs. Included in the 34 interviewees were 2 telehealth resource consultants from the Pacific Basin Telehealth Resource Center (PBTRC) and a telehealth consultant from Shriners, who were chosen for their work in Palau and expertise in telehealth. Those 3 specific interviews were conducted over a video conferencing platform. MOH interviews were 30 minutes to 1 hour, and conducted and audio recorded in a semi-structured setting in the individual's office or department. The interview consisted of 5 standardized questions but with flexibility for follow-up or clarifying questions. The standardized questions were:

1. What telehealth or distance learning services are you already using or do you have experience using? (ie, phone calls with patients, phone or video consultations with specialists, educational learning sessions, etc)
2. How do you envision telehealth assisting the mission of your bureau or department? How can telehealth be used as a tool to meet your goals and objectives? (Examples of goals include: better patient outcomes, saving time and money, better education for patients or providers, etc)
3. What types of telehealth services (clinical consultation / distance continuing professional development / accredited-degree learning) would you or your staff like to use? Are there particular topics that you or your staff would like to cover?
4. Do you feel you have the equipment necessary for telehealth?
5. If telehealth services were offered to you, would you utilize them?

Interview recordings were reviewed and discussion points were summarized and categorized into a spreadsheet by interviewee, department, and question. Concerns that were raised and not associated with one of the standardized questions were summarized separately. Data from all interviews were reviewed by the authors and common or recurring responses were identified.

A paper survey was completed by the interviewees at the conclusion of the interview to evaluate current telehealth knowledge, use, and future interests. The survey included questions on telehealth delivery, types of patient care performed via telehealth, distance learning platforms, current equipment, and equipment needs. See Table 1. Paper survey responses were also entered into a spreadsheet by department, interviewee, and question and reported as the percentage of participants who indicated "yes." Any individual "yes" within a department was indicated "yes" for the entire department. For example, 1 of the public health interviewees indicated that they were using telehealth for radiology but no other individuals from that department indicated "yes." In this situation, it was documented "yes" that the public health department utilized telehealth for radiology and 1 individual within that department was doing so.

Data management and calculation of the percent of positive responses by department was performed using Microsoft Excel software, Version 16.42 (Microsoft Corporation, Redmond, WA). The study was conducted as a hospital-based, quality improvement survey and Institutional Review Board approval was not required.

Results

Interview Results

Of the 34 individuals contacted for an interview, all 34 (100%) agreed to be interviewed.

Despite telehealth's use in a majority of departments, there was little awareness between departments about programs or equipment available. There were some resources that were available to all providers but that many staff members were unaware of, such as the Ocean Medicine Foundation that provides free access to UpToDate evidence-based clinical support software (Wolters Kluwer Health Division, Philadelphia, PA). Of clinical providers surveyed, 54% obtained continuing medical education and conducted distance learning through online resources such as the Pacific Open Learning Health Net (POLHN), Project Extension for Community Healthcare Outcomes (Project ECHO), and the PBTRC. While 46% of providers were unaware of these resources or had tried to obtain distance learning certificates through POLHN, they were unsuccessful due to lack of technical support and time. Of the departments surveyed, 71% utilized a variety of patient care models such as live video conferencing, a store-and-forward technology with TAMC remote patient monitoring, and direct texting or calling patients. The other 29% responded "N/A or I don't know". Physicians had the highest utilization rates of telehealth consultations, primarily using the consultant as a second opinion for a medical specialty not available in Palau or to refer patients to care centers outside of Palau.

There were specific examples of telehealth usage. One was the physical therapy department's electronic medical record. The database was established in 2005 by Carnegie Mellon University (CMU), a university that sends students trained in different areas of science and technology abroad to help build sustainable technical models through the Technology and Consulting in the Global Community (TCGC) program. The department uses the electronic medical record to track patient progress and consolidate patient medical records. Another example was the nursing department's successful bachelor degree program in 2015, via partnership with the MOH, PCC, and Fiji National University. This was a 2.5-year hybrid program, combining

Table 1. Telehealth Survey Results, Palau								
	Lab (n = 1)	Public Health (n = 6)	Behavioral health (n = 1)	Physicians (n = 6)	Physical Therapy (n = 1)	Radiology (n = 1)	Nursing (n = 1)	Total (%)
What would you like to use distance learning for?								
Upskill staff	x	x		x	x	x	x	86%
Maintain licensure		x	x	x			x	57%
Professional betterment	x	x	x	x	x	x		86%
Case presentations	x	x	x	x	x		x	86%
Not Interested								0%
Other								0%
Do you have telehealth/distance learning equipment available in your health care location?								
Yes	x	x		x		x	x	71%
No					x			14%
N/A or I don't know			x					14%

distance learning modules with live class sessions. All 18 nurses who entered the program graduated. The pharmacy technician program also ran a successful certification program with the University of Alaska Anchorage in 2007. Both department heads expressed that their respective programs' successes were due to having a cohort, having a facilitator, dedicated study time off from work responsibilities, and proper motivation (including pay increases). One physician described his plan to set up a nationwide screening for rheumatic heart disease in all elementary students in Palau.

Physicians also engage in telehealth consultations with TAMC and Shriners, both located in Honolulu, Hawai'i. For TAMC, physicians at the MOH are able to upload patient information, including radiology images, through TAMC's website for evaluation in their medically complex patient program. This process of taking information and relaying it elsewhere is known as store and forward. Shriners provides pediatric orthopedic surgery services to Palau. Physicians come to Palau annually to examine and refer patients into the program where patients may have expense-free, corrective surgery in Honolulu, and then have post-surgical examinations via teleconferencing after they return to Palau.

Overall, 71% of all departments utilized some form of telehealth, 100% of departments needed more telehealth equipment, and physicians utilized telehealth the most. Although obstacles were not included as a standardized interview question, this was a common theme that emerged during interviews. Interviewees spontaneously raised the topic of obstacles to overcome in order to advance telehealth and 6 common challenges were identified: (1) lack of telehealth leader, (2) lack of telehealth facilitator, (3) unsuccessful distance learning, (4) lack of dedicated space, (5) lack of technological support, and (6) lack of infrastructure to utilize telehealth with the rural clinics.

The first obstacle noted was the need for a telehealth leader. Of those interviewed, 18% directly stated that telehealth was limited by a lack of leadership or mentioned how previously successful programs were discontinued upon the departure of the leader who implemented the program. A second obstacle identified was the lack of a telehealth facilitator. Almost every respondent was unaware of the available telehealth options and several mentioned wanting resources to which they already had access to but were unaware. Respondents stated that having a dedicated telehealth facilitator could help with these issues. A third obstacle was the lack of successful distance learning for auxiliary staff. At the MOH, many departments had previous students who attempted to pursue certificates for higher education through online resources like POLHN or Project ECHO. However, due to lack of funding, time, and incentives, they were unsuccessful in pursuing these opportunities. A fourth obstacle was the lack of dedicated telehealth clinical space. Of interviewees, 27% of departments and 100% of clinical providers noted that post-surgical evaluations completed by Shriners were limited by lack of telehealth dedicated space. Follow-up examinations were conducted in the open space of the hospital library, where onlookers could observe and hear the encounter. A fifth obstacle was the need for technological help for staff. Given the relatively recent introduction to the internet, computer illiteracy was a problem for many of the older respondents. Throughout the MOH, many staff members did not feel confident or understand technology sufficiently enough to take advantage of telehealth opportunities. Finally, the sixth obstacle was infrastructure issues making telehealth communication with the rural clinics difficult. Each physician mentioned this as a major concern as physicians must travel to distant and rural clinics, the farthest being an entire day's boat ride away.

Survey Results

Seventeen (50%) of the 34 of the interviewees completed the paper survey. The 17 consisted of: 1 from laboratory services, 6 from public health, 1 from behavioral health, 6 physicians, 1 from physical therapy, 1 from radiology, and 1 from nursing. The individuals from those with a single respondent were the heads of those departments. For statistical analysis regarding departments with multiple responses (public health and physicians), responses were combined. See Table 1 for a summary of responses.

Generally, 71% of departments had some access to telehealth or distance learning resources. While there was a high utilization rate, 100% of the departments stated they needed more equipment to conduct telehealth. Furthermore, most departments wanted to use telehealth for professional improvement (86%) and staff education or training (86%).

Discussion

The MOH has a variety of telehealth services predominantly in the form of consultations and distance learning platforms. There are numerous consultation and distance learning programs available, highlighting the need of a telehealth facilitator to organize and distribute these resources. Additionally, there were many ideas of how staff could utilize telehealth but needed someone to assist in the action of these projects. Consultation services like Shriners and TAMC were the most utilized and sustainable. In order to assist with future consultations, almost all departments, including Shriners, requested a dedicated clinical telehealth room to improve teleconsultations. This would allow medical staff to offer a full range of physical exams while protecting the patient's privacy. Distance learning programs have had mixed success. Many distance learning services have depended on the efforts of a single individual. This led to the programs ending once the individual left. Successful distance learning programs had a cohort, a facilitator, dedicated study time, and motivation.

Telehealth Champion

A common theme noted in the interviews was that successful telehealth programs have a local leader. This is supported in the literature and described as a telehealth champion: one who takes personal responsibility of moving the adoption of these telehealth resources along.[12,13] These champions generally describe themselves as "just doing their jobs" and are innovators who are already involved in telehealth.[14] The need for a champion was noted in Palau and has been identified as an issue in the adoption of other telemedicine initiatives. A European case-study compared the adoption of 2 telehealth systems, 1 was a picture archiving and communication system used to send radiological images, and the other was a community nurse information system designed to assist with digital record keeping.[15] While both filled a need in the health care system, only the picture archiving and communication system was successfully implemented. The archiving and communication system had a single strong leader who advanced the directive, while the other case study had multiple leadership changes and no central leader to ensure the adoption of the telehealth resource. Similarly, in Palau, strong leadership of both the pharmacy technician program and the bachelor of nursing program led to the success of those programs.

Strong leadership is essential to the adoption of a telehealth initiative, and in the Pacific, there has already been a concerted effort to train and support telehealth champions. In 2016, a 3-day workshop called US Affiliated Pacific Islands Telehealth Champion Building and Planning was held in Honolulu. Thirty-four Pacific Island health administrators and health care providers were in attendance and telehealth potential and barriers were discussed. During the event, multiple telehealth champions came forward to improve the telehealth capabilities of their home countries.[16]

Telehealth Facilitator

Another resource that would be essential for the progress of telehealth is a telehealth facilitator, who is different from a telehealth champion. The facilitator is an individual who provides administrative support for available telehealth resources including distance learning, consultation scheduling, technical support for setting up telehealth platforms, and disseminating information on telehealth resources to staff. The Ocean Medicine Foundation resource is an example of how a facilitator could be beneficial. This foundation provides resources such as UpToDate, which was highly requested by MOH staff. However, due to lack of awareness, most staff did not know they already had access to the tool. A facilitator could help make telehealth accessible and efficient for staff.

The term telehealth facilitator was not found in the literature but the term facilitator was brought up by multiple interviewees citing a lack of organization in regards to the different resources. A previous study on the role of telehealth champions across 37 diverse telehealth services found that many did not succeed due to repeated technical and organizational barriers; barriers that could be overcome with a telehealth facilitator.[12] Furthermore, 2 studies cited the need for a clinical and managerial champions, highlighting the difference between a telehealth champion and a facilitator to manage the resources.[17,18]

Distance Learning for Auxiliary Staff

Continuing education was a priority for many department heads, 86% cited "upskilling staff" as a reason for wanting to utilize distance learning. Many staff members at the MOH learn "on the job" and have no formal education in the field they are working. Education of staff is key to improving patient outcomes. In a study among 300 hospitals in 9 European countries, it was found

that for every 10% increase in bachelor degree trained nurses, there was a 7% decrease in inpatient deaths within 30 days of admission.[19] Increased training of staff could reduce preventable hospital deaths and also decrease referral costs. Currently in the MOH, physicians refer patients with possible malignancies off-island prior to receiving a confirmatory diagnosis from pathology samples that take many weeks to be analyzed and are often lost in transit due to shipping errors. However, if laboratory personnel were trained to become histotechnicians, specimens could be fixed at the MOH and diagnosed in-house or electronic images could be sent to a pathologist.

