MEASURING PUBLIC HEALTH PRACTITIONER'S INFORMATION AND COMMUNICATION TECHNOLOGY COMPETENCE AND PREPARATION: A MIXED METHODS APPROACH

A Dissertation

by

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ABSTRACT

There has been an increase in the use of information and communication technologies (ICTs) in the field of public health. The World Health Organization (WHO) states that this is imperative in health promotion and disease prevention. The accrediting body for schools and programs of public health, the Council on Education for Public Health (CEPH), points to the importance of educating the next generation of public health practitioners on developing and implementing ICTs into the delivery of health-related services. Little is known about how public health practitioners are using ICTs and how they are being trained.

This dissertation utilizes both quantitative and qualitative approaches to understand the use of ICTs as public health tools; while examining information regarding the education, training, and professional preparation of public health practitioners. This study aimed to 1) Identify the status of ICT use in public health training and practice, 2) Clarify the existing ICT training opportunities in schools and programs of public health, and 3) Understand the ICT experiences of a public health practitioner.

A scoping review of the literature pointed out that while public health practitioners are using ICTs; we do not know how these practitioners were trained; thus, we are unable to link training to program outcomes. A quantitative content analysis of the curriculum and syllabi of a School of Public Health showed that while ICTs are being incorporated into course learning objectives' they are not fully integrated across all departments and courses evenly. Lastly, public health practitioners interviewed for this study could not identify specific instances in their academic training on delivering services using ICTs. They did, however, point to the importance that ICTs will have in advancing public health in the future.

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CONTRIBUTORS AND FUNDING SOURCES

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LIST OF ABBREVIATIONS

AMA	American Medical Association
AMIA	American Medical Informatics Association
APA	American Psychological Association American
ATA	Telemedicine Association
CEPH	Council on Education for Public Health
ICS	Incident Command System
ICT	Information and Communication Technology
IPE	Interprofessional Education
IoM	Institute of Medicine
PHI	Public Health Informatics
WHO	World Health Organization

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1. INTRODUCTION

1.1. Information and Communication Technologies (ICTs)

Health communication and health information technology (also known as information and communication technologies (ICTs) are essential public health elements. ICTs are technologies used to convey, manipulate, and store data by electronic means (Openlearn from the Open University, nd). ICTs come in many different forms, including email, SMS text messaging, video chat (ex. Skype), and other online social medial platforms such as Facebook (Perron et al., 2010). ICTs also use different computing devices such as laptop computers and smartphones (Perron et al., 2010).

ICTs are an essential part of the workforce climate and will continue to become even more important over time (Parrot & Madoc-Jones, 2008). The National Business Education Association (NBEA) states: "mastery of technology tools is a requirement rather than an option for enhancing academic, business and personal performance" (NBEA, 2007). Given ICT's ubiquitous presence in workplace settings, it seems essential that educational and other training programs should include preparation in utilizing ICTs. In fact, many disciplines recognize the importance of ICTs and include them in part of their professional development (Perron et al., 2010).

ICTs have also impacted our daily lives. ICTs impact our working environment, how we socialize and communicate with others and how we access information. Now we can read the local newspaper online, we can connect with family and friends via email, direct messenger services and videoconferencing. ICTs are also seen in our finances. Every time one uses a debit or credit card the machine is connected to other computers using a network. Once you verify your information; your balance is adjusted immediately. ATMs are another form of ICTs that allow you to check your balance, withdraw cash and transfer funds to

others. Digital cameras, printers and scanners allow people to experiment with creating and formatting their own images. ICTs have also impacted the "gaming community." Due to enhanced graphics and people being able to connect with other gamers regardless of location; the gaming industry has not only experienced and enjoyed the growth of ICTs but they have been able to take advantage and make the "gaming experience" more enjoyable.

1.2. ICT History

In 1948 the United States saw the first reference in the medical literature to ICT; In this instance it was telemedicine (Institute of Medicine (U.S.) & Field, 1996). This was the transmission of radiological images by telephone (Institute of Medicine (U.S.) & Field, 1996). The first use in social sciences was video therapy at the University of Nebraska in the late 1950s, which included clients and therapists connected via television (Bashshur, 1997). In the 1970s, the US sees the first push of video conferencing with 15 federally funded projects that linked health care professionals in medical centers to patients in remote areas of Alaska, Canada, Indian reservations, and ships at sea (Barrett & Brecht, 1998).