Distance learning can also save learner time and money, as staff can stay in Palau rather than having to relocate. This has the added benefit of keeping workers in Palau as, according to many of those interviewed, many Palauans obtaining education abroad often do not return. Migration of skilled workers and those with advanced degrees has been noted across the Pacific, and online learning platforms have been proposed to help counter this trend.[20,21]

Multiple resources have been used for continuing education. POLHN provides fully funded telehealth educational opportunities in medical laboratory sciences, dentistry, nursing, epidemiology, and more. Project ECHO incorporates clinicians in a continuous learning system and connects them to specialist mentors at an academic medical center or hub. And the PBTRC provides access to resources and consultation on use of telehealth services. While there are a variety of distance learning sources for MOH personnel, few departments utilize such services due to lack of knowledge of resources or previously high failure rates of the courses. However, 2 examples of successful distance learning programs at the MOH were the pharmacy technician program and the nursing department's bachelor of nursing program.

Dedicated Telehealth Clinical Space

Currently, the only telehealth space available to most of the staff is the library. Almost all departments at the MOH and a representative from Shriners Hospital expressed the need for a dedicated telehealth clinical room. This would be beneficial because it would allow increased access to telehealth services, improve the quality of such telehealth services, offer better internet connectivity, and protect patient privacy.

While the library is equipped with certain telehealth resources such as a computer and projector, it is often used for other events not related to telehealth. This makes it difficult for staff at the MOH to reserve the space when needed. If a dedicated telehealth clinical space were created, bandwidth could be diverted to the telehealth room when it is being used, ensuring strong connectivity. Furthermore, having such a room would allow physicians to conduct physical exams in an appropriately private place during live video consultations.

Dedicated telehealth clinical spaces have already been completed in other under-resourced, remote Pacific Island countries. Dr. Payne Perman, a physician in Pohnpei, created a dedicated telehealth space following a workshop by the PBTRC.[16] The first teleconsultation he did with Shriners Hospital resulted in 3 expedited referrals to Honolulu. In addition, due to the press from the event, donations came in to support further telehealth initiatives. Furthermore, the momentum behind this room spurred initiative for other telehealth programs. For example, the laboratory service in Pohnpei was able to expedite training and set up a program to visualize cervical histopathology and go through a backlog of cervical specimens.

In creating this telehealth room and other telehealth initiatives, Dr. Perman sought support from local non-governmental organizations (NGO) that already had relationships with the hospital due to insufficient hospital funds to support the project.[16] This allowed Dr. Perman to rapidly advance Pohnpei's telehealth services. One of the NGOs he received support from was MAHI international, an organization whose mission is to improve the quality of life of citizens in underdeveloped communities of the Pacific Island region.[22]

Technological Help for Staff

Given that Palau obtained high-speed internet in 2017, just 2 years prior to the survey of the current report, many staff members at the MOH were not sufficiently familiar with technology to take advantage of telehealth opportunities. Basic computer courses, training on distance learning software, and education on using computers for academic pursuits, such as search engines to support students academically, are important to the advancement of telehealth. PCC and PBTRC are 2 resources that can offer help in this area. PCC offers in-person computer classes at their college through the Maintenance Assistance Program, a training course that requires a 10-person minimum enrollment and provides needed maintenance and troubleshooting services in technology. PBTRC can also assist with specific challenges through resources on their website, like how to connect to telehealth platforms or finding funding for telehealth projects. In the past, PBTRC has assisted Pacific Island nations through various means. For example, in 2018, when the Pacific Islander Health Officers Association held their 63rd annual executive board meeting, 2 PBTRC members assisted in providing technical support and presented information on telehealth basics and telehealth programs within the Pacific region.

In addition, the TCGC program at CMU is a resource that could be explored again with the MOH. In the past, not only has the TCGC program helped create the physical therapy electronic medical record but it also helped redesign the website for PCC and increase internet speed for the college. For example, an interviewee from the department of epidemiology had many ideas of how to utilize telehealth, including the creation of a public health application to map dengue outbreaks by tracking

recent infections and mosquito breeding grounds through community efforts. Dengue is endemic to Palau and is a high risk year round.[23] Such an application may help control infections and identify areas where the mosquito population needs to be controlled. However, she lacked the technical skills to make this idea into a reality. Through collaboration with CMU, this disconnect between ideas and appropriate tools may be fixed. Currently, lack of funding and lack of knowledge of available resources are the largest obstacles to developing such technology.

Telehealth Communication with Rural Clinics

Telehealth communication with the rural clinics is an idea supported by multiple departments within the MOH. The behavioral health department in particular wanted to better develop this communication as many of their patients often do not come to the MOH due to the cultural stigma against mental health disorders. Palau has one of the highest rates of schizophrenia diagnoses in the world and the Western Pacific accounts for a disproportionately high amount of total global suicides at 25%.[24, 25]

Currently, the rural clinics, staffed by 1 physician and 1-2 nurses, do not have the internet or technological capabilities to do direct face-to-face consultations with Belau National Hospital. These clinics act as primary care providers and urgent centers for rural communities in Palau. Connecting the rural clinics to the hospital via high speed internet would increase patient access to care, support the nurses, and cut down on costs and time spent for physicians traveling to the clinics. A 2013 meta-analysis found that not only did telehealth support used for mental health services in American rural communities help with reduced travel time, reduced family separation, and reduced number of missed appointments, but also that patients expressed greater satisfaction with telehealth resources and a willingness to use these same resources again.[26] While staff at the MOH have hopes for these capabilities, funding and lack of a dedicated telehealth staff member to manage such a project are current barriers.

Conclusion

This study offers insight into the current telehealth status in the Republic of Palau and examines common obstacles to overcome to further telehealth at the MOH. Palau has a high utilization rate of different telehealth and distance learning programs, coordinated independently in the different departments within the MOH, and the department of health. Across all departments, a lack of equipment and infrastructure are barriers to the adoption of telehealth. To promote the advancement of telehealth 6 common challenges were identified: (1) lack of telehealth leader, (2) lack of telehealth facilitator, (3) unsuccessful distance learning, (4) lack of dedicated space, (5) lack of technological support and (6) lack of infrastructure to utilize telehealth with the rural clinics. Despite these, Palau is on the forefront of expanding telehealth in the Pacific. Telehealth has the ability to provide care to rural populations, streamline consultations, and increase staff training and skill. Many other Pacific Island communities face similar challenges in the adoption of telehealth, and Palau is poised to further develop its own programs to serve as an example of telehealth's capabilities in the Pacific.

Conflict of Interest

None of the authors identify a conflict of interest.

Disclosure

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Quality Improvement Projects as Training Tools for Family Medicine Residents and Faculty

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Abstract

Quality improvement (QI) is part of the future of medicine. However, QI concepts are often poorly understood by physicians. Although teaching QI is required in resident training, an effective QI curriculum is difficult to design due to competing demands from clinic schedules and required rotations. The objective of this project was to teach family medicine residents the basic concepts of QI and practical implementation skills based on use of a clinic population, electronic medical record (EMR) system, and Plan-Do-Study-Act (PDSA) cycles. To do this, the Family Medicine residents and faculty at the University of Hawai'i participated in a QI curriculum to improve diabetes care from October 2018 to February 2019 with 5 sessions consisting of lectures, videos, discussions about QI data for diabetes patients, and group activities. Residents and faculty used quality measures pulled from the EMR and PDSA cycles to discuss, select, and implement QI projects for diabetes patients. Pre- and post-tests measured participants' baseline and end QI knowledge and skills. All 18 residents and 12 faculty in the program participated in the curriculum. The pre- and post-test comparisons showed significant improvement in knowledge of QI concepts and the comfort level among residents showing a 59% average improvement in knowledge questions and a 57% average improvement in comfort level in implementing a QI project (Table 4). This study shows that a 5-session QI curriculum based on EMR and PDSA cycles successfully increased family medicine residents' and faculty's knowledge of QI concepts and skills.

Keywords

Quality Improvement, Residency Education

Acronyms

ACGME = Accreditation Council for Graduate Medical Education
BMI = Body Mass Index
EMR = Electronic Medical Record
GME = Graduate Medical Education
HbA1c = Hemoglobin A1c
ICD-10 = International Classification of Diseases Tenth Revision
IHI = Institute of Healthcare Improvement
IQR = interquartile range
IT = information technology
JABSOM = John A. Burns School of Medicine
PDSA = plan-do-study-act
QI = Quality Improvement
SD = standard deviation
UH = University of Hawai'i
UHFMRP = University of Hawai'i Family Medicine Residency Program

Introduction

In the current healthcare climate, it is essential for physicians to be proficient in actively and continuously conducting quality improvement (QI) in their patient panel. Along with ensuring high quality patient care, knowledge of QI concepts and skills is necessary for meeting graduate medical education (GME) requirements,[1] certificate maintenance, and licensure. Additionally, Medicare, health plans, and other payers now incorporate quality scores into provider reimbursement and incentive schemes. Despite this, physicians often lack the training to measure quality or implement QI in real-life clinical practices.[2]

To address this QI knowledge gap, the Accreditation Council for Graduate Medical Education (ACGME) requires the integration of QI into clinical curriculum. In family medicine, residents in training must complete a QI project and "systematically analyze practice using QI methods and implement changes with the goal of practice improvement".[1,3] Developing such a QI curriculum can be challenging given residents' clinical demands, training at off-site locations, and time constraints. The curriculum must teach not only QI concepts, but also the practical skills to effectively implement QI projects in busy patient settings.

QI curricula often emphasize how to conduct "top-down", generic, disease-management interventions rather than teach residents the skills to develop targeted QI projects that address their own patient population.[4-6] However, if graduating residents are expected to competently incorporate QI into their practice populations, they must learn to develop achievable QI projects that target specific, small populations with quick turnaround times. Smith et al describe a resident-led hospital QI project in which third-year residents completed limited root cause analyses and proposed interventions to achieve system-wide change in their inpatient population.[7] Evidence in the literature of similar resident-led QI efforts targeting outpatient community clinic populations is scarce.

In this study, a curriculum to teach QI concepts and skills to family medicine residents and faculty in a busy clinical practice was developed. The two goals were to:

1. Teach residents and faculty to use electronic medical records (EMR) as a QI tool for comprehensive, efficient gathering of quality data, ie, to identify patients, abstract clinical data, and track changes.

2. Teach residents and faculty to plan and complete QI projects using rapid Plan-Do-Study-Act (PDSA) cycles. [8]

Methods

Setting

The UH Family Medicine Residency Program (UHFMRP) is a community-based primary care practice with approximately 3600 patients served by 18 residents and 12 faculty (both full- and part-time). The residents and faculty operate in a busy, challenging clinic environment. The clinic provides a full range of care to children, adults and geriatric patients including general primary care, obstetrics/prenatal care and office-based procedures.

Curriculum Development and Delivery

Using concepts from the Institute of Healthcare Improvement (IHI) modules, the QI curriculum was developed and delivered by the first and second authors. The biostatistics lecture during the fourth QI session was led by the third and fourth authors. The number of QI sessions were determined by looking at the UHFMRP didactic schedule. The residents only have 1 half-day of didactics per week, and because the didactic schedule had already been finalized prior to the inception of this project, the QI sessions had to be scheduled whenever there was an opening in a half-day didactic. A total of 5 didactic half-days were open to deliver the curriculum. From there, the major objectives were mapped out and distributed across 5 QI sessions. A pre-test, which was adapted from the IHI and aligned to the major objectives, was subsequently developed to assess participants' baseline knowledge and comfort levels, with the intention of administering an identical post-test to assess their knowledge acquisition and impact on comfort levels. Finally, each QI session was developed using a variety of modalities (see below), ensuring complete alignment to the objectives and engagement from participants. The final curriculum was delivered at the Physician Center at Mililani, the UHFMRP headquarters (at the time).

UH Office of Research Compliance deemed this project exempt under the category of Quality Improvement.

Participants

Curriculum participants included all 12 faculty members and 18 residents of the UHFMRP. The faculty included physicians, a PharmD, and a behavioral therapist. All faculty and residents completed the pre-test and post-test. In terms of participation in QI sessions, however, 100% attendance was not achieved for various reasons. Not all faculty were available during didactic sessions due to competing obligations, particularly part-time faculty. Additionally, residents who were on away electives (rotations occurring at a site outside of a sponsoring institution or associated hospital) or on night float, did not attend didactics. Regardless, all faculty and residents were responsible for acquiring the material and assigned tasks from their teams (see *QI Projects* below).

Curriculum – QI Sessions

The QI curriculum was constructed as 5 sessions, between 1-2 hours each, occurring between October 2018 and February 2019 to teach residents and faculty concepts and skills of QI as it would apply to their clinic population. The 5 sessions focused on basic QI concepts, the PDSA cycle, QI's role in modern healthcare, presentation of extracted clinic data, and choosing a QI project (Table 1). Each session involved videos (acquired from the IHI website or YouTube) and short lectures (adapted from IHI modules) to teach QI concepts, followed by group discussions. Group discussions reinforced the content of the QI session and allowed participants to apply the content to the development of their own QI projects. Specific discussion questions for each QI session are outlined in Table 1. Diabetes was selected as the focus because it is very prevalent in the clinic's patient population, requires integration across healthcare teams, and has several ambulatory quality metrics under payment transformation. A diagram of the integration of curriculum components is displayed in Figure 1.

Use of EMR Data and Limited Patient Surveys

Concurrent with the teaching and discussion sessions, the clinic's information technology (IT) team used the EMR to abstract data on clinic patients with diabetes, including demographics (eg, age and sex), care received (eg, visit date) and quality of care measures (eg, HbA1C and blood pressure). The Biostatistics Core team within UH JABSOM's Department of Quantitative Health analyzed the de-identified patient data. Additionally, a second-year resident created and distributed a 4-question survey to 25 patients asking for thoughts and suggestions about delivery of care (ie, what the clinic was doing well and how the clinic could improve). Both the EMR and survey-based data were presented to the residents and faculty during the fourth QI session. The participants discussed the data in the context of the clinic's population with diabetes, which informed the selection of their QI projects.

QI Projects

The UHFMRP clinic had 3 teams – each team was comprised of 5-6 residents, 4 faculty members, 2 medical assistants, and 1 patient service representative. The development of QI projects occurred within this team structure. At each session, the teams worked on developing their unique QI projects. The teams submitted their final QI project proposals for approval by the first and second authors within 1 month of the last session. The residents chose home glucose monitoring, diet, exercise management, and medication compliance and understanding as top priorities based on the clinic data gathered (see *Use of EMR data and limited patient surveys).*

Table 1. Summary of Quality Improvement Teaching Sessions			
Session	**Total Duration**	**Content**	**Description**
1	1 hour	Pre-Assessment *Duration*: 20 min	Administered electronic 10-question pre-assessment (see Table 2) to all faculty and residents.
		Lecture: Introduction to Quality Improvement *Duration*: 15 min	One video and 6 slides on basic QI concepts: 1. 10 min. video by Dr. Mike Evans explaining QI and the PDSA cycle[10] 2. Two slides on the Swiss Cheese Model 3. One slide on 6 dimensions of quality in health care pre IHI 4. One slide on the process/steps of QI 5. One slide on the essential elements of a QI team 6. One slide on root cause analysis
		Activity: Whole Group Brainstorming *Duration*: 25 min	Whole group discussion around why patients with diabetes in their clinic might have difficulty with compliance, particularly regarding HbA1c measures (see Table 3).
2	1 hour	*Lecture*: PDSA Cycle and the Clinic *Duration*: 25 min	Two slides demonstrating the practical application of a PDSA cycle to a patient who has diabetes – taken from IHI education materials.[8]
		Activity: Clinic Care Team (Resident and Faculty) Brainstorming *Duration*: 35 min	Clinic care team group discussions around applying the PDSA technique to our own clinic population – focusing on potential opportunities and barriers.
3	3 hours	*Lecture*: Why Teach Quality Improvement? *Duration*: 1.5 hours	Guest lecturer (population health practice liaison) from local insurance company given 30 minutes to explain payment transformation and performance measurements. Word cloud exercise to discuss difference of quality of care based on perspective – ie, patients vs providers vs ancillary staff. Nine slides explaining why QI is being taught in the residency program. 1. Two slides on how healthcare is changing and how it is incorporating QI 2. Two slides on forming and leading a QI team 3. One slide on the goal of QI (moving patients to active participants in their care and the IHI triple aim of Population Health, Experience of Care and Per Capita cost 4. Three review slides of basic QI concepts (repeated from previous session) 5. One slide of PDSA cycle example (repeated from previous session)
		Activity: Clinic Care Team (Resident, Faculty and clinic staff) Brainstorming *Duration*: 1.5 hours	Clinic care team group discussions around potential interventions to address barriers to compliance that were discussed in Session one. Discussions during this session involved clinic staff members (registrars and medical assistants).
4	1 hour	*Lecture*: QI Review and Data Presentation *Duration*: 45 min	7 slides reviewing QI concepts & basic biostatistics (repeated from previous sessions): 1. Two slides defining QI 2. One slide reviewing the QI team 3. One slide reviewing the QI process 4. One slide reviewing PDSA cycle 5. Two slides on basic biostatistics 15 slides of clinic data analysis
		Activity: Whole Group Reflection *Duration*: 15 min	Residents and faculty reflected on the data that was presented, discussed as a whole group whether the data made sense, asked any questions about the data, and thought about how this data (or lack thereof) would inform their approach to QI.
5	30 minutes	*Lecture*: Selecting ABFM (American Board of Family Medicine) Performance Improvement Activity *Duration*: 15 min	Residents and faculty were shown how to select their required ABFM Performance Improvement Activity via a short (15 slides) step-by-step lecture, as residents and faculty followed along with their accounts.
		Activity: Clinic Care Team (Resident & Faculty) Selection of Intervention *Duration*: 15 min	Clinic care team group discussions about which specific intervention to develop. They also selected 10 patients to which they would apply their interventions.
		Post-Assessment	Administered electronic 10-question post-assessment (see Table 4).

Table 2. Assessment of Knowledge Acquisition and Comfort Levels Before and After Curriculum Implementation		
Item No.	**Question**	**Correct Answer**
1	How comfortable do you feel in implementing a Quality Improvement project by yourself on a scale of 1-5, with 1 being not comfortable and 5 being very comfortable	1-5
2	What are the six dimensions of quality in healthcare? a) Performance, features, reliability, durability, conformance, and serviceability b) Safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity c) Timeliness, completeness, consistency, conformity, accuracy, and integrity d) Patient-centeredness, timeliness, accuracy, completeness, safety, and integrity	b
3	What is a type of communication tool that "closes the loop" between sender and receiver? a) Advocacy inquiry b) Briefings and debriefings c) Verbal repeat back d) SBAR	c
4	What does data collection look like for quality improvement? a) Gather just enough data to inform improvement and only collect data on 1-2 confounders as needed b) Gather enough data to authoritatively study for effect and control for all known confounders c) Gather just enough data to inform improvement and control for all known confounders d) Gather enough data to authoritatively study for effect and only collect data for 1-2 confounders	a
5	Which of the following does NOT characterize a System Authority? a) Has authority in all areas affected by the change, who can overcome barriers that may arise b) Able to help the team determine what to measure c) Able to allocate time and resources to achieve the team's aim d) Understands the implications of the proposed change for various parts of the system	b
6	What is the scientific method used for action-oriented learning and tests a change in the real work setting? a) Vision-Plan-Execute (VPE) cycle b) Plan-Do-Study-Act (PDSA) cycle c) Problem-Plan-Solution (PPS) cycle d) Aim-Measure-Action (AMA) cycle	b
7	What is a written, measurable, and time-sensitive statement of the expected results of an improvement project? a) A vision b) An aim c) A hypothesis d) A measure	b
8	What are the essential elements of an improvement team? a) Clinical-technical expertise, healthcare providers, and day-to-day leadership b) Residents, faculty, and other healthcare employees c) System authority, clinical-technical expertise, and day-to-day leadership d) Faculty, clinical-technical expertise, and residents	c
9	What are the general steps (in the correct order) of a Quality Improvement project? a) Form a team → Set an aim → establish measures → identify changes → test changes → implement changes b) Set an aim → establish measures → collect data → identify changes → test changes → implement changes c) Form a team → set an aim → establish measures → collect data → identify changes → implement changes d) Set an aim → form a team → establish measures → identify changes → test changes → implement changes	d
10	What is a difference between quality research and quality improvement? a) The purpose of quality research is sustained improvement, whereas the purpose of quality improvement is proof of effectiveness b) The methods behind quality research involve a large test with a fixed hypothesis, whereas the methods behind quality improvement involve rapid sequential tests with a hypothesis that changes as learning takes place c) The data collecting process in quality research entails gathering just enough data to inform improvement, whereas the data collecting process in quality improvement entails gathering enough data to authoritatively study for effect d) Quality research requires no effort in controlling bias, whereas quality improvement requires controlling bias as much as possible	b

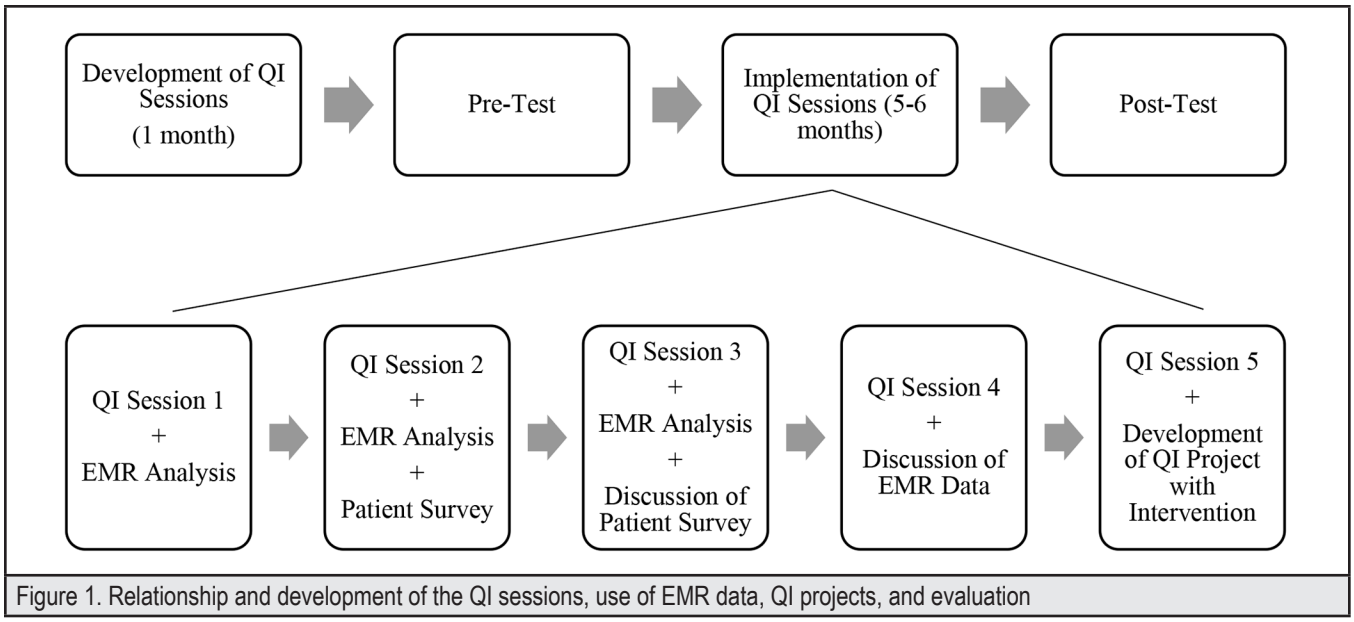

Figure 1. Relationship and development of the QI sessions, use of EMR data, QI projects, and evaluation

Evaluation

Teaching outcomes were measured with residents and faculty pre- and post-testing of QI concepts (Table 2). The test questions were adapted from the IHI website.[8] The post-test was administered 3 weeks after the last QI content lecture. Assessments were on paper, and data were entered manually into an Excel spreadsheet. Pre- and post-test results were summarized and compared using descriptive statistics such as mean, median, standard deviation (SD), and inter quartile range (IQR). Wilcoxon Signed Rank test was used for comparing pre- and post-scores, and R statistical software version 3.5.1 (R Foundation for Statistical Computing, Vienna, Austria) was used for data analysis.