When the funding for the federally funded project that linked patients in remote areas to health care professionals, telehealth almost disappeared, with the exception of teleradiology (McCarty & Clancy, 2002). However, as the cost of technology decreased, technological advances like the World Wide Web increased, and with increased funding from federal, state, and the military, there was a rebirth of telehealth in the late 1990s (Whitten & Collins, 1997; Bergeron, 1998; Edwards & Mota, 1997). Currently, almost everything a public health practitioner does in face-to-face meetings with clients can be done online (McCarty & Clancy, 2002). This includes counseling, home health visits, consultations with other colleagues, research, supervision of interns, and public health education (McCarty & Clancy, 2002). Yet there is a lack of information about past or present use of ICT among public health professionals.

1.3. ICT Terminologies

ICTs used in health professions have been referred to in many different terms over time. Telemedicine is an older and more common term; as it is being replaced by a more inclusive term, which is now known as: telehealth (Barrett & Brecht, 1998). Figure 1 provides examples of common terms used to describe ICTs in health contexts. What remains unclear is if there are standard lexicon specific to ICTs and various contexts in health-related professions.

Figure 1
Figure 1. Communication Technology Examples

ICT	Software	Communication Systems	Data Sharing & Connecting	Tasks
Hardware/ Physical Devices	***Operating systems***	***Means to Signal and/or Connect***	***Clouds***	***Know how to . . .***
Computers	IOS	Hardlines	Zoom / Skype	type
Printers	Windows	Wireless signals		enter data/information
Phones	Microsoft Suite	Satellite		retrieve data/information
	Access			create documents/forms
	Blackboard			Email (compose, send, retrieve)
	Qualtrics			identify when to use what

1.4. ICTs Utilization

In health professions, ICTs provide efficient and effective ways for organizing people and ideas, increasing access to knowledge and education, and increasing efficiency and collaboration with other treatment team members (Perron et al., 2010). An example of how ICTs are currently being used in health-related practice is in providing clinical services (Perron et al., 2010). Patients' needs can be met with technology such as telehealth and email

consultation (McCarty & Clancy, 2002). Surveys have documented that clients are open to and welcome these new treatment alternatives (NW et al., 2009).

While less formally documented, ICTs have been used in public health practice. The need exists to document ICT use in public health practice, however, remains particularly given the requirement that graduates demonstrate competency as part of school/program accreditation criteria.

It seems the public (patients, clients, and in general) may be acceptable of receiving services via ICTs. In the midst of the current global pandemic, it has been made clear that public health practitioners need to not only be comfortable but also skilled in the effective utilization of ICTs; especially when face-to-face options are unavailable. Yet, it is unclear how well-prepared health professionals are, and specifically public health professionals.

The United States Department of Education recognizes the Council on Education for Public Health (CEPH) as an independent agency to accredit schools of public health and public health programs outside schools of public health. Programs offering the Master of Public Health (MPH) degree are tasked with developing their curriculum in accordance with CEPH. CEPH has developed twelve foundational public health knowledge learning objectives and twenty-two foundational competencies that are a requirement for students earning an MPH from an accredited program. The foundational competencies are broken down into domains. One domain applies to the importance of ICTs. According to CEPH's 2016 criteria, "basic concepts of public health-specific communication, including technical and professional writing and the use of mass media and electronic technology" must be addressed in the curriculum and learning experience of public health students (Criteria & Procedures – Council on Education for Public Health, accreditation criteria schools of public health & public health programs, 2016, p.26). n.d.). While CEPH has stated the importance

of incorporating ICTs into public health education, there have been no standards for such integration.

1.5. Problem Statement and Overarching Research Question

1.5.1. Overarching Problem

Despite the broad use of information and communication technologies as a public health tool, there appears to be a paucity of information regarding education, training, and pedagogical strategies as part of the professional preparation of entry-level public health practitioners.

Overarching Research Question

What is the status of ICT as a professional competency among public health professionals?

1.6. Three Studies for Three Perspectives

In order to address my overarching research question, I propose three smaller studies, each with aims designed to address a critical dimension of the overarching problem.

1.6.1. Study 1: Identify the Status of ICT in Public Health Training and Practice

The answers to research questions should first be sought in the available research-based literature, typically conducted as an in-depth review of the existing body of research. This study will help identify what has been empirically shown to be useful specific to ICT use in public health-related practice. The findings of this study will also help in identifying factors relevant for the next study.

1.6.2. Study 2: Clarify Status of Existing ICT-Related Training Opportunities in Public Health Education

The most recent accreditation criteria of public health education programs includes competencies related to ICT-use. Yet, it is unclear if and how ICT-related training has been included in the educational preparation of public health professionals. This study will help clarify if and how professional preparation programs reconcile expressed competencies with their training module. Furthermore, the findings from this study will contribute to the development of methods (e.g., questions, approach) for the third study.