Results

The curriculum was developed in September 2018. The curriculum was then delivered from October 2018 to February 2019 with 5 sessions consisting of lectures, videos, discussions of QI data for diabetes patients, and group activities. Teams developed their QI projects throughout the curriculum, using knowledge acquired from the QI sessions to inform their discussions and plans.

In order to develop the QI projects, the clinic's patient population was analyzed using EMR data. The clinic's patient population is racially and ethnically diverse (23% white, 32% Asian American, 25% Native Hawaiian/Other Pacific Islander). Most clinic patients have Medicaid (51%) or Medicare (13%), with about a third on private or commercial insurance. Seventeen percent of the patients have been diagnosed with diabetes, with 22% of those with poor control as measured by HbA1C levels greater than 9%. EMR data was used to identify 672 (out of a total of 4,037) patients in the clinic with an ICD-10 billing diagnosis of diabetes between July 2016 and June 2018. Data obtained from these records included zip code, insurance payer, age, sex, medications, body mass index (BMI), blood pressure, low-density lipoproteins, comorbidities, HbA1c, and visit counts.

Concurrent to the aforementioned EMR analysis, factors identified as contributing to the patients' diabetic compliance was determined during the first QI session team discussion. Such factors included challenging social situations, proximity to fast food, limited access to healthy food, and language barriers. The complete list of factors is presented in Table 3.

In the fifth and final QI session, each team applied everything they had learned, discussed, and planned from the QI sessions to inform the development of a 12-month intervention.

Knowledge acquisition and change in comfort level were assessed using pre- and post-testing. Results showed a 59% average improvement in knowledge questions and a 57% average improvement in confidence level in implementing a QI project (Table 4) for residents. While there was a statistically significant improvement in both knowledge acquisition and change in comfort level for the residents, the improvement in faculty scores was not statistically significant.

Table 3. Group Discussion Session 1: Population Factors Believed to Contribute to Poor Diabetic Compliance			
Demographics	**Socioeconomics**	**Clinical**	**Other**
• Age • Sex • Ethnicity/Race • BMI • Family history • Household size • Cultural emphasis on food • Language barriers	• Zip code • Insurance • Education level • Low wages • Proximity to fast food • Access to healthy food • Living situation	• Co-morbidities • Number of medications • Number of missed visits • Number of total visits • Aversion to needles/injectables	• No time to monitor glucose • Denial • Behavioral Health • Challenging social situations

Table 4. A Summary of Pre and Post Test Scores							
Comfort levels (question 1)[a]							
	Pre-Test		**Post-Test**		**Δ score**		***P*-value**
	Median (IQR)	**Avg. (SD)**	**Median (IQR)**	**Avg. (SD)**	**Median (IQR)**	**Avg. (SD)**	
Combined (n=30)	3.00 (2.00)	2.80 (1.27)	4.00 (1.00)	3.80 (.81)	1.00 (2.00)	1.00 (1.44)	.002
Residents (n=18)	2.00 (2.00)	2.33 (1.19)	4.00 (1.00)	3.67 (.84)	1.00 (2.00)	1.33 (1.44)	.003
Faculty (n=12)	4.00 (1.00)	3.50 (1.09)	4.00 (.50)	4.00 (.74)	.00 (1.00)	.50 (1.38)	.280
Knowledge questions (questions 2-10)[b]							
	Pre-Test		**Post-Test**		**Δ score**		***P*-value**
	Median (IQR)	**Avg. (SD)**	**Median (IQR)**	**Avg. (SD)**	**Median (IQR)**	**Avg. (SD)**	
Combined (n=30)	4.50 (2.00)	4.20 (2.00)	5.50 (3.75)	5.60 (2.06)	1.50 (3.00)	1.40 (2.36)	.005
Residents (n=18)	4.00 (2.00)	3.56 (1.50)	6.00 (2.75)	5.67 (2.00)	2.00 (2.00)	2.11 (2.14)	.003
Faculty (n=12)	5.00 (3.00)	5.17 (2.29)	5.00 (4.25)	5.50 (2.24)	.00 (2.25)	.33 (2.35)	.675

[a] Question 1 was on a scale of 1-5.
[b] Questions 2-10 were given 1 point for each correct answer.

Discussion

The first goal of this curriculum was to teach residents and faculty to use EMR as a QI tool for comprehensive, efficient gathering of quality data. The initial discussion in session 1 was used to formulate a list of variables to pull from the EMR. The results of this discussion are presented in Table 3. Unfortunately, a lot of these variables were not easily captured in our EMR. This knowledge was used to improve the EMR system by creating new fields where some of this information can be stored, such as household size, living situation, and education level. Going forward, this will improve the EMR's capabilities of designing better informed QI projects.

The second goal of this curriculum was to teach residents and faculty to plan and complete QI projects using rapid PDSA cycles. The residents and faculty have completed the curriculum and successfully identified and planned out their QI projects. However, there are no clinical outcome data to date because the QI projects are still ongoing. Regardless, the residents and faculty understand the necessary steps in a PDSA cycle as evidenced by their knowledge acquisition and comfort levels. While the residents showed a statistically significant improvement in both knowledge acquisition as well as comfort level, the faculty who participated did not reach statistical significance in their improvement. This is likely because of the smaller number of faculty involved. We still believe it was important to have the faculty involved in the learning as they are key players in the training of the residents and also key players in the delivery of care to our patients.

Implementing a QI curriculum in a residency training site is challenging but feasible. The biggest challenge was the paucity of time available outside of resident rotations, which led to difficulties tracking down pre and post tests and team assignments. With increased charting requirements to cover all the quality measures already required by insurance companies and health partners, the residents already have little time to spare. In a given 80-hour work week, residents are in clinic between 1 and 4 half-days a week and, with the time that is not spent on external rotations, they need to work on finishing the charting for those clinic hours. The residents only have a half-day of didactics scheduled per week. QI sessions were scheduled during this time. However, the breadth of topics that must be covered in Family Medicine training made it difficult to carve out time for QI. In total, QI training took 5 and a half hours over 6 months. The time in didactics was used to learn concepts and develop interventions. Based on lessons learned from this project, a future directive would be to dedicate 30 minutes to 1 hour every month for teams to follow up on QI projects.

An ideal QI curriculum would address knowledge of what quality care is, who are the essential elements of an improvement team and how to work with them, how to utilize data (and an EMR to collect it) as well as how to develop an aim, and how to work through a PDSA cycle. While the residents have demonstrated understanding of how to work through a PDSA cycle, there were challenges with some of the other curriculum components.

Understanding what quality care is for patients proved to be a challenge because of residents' proximity to issues of resident wellness and lack of experience focusing on QI in patient care. This was addressed by incorporating a few exercises to get residents and faculty discussing quality care as seen by patients. One technique was to discuss "What is good care from the perspective of a physician?" and "What is good care from the perspective of a patient?" A second technique was to present the patient survey results to the residents and faculty to read and discuss. These 2 strategies proved to be useful, and the subsequent discussions were more patient-centered.

One of the goals of QI, according to IHI, is to move the patient from a passive to an active recipient of care.[8] A good way to do this is to include them in the early stages of planning a QI project. Having patient representatives involved in the QI curriculum would be1 way to accomplish this. While this project was able to include the ancillary staff and high-level decision makers in the QI teams, it was not able to include patient representatives. This is still a future consideration because the team believes that an important step for any residency program developing a QI curriculum is to help the residents and faculty see that the challenges they personally face in healthcare delivery do not always translate to challenges in patient healthcare. Likewise, it is important to realize that the challenges patients see in receiving healthcare are not always factors that jeopardize the delivery of quality care.

Curriculum success factors included choosing core concepts of QI and repeating them at every session. Multiple studies have shown that spaced repetition improves retention.[9] Incorporating team-based brainstorming proved an engaging way to reinforce this knowledge. Having the ancillary staff involved in the group discussions proved beneficial. The residents expressed they did not realize the challenges to workflow experienced by the staff or the different perspectives they afforded. Including patient surveys in group discussions was helpful to allow the groups to see the patient point of view. Finally, resident and faculty "buy-in" was accomplished by having them register for an activity required for their boards or recertification, thus saving time in their busy workday. Despite all these challenges, the rewards of creating a QI curriculum for the residents were enough to justify continued work on sustainable implementation to programs, possibly through the use of improved EMR systems and incorporation of online training.

A limitation of this study was that it was conducted at only 1 training program and clinic site. While the curriculum can be replicated by other programs, it would likely require modifications tailored to address individual program constraints.

Conclusion

In summary, residents must receive training and experience in QI. Yet too often this training and experience is not robust or effective. The research team developed a way to teach residents QI by having them complete a QI project on clinic patients and involving them in every step, thereby helping them learn the process of QI. This 5-session QI curriculum based on EMR and PDSA cycles successfully increased family medicine residents' knowledge of QI concepts and skills.

Conflict of Interest

None of the authors identify a conflict of interest.

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Identifying the Physical and Emotional Needs of Health Care Workers in Hawai‘i During the COVID-19 Pandemic

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Abstract

A mixed-methods study was performed to identify the physical and emotional needs of Hawai‘i health care workers during the COVID-19 pandemic, and the degree to which these needs are being met by their clinic or hospital. Qualitative interviews and demographic surveys were conducted with two cohorts of health care workers. Cohort 1 (N=15) was interviewed between July 20 - August 7, 2020, and Cohort 2 (N=16) between September 28 - October 9, 2020. A thematic analysis of the interview data was then performed. Participants' primary concern was contracting the illness at work and transmitting it to their families. Solo practitioners working in outpatient clinics reported more financial challenges and greater difficulty obtaining PPE than those employed by hospitals or group practices. While telehealth visits increased for both in-patient and out-patient settings, the new visit type introduced new barriers to entry for patients. The study findings may serve to better understand the effect of COVID-19 on health care workers and support the development of hospital and clinic procedures. Further research into the impacts of COVID-19 on nurses in Hawai‘i is recommended.

Keywords

Coronavirus, COVID-19, Health Care Worker, Physical Health, Emotional Health, Hawai‘i, Health Care

Introduction

COVID-19 is a highly infectious disease caused by SARS-CoV-2 that was first identified in Wuhan, China.[1] Posing significant morbidity and mortality, the virus has created feelings of fear and anxiety among health care workers (HCWs). Social distancing mandates and shelter-in-place policies have been created to protect members of the community and stop the spread of the disease. For HCWs, these shelter-in-place policies are not possible to follow since their work is essential for the health of their communities. The COVID-19 pandemic has created vulnerabilities among HCWs by exposing weak spots in the health care system. Health systems in major cities are under unprecedented strain from the high demand for health care in hospitals and intensive care units (ICUs).[2] There was also a shortage of personal protective equipment (PPE) in the hospitals and a limited amount to adequately protect HCWs as they dealt with the incoming amounts of patients.[3]

Health Care Worker Mental Health Outcomes

During major epidemics, there is an increase in demand for HCWs, putting them in a vulnerable position for increased levels of anxiety from long work hours and limited resources.[4] A cross-sectional study in China between January 29, 2020 and February 3, 2020 identified that medical staff experienced more moderate to severe fear related to COVID-19 than administrative staff, 70.6% and 58.4% respectively.[5] Further research conducted with medical staff in China indicated that 50.4% of participants reported symptoms of depression, 44.6% endorsed anxiety symptoms, 34.0% insomnia, and 71.5% distress.[6] Those directly treating patients on the front line also experienced more psychiatric symptoms than those on the second line.[6] Interestingly, there were lower rates of burnout among medical staff working with COVID-19 patients due to an increase in a sense of personal accomplishment.[7,8]

Lessons from Previous Outbreaks

As noted, the impact of the COVID-19 pandemic has had significant negative effects on the emotional health and well-being of HCWs. The aforementioned negative effects are similar to those experienced following other pandemics. For example, one year after the global SARS outbreak in 2003, HCWs exhibited significantly higher levels of psychological distress than non-HCWs in all dimensions including post-traumatic stress, depression, anxiety, intrusion, avoidance, and hyperarousal.[9]

The psychological distress of working during an outbreak may also lead to more absenteeism among HCWs. Previous studies have shown that the provider's willingness and ability to work changes during a pandemic situation.[10] One study found that if HCWs were asked to go to work during an influenza pandemic, 28% would be unlikely to respond.[11] However, another study conducted during the A/H1N1 pandemic showed that most HCWs would continue working despite the possible risks.[12]

Disparities among Female Health Care Workers

Although infectious outbreaks can impact HCWs in different ways, female HCWs appear to be more vulnerable to developing negative mental health outcomes. Female health care providers make up 88.2% of registered nurses and 36% of physicians.[13,14] Female HCWs exposed to COVID-19 in China were found to have more severe symptoms of depression, anxiety, and distress than male HCWs.[6] Female HCWS were also found to be more likely to have primary responsibility for household chores, making it more difficult for them to have a positive work-life balance.[15,16] For some female HCWs, an increase in hours

because of COVID-19 led to unsatisfactory work-life balance, an increase in work-family conflicts, and the development of adverse psychological health effects.

Purpose of this Study

Limited research has been conducted on the impact of COVID-19 on the physical and emotional health of HCWs in Hawai‘i during the time of this study. The main objective of this study was to identify how COVID-19 has affected the physical and emotional health of HCWs in Hawai‘i.

Methods

Original Study Design

Key-informant interviews were conducted with HCWs in the state of Hawai‘i about their experiences with COVID-19. This study was reviewed and approved by the University of Hawai‘i at Mānoa Human Studies Program (Protocol ID: 2020-00511). Participants were a convenience sample of HCWs identified through the snowball sampling method. Identified individuals were asked to provide the name of colleagues they knew who might be interested in participating. Once 16 participants were recruited and interviewed, all recruitment stopped. The inclusion criteria required participants to be HCWs (i.e., physicians or nurses) who worked in a hospital and/or clinic, adults over eighteen years old, and individuals who worked with patients during the pandemic. Participation was not restricted to those who interacted with known COVID-19 cases, as the risk of exposure during a pandemic existed in any direct patient interaction. Participants were offered a $20 gift card to CVS or Starbucks as a thank you for their participation.

Some interview questions included: “How has your sense of physical and emotional safety and security in the workplace changed since the beginning of COVID-19?” and “How have these experiences changed the way you will do your work moving forward?”

IRB Changes

The total number of participants was expanded from the original 16 to 35 participants to include a second round of interviews. The purpose of these added interviews was to gather information on the spike in COVID-19 cases in the state of Hawai‘i which occurred during August and September 2020, which prompted the lockdown on August 27, 2020. The questions asked during the interviews were the same to allow for comparisons between the two data collection periods. However, the option of “unsure of COVID-19 exposure” was added to the survey question regarding exposure because many participants were unsure or categorized exposure as “never”.

In total, thirty-one participants were recruited in two cohorts (N=15, N=16). Each data collection period occurred between July 20 and August 7 or September 27 and October 17 of 2020 (Figure 1).

Questionnaire Design

The interviews consisted of 12 closed-ended, demographic questions and 10 open-ended, semi-structured questions. As COVID-19 was a rapidly-evolving situation, the questions were designed to document issues and concerns that were emerging in literature and media coverage during the pandemic response. The questions were developed and selected under the guidance of a clinical psychologist. Closed-end questions were used to gather basic demographic data on the individual and their health care setting. The open-ended interview questions asked for: (1) participants’ perspectives on the impact of the COVID-19 pandemic on their wellbeing in their health care setting; (2) how their needs are being met by their employer; and (3) their ideas about how to best ensure their physical and emotional safety.

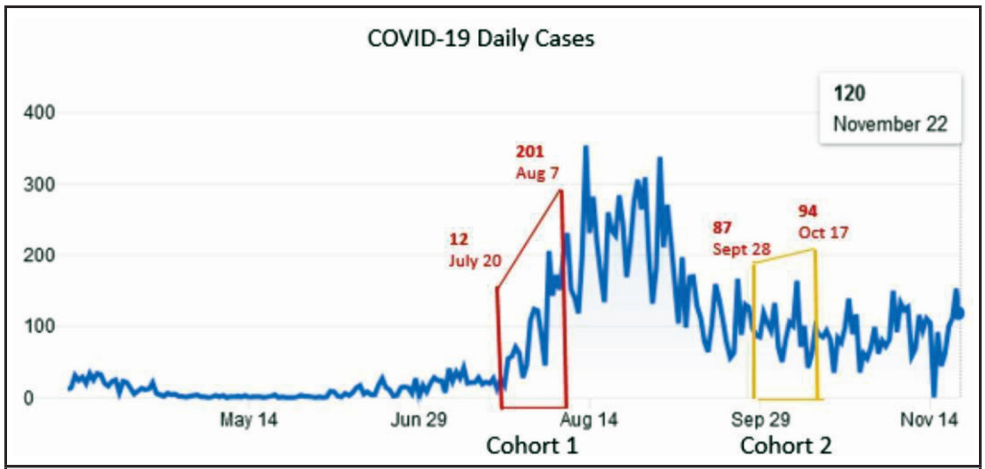

Figure 1. Number of COVID-19 Cases during the Study Cohorts

Note. This figure depicts Hawai‘i’s cases count from the beginning of the pandemic through the point of data collection of cohort 1 and 2.[18]

Study Protocol

A team of two researchers worked together to conduct the interviews, which were recorded through audio-only Zoom sessions. Each interview session lasted approximately 1 hour. The first 15 minutes were dedicated to reviewing the consent form, obtaining oral consent, and administering the demographic survey. The rest of the interview was dedicated to the 10 open-ended interview questions. Transcripts were coded and a thematic analysis was performed by identifying recurring subject matter, thoughts, and concerns that were mentioned and related to participants' stressors and needs.

Results

Demographic Surveys

Participants self-reported their occupation and their work setting prior to the pandemic, whether they were in a clinic (outpatient), a hospital (inpatient), or a mix of both. Survey participants included 28 physicians and 3 registered nurses, with all three nurses working in acute care settings within hospitals. More than half (54%) of the participants were primary care physicians, with 23% working in mixed settings and 32% exclusively in the hospital (Table 1).

Participants were asked about their degree of worry about the COVID-19 pandemic, their overall wellbeing at the beginning of the pandemic as well as their degree of worry at the time of the survey. HCWs in Cohort 1 self-reported a higher level of worry at the time of the interview compared to the beginning of the pandemic, whereas Cohort 2 showed the opposite (Figure 2). This is supported by the increase in mean levels of worry from the beginning of the pandemic until the time of the assessment for Cohort 1 and a decrease for Cohort 2.

Table 1. Demographic Characteristics of Participants (n=31)

Characteristic	Cohort 1 (n=15)		Cohort 2 (n=16)		Both Cohorts (n=31)	
	n	%	n	%	n	%
Gender						
Female	7	47	13	81	20	65
Male	8	53	3	19	11	35
Age						
18-30 Years Old	2	13	1	6	2	6
31-39 Years Old	6	40	6	38	12	39
40-49 Years Old	4	27	5	31	9	29
50-59 Years Old	2	13	3	19	5	16
60+ Years Old	1	7	1	6	2	6
Race/Ethnicity						
Caucasian	3	20	5	31	8	26
Filipino	4	27	3	19	7	23
Chinese	3	0	2	13	5	16
Japanese	1	44	1	6	2	6
Other Asian	1	54	1	6	2	6
Mixed Ethnicity	3	20	3	19	6	19
South Asian	0	0	1	6	1	3
Provider Type						
Physician	14	93	14	88	28	90
Registered Nurse	1	7	2	13	3	10
Specialty						
Primary Care	10	67	6	38	16	52
ICU	3	20	4	25	7	23
Other Specialty	2	13	6	38	8	26
Work Setting						
Clinic	11	73	3	19	14	45
Hospital	3	20	7	44	10	32
Mixed	1	13	6	38	7	23

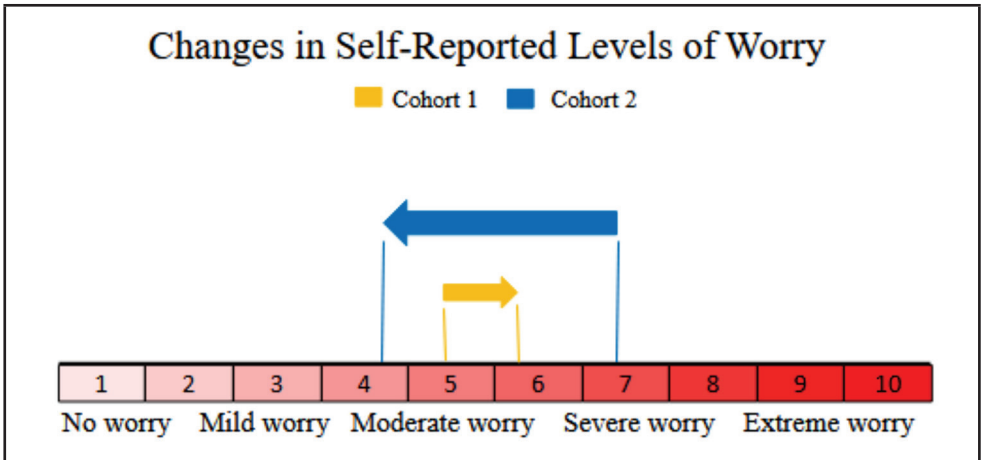

Figure 2. Changes in Participant Self-Reported Levels of Worry

Note. For Cohort 1, the mean worry in participants increased from 5.7 to 6.3 as time continued. In Cohort 2, the mean worry decreased from 7.4 to 4.3 as time continued.

The survey data assessing the levels of worry suggests that hospitals and clinics have better-supported HCWs in Hawai‘i as the pandemic has continued. When comparing the levels of worry for both cohorts to the number of current cases, the increase in cases is reflected in the increase in mean worry. Cohort 1 was measured between July 12 and August 7, 2020 where Hawai‘i experienced a drastic increase from 12 cases to 201 new cases, respectively.[17] The increase in cases is reflected in the rise of worry level among participants, with the mean current level of worry rising by 6%. After the spike in cases during August and early September, cases decreased and Cohort 2 expressed a decrease in worry from initial worry to a mean present worry by 31%.[17]

Interviews

1. Emotional Effects

The interview results revealed several common themes in both cohorts. The emotional effects on the individuals were largely negative. In particular, participants expressed anxiety and paranoia over the possibility of contracting COVID-19 at work and unknowingly transmitting the virus to their loved ones or colleagues. One participant stated, "*Every day that you go to work you [are] worried about someone in your team is going to get sick, that someone will die from your team."*

Participants reported feelings of frustration towards their employer, the state, or federal government for not making changes to better support and protect health care workers. Other points of frustration were towards individuals who didn't wear masks or follow social distancing mandates. Another participant stated, "*There are people that don't believe what they see on the news or what you do in the hospital, and it undermines what you do at work.*"

Participants observed that their mental health improved with consistent knowledge of best practices for PPE that they could use in medical practice.

2. Physical Effects

A majority of the participants in both groups reported lower levels of physical activity because of the closure of gyms. However, some physicians who started working from home reported an increase in physical activity because the time usually spent commuting was able to be dedicated to exercising. These participants also stated that they were able to spend more time with their family since they were all together in the same house. Individual health concerns primarily focused on weight changes.

In both cohorts, individuals reported being more meticulous about their hygiene and environment to protect themselves, colleagues, and family. Several participants reported that there had been a loss of opportunities for themselves and their family members. The loss of opportunities included networking opportunities while physically attending conferences rather than virtually and the inability of participants' children to move away to attend college due to the switch to online learning.

Participants in hospital settings expressed feeling drained from physically going to work and having to wear PPE. Participants who worked in the ICU felt safer working and wearing their full PPE gear than outside of work. Other participants, who worked in out-patient settings, felt safer when their workplace culture promoted an increase in diligence with social distancing and use of PPE.

3. Workplace Effects

Participants noted a change in their workplaces. Some reported that having to switch between telehealth and in-person visits altered their workflow. Social distancing contributed to less socialization during downtime between coworkers.

Participants noted that the pandemic generated an increase in communication within group practices and hospital systems. Participants reported communicating with coworkers from different locations more frequently than before the pandemic. Participants mostly felt positive regarding the initial response of hospitals and health care organizations on the island, but others also noted that there could have been a more cooperative response between the different medical systems as a whole.

Other effects reported were a more tolerant workplace for family leave and burnout prevention. Participants in academic roles observed the loss of mentorship, learning opportunities, and critical clinical experiences in rotations for residents and medical students.

4. Telehealth and Patient Care

Nearly all physicians reported an increase in the use of telehealth, regardless of whether they practiced in a hospital or clinic setting. Several mentioned medical practice has been less fulfilling since PPE has made communication and the connection between patient and provider more difficult. Some participants experienced discomfort wearing masks due to the constant pressure on their faces. All mentioned that they are more cautious around patients and experienced an increase in difficulty when communicating with patients since wearing PPE hid facial expressions and muffled sounds.

All physicians believed that telehealth is a good option for both the patient and provider and will be used much more frequently in the future. Some participants working in private practice have started using telehealth for almost all patient care, switching from in-person care to virtual care. Some providers identified finding appropriate telehealth platforms for their unique work

environments to be a major challenge, and noted barriers for elderly and underserved populations such as poor internet connectivity and low technological literacy. While some health care providers were initially concerned about negative outcomes such as a decline in the quality of conversation, they reported being pleasantly surprised that was not the case.

5. Private Practice Challenges

Clinicians reported more financial challenges than those employed by hospitals or group practices. Many clinics closed at the beginning of the pandemic and began to see fewer patients to follow social distancing guidelines. Spacing out appointments to reduce crowded waiting rooms, and facing more cancelations and no-shows caused clinics to experience financial losses during the pandemic. Payment protection loans were utilized to avoid laying off staff. "*Finances scary at first, so there were few patients at first... But with the payment protection program, that helped."*

Physicians who worked in clinical settings or owned private practices reported that clinics were less supported in sourcing PPE than hospitals. "*The hospital provided all of the appropriate PPE that we needed… What was lacking was that same stash of equipment that I did not have for my staff.*" These challenges included having their usual suppliers favor hospital orders over their business, price gouging of needed supplies, or needing to make new purchases such as plexiglass for barriers. Individual private practices reported that free PPE programs from community medical associations or the City and County of Honolulu's "Back On the Wave" program were beneficial resources.

6. Mental Health Resources

Participants' experiences of mental health resources were mixed, with some reporting no resources or support, while others identified multiple resources. A majority of participants in hospital settings were aware of counseling services and hotlines being offered, but never personally felt the need to utilize them. Several observed that chaplains were also available to them on different department floors with light refreshments.

Participants identified a variety of services offered, including counseling, meditation, yoga, relaxation apps, free lunch offered by their hospital, and a hotel program. The services utilized by participants most frequently were the relaxation apps, free lunch, and the hotel program. Participants reported the most useful resources were the rapid tests, daily COVID meetings, and UV sanitation for N95 masks.

7. Regional Attitude

In both cohorts, individuals reported feeling fortunate to live in Hawai'i since there have been fewer cases in the state compared to the continental US. A majority felt positively towards COVID-19 response from hospitals and organizations in the state, but noted the coordination between the different medical systems (hospitals, clinics, organizations, etc.) could have been improved. Participants in the first cohort attributed the low cases to the fact that Hawai'i was geographically isolated, which prompted stricter travel restrictions.

"We are an island with relatively low resources. Any spike [in positive cases], we will run out of our capabilities. We can't easily send a patient to another hospital if all our hospitals are full."

Cultural differences between Hawai'i and the continental US were frequently mentioned. Participants identified local attitudes and the emphasis on family and community to be the reason for low case numbers. Multigenerational housing in Hawai'i was identified as a contributing factor to community spread. When reflecting on Hawai'i's surge in cases in comparison to those in other COVID-19 hotspots, one participant reflected: "*We got off easy, because when our surge happened, we were ready…we didn't have to experience it like they had*."

Differences between Cohort 1 and Cohort 2

Several participants in Cohort 1 reported the feeling of working hard, but not doing enough. This sentiment was not repeated in the second cohort. Some participants in Cohort 2 reflected on the possibility that Hawai'i had a false sense of security at the beginning of the pandemic since the islands were geographically isolated.

Participants in Cohort 2 discussed several workplace effects from COVID-19 not previously mentioned. Participants expressed concerns regarding the inability to social distance in the breakroom, the slowdown in workflow due to lost time spent putting on and taking off PPE, the need to retest patients for COVID-19 as a precaution against false negative readings, having enough trained staff to use certain equipment, and the importance of effectively redistributing and utilizing staff where needed.

The survey data assessing the levels of worry suggests that hospitals and clinics have better-supported HCWs in Hawai'i as the pandemic has continued. When comparing the levels of worry for both cohorts to the number of current cases, the increase in cases is reflected through the increase in mean worry. Cohort 1 was measured between July 12th and August 7th where Hawai'i experienced a drastic increase from 12 cases to 201 new cases respectively.[17] The increase in cases is reflected in the rise of worry level among participants, with the mean current level of worry rising by 6%. After the spike in cases during August and early September, cases decreased and Cohort 2 expressed a 31% decrease in worry from initial worry to a mean present worry.[17]

Discussion

The study identified a need for additional mental health resources offered by employers. Resources found to be helpful to participants in clinics were based on workplace communication, clear information of what supplies were available, and flexible work environments. Participants were concerned that new "forgiving" workplace attitudes that emerged from COVID-19, would be diminished after the pandemic subsides. These new workplace attitudes included increased leniency toward leave for child care or to prevent burnout. It is recommended that employers support initiatives to improve work culture in support of positive work environments.

In the clinical setting, clinicians in independent practices cited difficulty in obtaining and affording PPE supplies. They noted the importance of grants from local governments to obtain PPE, community medical organizations that allowed for the ability of group purchases, and donations from patients. In both outpatient and hospital settings, physicians stated they felt safer in their workplace since PPE was easier to access.

Participants working in outpatient clinics reported that PPE was more difficult to source because distributors favored hospital client orders and clinics had less financial support to afford new supplies. Generally, outpatient clinic staff were limited to surgical or cloth face mask use, social distancing, and handwashing as basic safety exposures. This led participants to worry that COVID-19 transmission is more likely to occur in clinics than in hospitals where full PPE equipment could be used to see patients. Perceived hoarding of PPE from hospitals was a point of frustration for clinicians. It is recommended that medical systems regulate their PPE stores and create a system for appropriate distribution between clinic and hospital settings.

The decrease in worry among Cohort 2 may be due to the fact that participants already experienced the surge in COVID cases and had a lower number of cases at the time of their interviews. Another contributing factor could be that Cohort 2 had new information regarding COVID-19 that was not available to Cohort 1 and hospitals and clinics had taken advantage of the brief period to adjust policies and workflows as seen fit.

Limitations

The overwhelming majority of the participants were physicians, leaving nurses and other HCWs underrepresented. During recruitment, some nurses declined to participate due to concerns about their ability to speak freely about COVID-19 and their workplaces. This area may need to be explored further.

The survey question regarding ethnicity did not account for participants who were of mixed ethnicities and grouped them together as "mixed". The survey question regarding health care settings also categorized those who worked in multiple settings as "mixed".

There is a lack of research studies on COVID-19 and the impact specifically in Hawai'i. The effects of COVID-19 are still ongoing and further investigation into this topic is suggested.

Conclusions

Key resources and services that contributed to HCWs' sense of safety included available PPE, good communication and leadership from employers to HCWs, and new information regarding best practices against COVID-19. The differences in workplace effects point to that as the COVID-19 pandemic changes and develops so must hospitals and clinics in order to effectively respond to the needs of the community and staff.

Conflict of Interest

None of the authors identify a conflict of interest.

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Factors Related to Pediatric Readmissions of Four Major Diagnostic Categories in Hawai‘i

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Abstract

Readmissions are a key quality measure for health care decision making and understanding variables associated with readmissions has become a crucial research area. This study identified patient-level factors that might be associated with pediatric readmissions using a database that included inpatient data from 2008 to 2017 from Hawai‘i. Four major diagnostic categories with the most pediatric readmissions in the state were identified: respiratory, digestive, mental, and nervous system diseases and disorders. The associations between readmission and patient-level variables, such as age, sex, race/ethnicity, insurance status, and Charlson Comorbidity Index (CCI), were determined for each diagnosis and for overall readmissions. CCI and insurance were the strongest predictors when all diagnoses were combined. However, for some diagnoses, there was weak or no association between CCI, insurance, and readmission. This suggests that diagnosis-specific analysis of predictors of readmission may be more useful than looking at predictors of readmission for all diagnoses combined. While this study focused on patient variables, future studies should also incorporate how hospital variables may also be related to diagnosis.

Keywords

Patient Readmission, Pediatrics, Hawai‘i, Comorbidities, Health Disparities

Abbreviations

AUC = Area under the Curve
CCI = Charlson Comorbidity Index
CI = Confidence Interval
MDC = Major Diagnostic Category
NHPI = Native Hawaiian and Other Pacific Islander
OR = Odds Ratio
PPR = Potential Preventable Readmission

Introduction

Around 6.5% of hospitalized children have experienced a hospital readmission.[1] Re-hospitalized children often require a disproportionate amount of medical services and resources, resulting in higher medical costs and multiple hospitalizations.[2,3] Increased number of hospital visits can also negatively affect children's lives by increasing school absences,[4] development of posttraumatic stress response,[5] and family conflict.[6] In addition, multiple hospital visits across different hospitals can lead to a disconnect of patient health information, thereby increasing the risk of medical errors.[7]

While the overall readmission rate for pediatric patients is low, readmission rates vary by diagnosis. One multi-hospital study found that the most common reasons for pediatric admission were mood disorders, asthma, pneumonia, bronchitis, and epilepsy.[8] Type of diagnosis was strongly related to readmission risk. For example, 21.1% of children with neoplasm-related conditions such as leukemia or brain cancer, experienced an unplanned readmission within 30 days, compared to 9% of those with a mental disorder diagnosis and 6% of those with a respiratory-related diagnosis.[1]

Patient level variables also relate to readmission. Underserved populations, such as minorities and those with lower social economic status, have a higher risk of readmission even when controlling for diagnosis.[1,3,9–15] Studies have found that adult Native Hawaiian patients have higher rates of readmissions when compared with White patients.[16–18] However, there has been limited research looking at these variables among pediatric patients and their relationship to readmission in Hawai‘i. Some variables related to readmission are not tied to the patient, but to the environment instead. Variables such as day of visit, weather patterns, family composition, and peer relationships may correlate to readmissions for some diagnoses.[19–23]

Even with many variables identified, prediction of patient readmission has not been very successful.[24] It is even more challenging for pediatric readmissions as they have not been as well studied as readmissions for adults.[1] To fill this gap, this study focused on (1) identifying major diagnostic categories prevalent in the pediatric in-patient population in Hawai‘i and (2) exploring patient-level variables related to readmissions within each of those major diagnostic categories.

Methods

Sample

This was an observational retrospective study using statewide in-patient pediatric data for nearly all hospitals in Hawai‘i for the years 2008 to 2017.[25] The University of Hawai‘i Institutional Review Board deemed this study exempt from review. The dataset had detailed discharge information including unique patient identification (ID) numbers that allowed the tracking of patients within and across hospitals, Major Diagnostic Categories (MDCs) for each visit, and a potentially preventable readmission (PPR) chain indicator. A readmission chain was determined as a sequence of PPRs that were "clinically related to the initial admission," based on the 3M software, version 20 (3M Health Systems Information, Maplewood, MN). A readmission was considered potentially preventable if it could

have possibly been prevented with better quality of care at hospitalization, better discharge planning or follow-up, or better coordination between out and in-patient health care providers.[26] As a readmission chain is tied to its initial admission, readmissions might have different diagnoses from the initial admission diagnosis but initial admission MDC was used for classification of readmission. MDCs were classified using ICD-9 and ICD-10 codes depending on the year.

There were a total of 230 021 in-patient visits for patients under the age of 18 years. Excluded were newborn related visits (171 273 records), transfers (8506 records), visits with Department of Defense insurance (26 046 records), visits that included a non-Hawai'i resident (4237 records), and those who were marked as deceased during the first visit (832 records). Patients with Department of Defense insurance were excluded due to incomplete patient demographics. Additionally, if the initial visit in a readmission chain was excluded according to criteria above, the complete chain of visits was also removed (226 records). The final dataset contained 41 918 visits among 29 694 unique patients (Figure 1).

Patient-level Variables

Patient-level variables available were age, sex, race/ethnicity, patient geographic location, type of insurance, and Charlson Comorbidity Index (CCI).[27] After exploring the distribution of race/ethnicity, the race/ethnicity variable was categorized into 5 groups - White, Filipino, Native Hawaiian/Pacific Islander (NHPI), Asian but not Filipino, and other/unknown. Race/ethnicity was self-reported and patients chose the race/ethnicity they most closely identified with. Type of insurance was categorized as public (Medicare or Medicaid) versus all other payment types, which included mostly private insurance but also some self-pay and miscellaneous. Among the 4 MDCs in the "all other payment types" category, 94% had private insurance. Patient residence was classified as O'ahu island versus all other Hawaiian islands. CCI was categorized as 0 vs ≥ 1 to compare people with comorbidities to people with no additional conditions.

Statistical Analysis

First, the number of patients with a readmission by MDCs was determined. The top 4 MDCs with the most unique patient readmissions were identified for further investigation of the association between patient-level variables and readmission. If patients had multiple admissions for an MDC, 1 visit (initial visit if admission was part of a readmission chain) was randomly selected when assigning demographic variables to the patient. A multivariable logistic regression model was developed using R Statistics, 4.0.2 (R Core Team, Vienna, Austria) with the patient-level variables for all MDCs combined and for each of the 4 top MDCs. Odds ratios (ORs) and their 95% confidence intervals (CIs) were used to estimate the strength of the association between a patient-level variable and readmission. The area under the receiver operating characteristic curve (AUC) was calculated to evaluate the accuracy of the models. Statistical significance was set at $P < .05$.

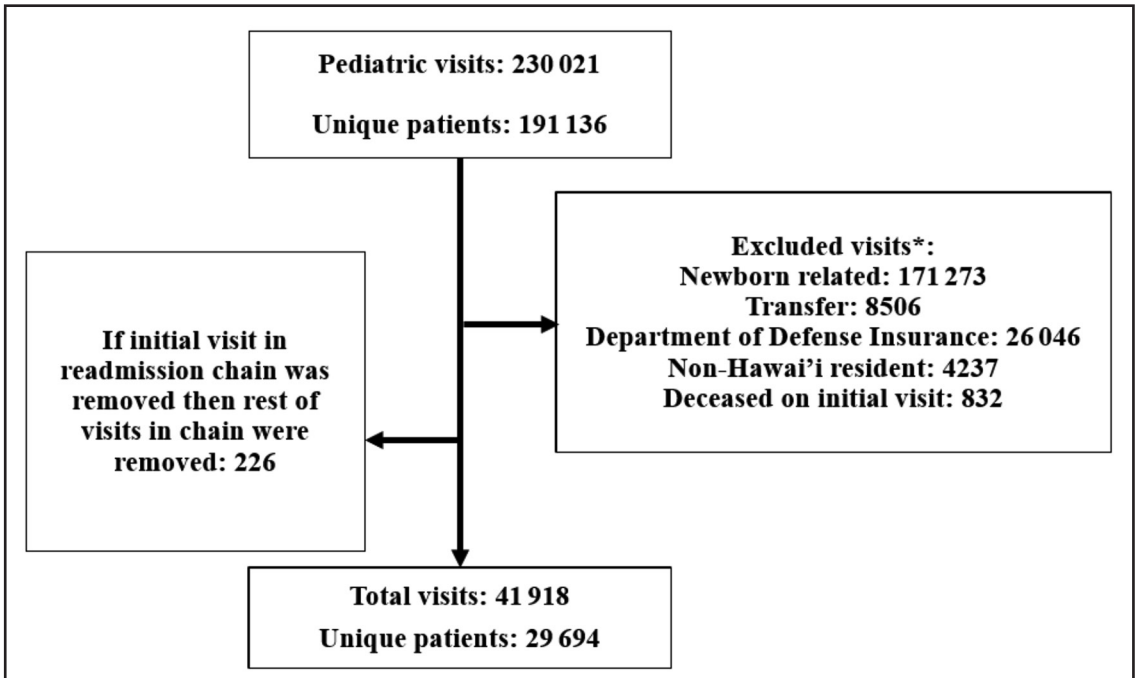

Figure 1. Pediatric Readmission Study Inclusion Flowchart, Hawai'i 2008-2017

Results

Pediatric inpatient data, including readmissions, were summarized for MDCs (Table 1). The 4 diagnosis categories with the largest number of patients who had a readmission, each with at least 100 patients readmitted, were: diseases and disorders of the respiratory system (279 readmissions, percent who had a readmission = 4.1%), digestive system (171 readmissions, 4.4%), mental diseases and disorders (153 readmissions, 9.1%), and nervous system (118 readmissions, 4.5%).

A multivariable logistic model was created for all pediatric patients, regardless of diagnosis (Table 2). When looking at pediatric patients overall, the average age was 7.3 years and 51% were male. For race/ethnicity, 45% of pediatric patients were NHPI, 16% were Filipino and 15% were White. Fifty-eight percent were on public insurance and 14% had at least 1 comorbidity on initial admission. Sex, race/ethnicity, location, insurance, and CCI were all significant predictors of readmission. Male pediatric patients were more likely to have a readmission (odds ratio [OR] = 1.18, 95% confidence interval [CI] = 1.04 – 1.33). Patients who were NHPI (OR = 0.79, 95% CI = 0.66-0.94), Filipino (OR = 0.75, 95% CI = 0.61-0.94), or had other/missing as their race/ethnicity (OR = 0.77, 95% CI = 0.61-0.97) were all less likely to be readmitted. The strongest predictors of readmission however were residence (OR = 1.49, 95% CI = 1.29 - 1.71), insurance (OR = 1.34, 95% CI = 1.18 - 1.53), and CCI (OR = 1.86, 95% CI = 1.61 - 2.14) with patients on O‘ahu, those with public health insurance, and those with 1 or more comorbidities more likely to have a readmission. However, while many predictors were statistically significant, the AUC of the multivariable logistic regression model was only 0.593 and an acceptable AUC should be 0.7 or more.

The top 4 MDCs with the most pediatric readmissions were then evaluated to determine how variables might differ in their association with readmission from each other and from the overall model. The multivariable logistic regression model for predicting readmissions from respiratory system diseases and disorders had an AUC of 0.636 (Table 3). Insurance type, CCI, and patient’s residence were significant predictors of readmission. Patients on public insurance were about twice as likely to have a readmission as those not on public insurance (OR = 1.94, 95% CI = 1.44 - 2.63). Those having at least 1 comorbidity had 1.95 times higher odds of readmission as those without any comorbidities (OR = 1.95, 95% CI = 1.50 - 2.53). Those living on O‘ahu had 1.61 times higher odds of readmission as those living on the other islands (OR = 1.61, 95% CI = 1.21 - 2.15).

The AUC of the model for predicting readmissions for digestive diseases and disorders was 0.573. The only significant predictor for readmission for this MDC was CCI, with those having at least 1 comorbidity 1.79 times higher odds as likely to have a readmission (OR = 1.79, 95% CI = 1.23 - 2.62).

The model for predicting readmissions for patients diagnosed with mental diseases and disorders had an AUC of 0.591. The strongest predictor of readmission for this model was insurance type with those having public insurance more likely to have a readmission (OR = 1.46, 95% CI = 1.03 - 2.06). NHPI patients were less likely to have a readmission compared to white patients (OR = 0.58, 95% CI = 0.37 - 0.89).

Table 1. Number of Patients and Readmission Rate by Major Diagnostic Category

Major Diagnostic Category	# Patients	# Readmissions	% Readmissions	Rank of Readmission %
Respiratory System	6732	279	4.1	7
Digestive System	3905	171	4.4	6
Mental Diseases & Disorders	1691	153	9.0	1
Nervous System	2620	118	4.5	5
Musculoskeletal System & Connective Tissue	2748	84	3.1	11
Endocrine, Nutritional & Metabolic	1379	65	4.7	4
Ear, Nose, Mouth & Throat	2079	54	2.6	12
Infectious & Parasitic Diseases	1449	49	3.4	10
Kidney & Urinary Tract	1208	44	3.6	8
Circulatory System	694	42	6.1	3
Skin, Subcutaneous Tissue & Breast	2556	42	1.6	14
Blood, Blood Forming Organs, Immunology	887	31	3.5	9
Hepatobiliary System & Pancreas	308	26	8.4	2
Injuries, Poisonings & Toxic Effects of Drugs	817	16	2.0	13

Note: Initial visit was used to assign patient to major diagnosis categories (MDCs). Patients can be duplicated in the above chart if they had initial visits for multiple diagnoses. Rank of readmission shows the diagnoses category that had the highest percent of readmission (1) to lowest (14) excluding MDCs with 10 or less readmissions. Pregnancy related MDCs and MDCs with 0 patients were not included.

Table 2. Association between Patient Characteristics and Readmission for All Causes			
Variable	**No Readmission, n = 28 555 (96.2%)**	**Readmission, n = 1139 (3.8%)**	**Odds Ratio (95% CI)**
Age (years), Mean ± SD	7.26 ± 6.5	7.29 ± 6.5	1.00 (0.99 – 1.01)
Sex			
Female	14 014 (96.5%)	509 (3.5%)	Ref
Male	14 541 (95.8%)	630 (4.2%)	1.18 (1.04 – 1.33)**
Race/Ethnicity			
White	4292 (95.9%)	184 (4.1%)	Ref
NHPI	12 946 (96.2%)	509 (3.8%)	0.79 (0.66 – 0.94)**
Filipino	4462 (96.5%)	162 (3.5%)	0.75 (0.61 – 0.94)*
Other Asian	3256 (95.5%)	154 (4.5%)	1.01 (0.81 – 1.27)
Other/Missing	3599 (96.5%)	130 (3.5%)	0.77 (0.61 – 0.97)*
Patient's Residence			
Rural (Other Islands)	9527 (97.0%)	291 (3.0%)	Ref
Urban (O'ahu)	19 028 (95.7%)	848 (4.3%)	1.49 (1.29 – 1.71)***
Insurance			
Other	12 165 (96.6%)	425 (3.4%)	Ref
Public (Medicaid/Medicare)	16 390 (95.8%)	714 (4.2%)	1.34 (1.18 – 1.53)***
Charlson Comorbidity Index			
0	24 547 (96.6%)	872 (3.4%)	Ref
≥1	4008 (93.8%)	267 (6.2%)	1.86 (1.61 – 2.14)***

CI = Confidence Interval. SD = Standard Deviation. Ref = Reference. NHPI = Native Hawaiian and Pacific Islander. *P<.05, **P<.01; ***P<.001.
Multivariable logistic regression was conducted with the variables in the table. The AUC of the model was .593 (95% CI = 0.576 – 0.610).

Table 3. Odds Ratios for Readmission by Patient Demographics by Major Diagnosis Category				
Variable	**Respiratory System**	**Digestive System**	**Mental Health**	**Neurological**
Age (years), Mean ± SD	1.01 (0.98 – 1.04)	1.00 (0.97 – 1.03)	0.96 (0.89 – 1.02)	0.99 (0.95 – 1.02)
Sex				
Female	Ref	Ref	Ref	Ref
Male	1.17 (0.91 – 1.50)	1.10 (0.80 – 1.50)	1.08 (0.77 – 1.51)	1.09 (0.74 – 1.60)
Race/Ethnicity				
White	Ref	Ref	Ref	Ref
NHPI	1.52 (0.93 – 2.48)	0.86 (0.54 – 1.37)	0.58 (0.37 - 0.89)*	0.90 (0.50 – 1.62)
Filipino	0.98 (0.55 – 1.75)	1.18 (0.71 – 1.96)	0.73 (0.44 – 1.22)	0.96 (0.48 – 1.94)
Other Asian	1.39 (0.75 – 2.60)	1.16 (0.67 – 2.00)	0.68 (0.40 – 1.16)	1.26 (0.65 – 2.46)
Other/Missing	1.26 (0.71 – 2.24)	0.89 (0.50 – 1.60)	0.91 (0.49 – 1.70)	0.98 (0.46 – 2.08)
Patient's Residence				
Rural (Other Islands)	Ref	Ref	Ref	Ref
Urban (O'ahu)	1.61 (1.21 – 2.15)**	1.16 (0.83 – 1.62)	0.89 (0.61 – 1.31)	1.94 (1.18 – 3.19)**
Insurance				
Other	Ref	Ref	Ref	Ref
Public (Medicaid/Medicare)	1.94 (1.44 – 2.63)***	0.91 (0.66 – 1.26)	1.46 (1.03 – 2.06)*	1.10 (0.74 – 1.65)
Charlson Comorbidity Index				
0	Ref	Ref	Ref	Ref
≥1	1.95 (1.50 – 2.53)***	1.79 (1.23 – 2.62)**	0.94 (0.58 – 1.51)	3.59 (2.40 – 5.38)***
Overall Model AUC	0.64 (0.60 – 0.67)	0.57 (0.53 – 0.62)	0.59 (0.54 – 0.64)	0.66 (0.61 – 0.72)

CI = Confidence Interval. SD = Standard Deviation. Ref = Reference. NHPI = Native Hawaiian and Pacific Islander.
*P<.05, **P<.01; ***P<.001.

The model for predicting readmissions for patients with neurological diseases and disorders had an AUC of 0.664. CCI and patient's residence were significant predictors of readmission. Those having at least one comorbidity had 3.59 greater odds of being readmitted than those with no comorbidity (OR = 3.59, 95% CI = 2.40 - 5.38). Those living on O'ahu had increased odds of readmission compared to those living on the other islands (OR = 1.94, 95% CI = 1.18 - 3.19).

Discussion

Four Major Diagnostic Groups were evaluated to determine which variables were related to readmission for those diagnoses. Similar to the national pediatric readmissions rate of 6.5%,[1] there were relatively low pediatric readmission rates overall in Hawai'i (3.8%). The pediatric distribution in this study seems to have a higher proportion of NHPI patients and lower proportion of White patients compared with studies based on Hawai'i adult inpatients.[16] In contrast, the locations where pediatric and adult patients came from (particularly O'ahu versus other places) seem similar.[16] The variables that related most to overall readmission rate were residence, insurance type, and CCI. While some variables tended to be relatively consistent across the diagnostic categories in their relationship to readmission, this was not the case for all diagnostic categories and the readmission rates for diagnoses also varied.

The current study showed that patients on public insurance had a higher risk of readmission for the respiratory and mental health diagnosis categories, which is consistent with many studies involving insurance as a variable.[1,3,13,15,19,29] However, this relationship was not present in this study for the digestive or neurological diagnoses. Some studies that have looked specifically at certain neurological disorders[30] and digestive disorders[31] for adult patients found that those on public insurance had higher readmissions. However pediatric studies focused on certain neurological disorders[32] and digestive disorders[33] found that insurance was not a significant predictor of readmission when controlling for other patient variables which is more aligned with the findings from this study. These highlight potential differences in predictors of readmission between pediatric and adult patients and by diagnosis.

Additionally, patients with comorbidities had a higher risk of readmission in all MDCs studied except the mental diseases and disorders category. These findings are consistent with the current literature.[34–37] Patients on O'ahu had a higher risk of readmission than patients from other islands in Hawai'i. Even though not all patients on O'ahu would be considered to live in urban areas, they tend to have easier access to more advanced medical facilities; therefore, this island difference in readmission may possibly be an indicator of how rural and urban residence of patients may relate to PPRs. Others have also found that rural areas had lower readmission rates as well.[38] However, there have also been studies suggesting that certain diagnoses showed higher readmissions at rural hospitals[39] while others found no differences between rural and urban.[40] More studies are needed to better understand urban/rural hospital differences.

The rates of readmission for pediatric patients who are NHPI depended on diagnosis and the association tended to be weak. It is worth noting that this relationship tended to show NHPI patients having a lower risk of readmission which is in the opposite direction of what other studies on NHPI readmission have found.[16–18] However, those were all done with the adult population. More research should be conducted to evaluate whether and how readmission rates for NHPI may vary across age.

Hospital readmissions have been of increasing interest to researchers, policy makers, and health officials. The Affordable Care Act established a Hospital Readmissions Reduction Program (HRRP) that would reduce payments made to hospitals if their readmission rates for certain diagnoses were above what would be expected but only for some groups of patients and for some diagnoses.[41] This approach assumes that the hospital would be the main catalyst in reducing readmissions, while the literature demonstrates that various patient level variables are also related to readmission. Additionally, readmission is not always a negative outcome as it could be seen as a preventative measure for an even worse outcome like death. While readmission rate is an important outcome, the use of readmission rate as a quality of care indicator has been criticized for various reasons ranging from data issues regarding readmission statistics to the oversimplification of viewing the medical care providers as the primary reason for readmission.[9,29,42,43] If hospitals were penalized for having higher readmission rates without accounting for patient demographics, resources could be denied to institutions taking care of higher risk patients.[44]

Other literature studying readmissions has indicated multiple variables that relate to readmission but overall, the prediction of readmission has been difficult with most AUCs below 0.70.[24,45] The AUC for the readmission models in the current study was usually around 0.60. With the difficulty in predicting readmissions in this and other similar studies,[24] more research incorporating additional variables, at both the patient and hospital levels, should be done in the future to increase our understanding of what relates to pediatric readmissions.

The study has several limitations. Due to the relatively small sample size of the pediatric readmissions and limited data available on pediatric patients and hospitals in Hawai'i, incorporating hospital levels variables into the model was not feasible with the current sample. Second, MDCs were used rather than more specific diagnosis groups which could have provided more details into readmissions relating to diagnosis. This can affect the estimated strengths of the associations of the variables as MDCs could encompass a broad number of diagnoses which may have different rates of readmission or different strengths of associations related to readmission. Third,

the data lack details about dates of admissions and discharges due to confidentiality. This study used readmission based on the 3M PPR definition already built in the dataset. This could have led to some discrepancies with other investigations that were able to consider all readmissions based on detailed admission and discharge dates. Fourth, with the context of secondary data analysis, the quality and selection of variables of the current data could be limited. Additionally, readmission was the only outcome looked at. Length of stay or death could have been related to readmission as well and have shown additional information concerning pediatric readmissions.

This study found that Hawai'i pediatric patients with public insurance and those with more comorbidities had a higher rate of hospital readmission overall. Although the model fits were not very strong in either the overall model or within diagnoses, the different strengths of variables for different diagnosis categories suggest the usefulness of analyzing readmissions by diagnosis. Additionally, due to the increasing use of hospital readmission rates in health care decision making, more studies should be done to better understand how diagnosis, patient, and hospital level variables interact to predict pediatric readmission.

Conflict of Interest

None of the authors identify a conflict of interest.

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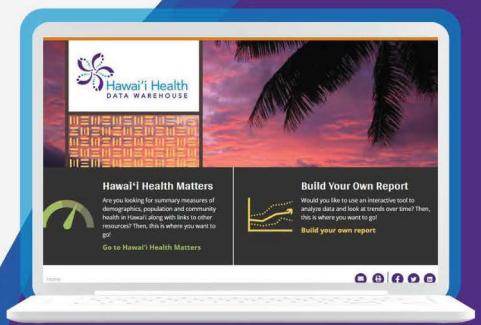

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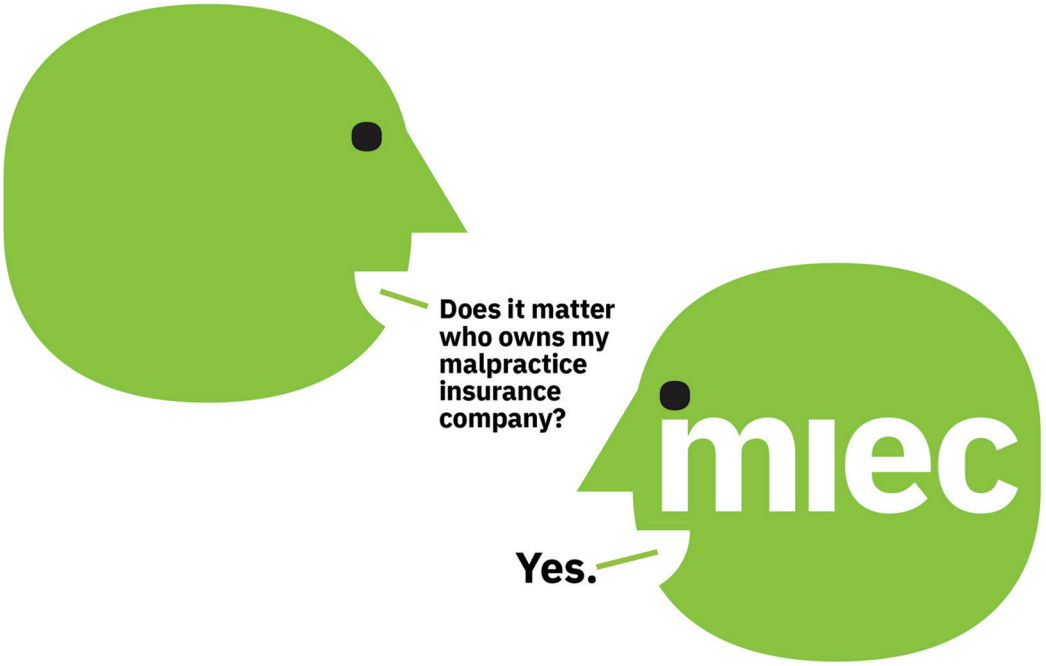

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