1.6.3. Study 3: Understand the ICT-Related Experiences of Public Health Practitioner

While the most recent CEPH criteria include ICT-related competencies, a significant proportion of public health professionals graduated from programs without expressed competencies. Understanding the experiences of these practitioners is important to identifying specific types of ICT skills were deemed critical, and how they went about acquiring the ICT skills needed. This study will improve our understanding of their lived experiences.

Combined, the three studies will provide data and yield knowledge independent from each other (i.e., unique perspective). Yet, the studies' aims work synergistically toward developing a body of evidence meant to make meaningful contributions to our knowledge base on this topic.

2. ICT IN PUBLIC HEALTH TRAINING AND PRACTICE

2.1. Information and Communication Technology

Healthcare presents one of the supreme critical social and fiscal challenges facing numerous countries today. One of the government's primary goals is to ensure a healthy population where they can receive quality and safe medical care. Government administrators, policymakers, clinicians, physicians, and public health practitioners are experiencing increased pressures to enhance healthcare services from both the community and private sectors (Aceto et al.,2018). Given that the rising costs have a significant influence on the quality of individual's lives, the increased population growth and aging population dictate the need for better scientific solutions in this field. Since the late 20th century, Information and Communication Technologies (ICTs) driven up by the rise and success of the internet have played significant roles in improving efficiency, quality, and healthcare processes (Aceto et al., 2018). The concept of e-health, commonly described as the application of ICTs in health care, has become common. The recent years have seen increased public interest in e-health and an unprecedented level of investment in funding and research.

The rise of the spread of wireless and mobile technologies has further led to an upsurge of these technologies and their potentialities. Internet and Cloud computing have made it possible to access unlimited amount of data, thus enabling services in the public health sector, such as effective health recording, diagnosis, and treatment of diseases (Aceto et al., 2018). Together with the increasing medical software applications, these technologies have driven the use of mobile technologies in public health.

ICTs represent an enormous opportunity that has introduced a significant and lasting positive change in the current evolving world. ICTs presents possible solutions to solve the long-lasting challenges that have existed in healthcare (Aceto et al., 2018). Communication among healthcare and allied health professionals has been enhanced, improving cooperation and collaboration among providers resulting in coordinated care to patients and populations. ICTs have made it possible to ensure digital record-keeping that has facilitated faster diagnosis, treatment, and response to healthcare challenges (Aceto et al., 2018). As ICT technology continues to grow, they present even more possibilities and potentials in healthcare in the future.

2.2. Theoretical Approaches: Information and Communication Technology in Public Health

System approaches in health refer to the methods and scientific insights used to understand health outcomes and the relationships between these factors to produce better health (Li, 2010). One of the major approaches that can be used to evaluate ICT use to assist in the improvement of healthcare is the socio-technical approach (Li, 2010). The socio-technical approach is a theory that provides a paradigm against which the workflow of ICT in healthcare can be explored and understood. Healthcare settings are complex and composed of deeply interconnected and relatable social and cultural elements (Li, 2010). The introduction of new technologies results in changes in clinical roles, healthcare processes, and cultural change (Li, 2010). Instead of viewing it as a separate entity, this approach views these technologies as an active component of the healthcare setting, constantly cooperating and interacting with the healthcare and allied health team and organizational processes (Li, 2010). The approach identifies the dynamics between ICTs and the relevant social, cultural, and professional environment.

The theory proposes that ICTs in healthcare settings and the organization's success depend on these systems' applicability and accuracy (Li, 2010).

2.3. ICTs in Health Profession Education and Training

The World Health Organization (WHO) estimates that the world needs more physicians, nurses, public health practitioners, and other frontline employees (World Health Organization, 2013). The increased rise in the availability of ICTs can be used to facilitate the education and training of healthcare-related practitioners. The recent global investments in fibers and wireless technologies, e-health, mobile health, and social media can be leveraged to help train, support, and empower health care workers. The telecommunication union approximates that mobile subscriptions from 2007 to 2011 increased by more than tenfold (World Health Organization, 2013). These mobile and wireless technologies have become increasingly essential technologies for healthcare and allied health practitioners at all levels. This new fiber and wireless infrastructure and the rapid development of computer power have presented opportunities for scaling up health-related workers' education and training to improve its quality, optimize healthcare and allied health services, and strengthen healthcare systems.

Over the past decade, learning administration systems have contributed tremendously to the growth of e-learning. There has been a tremendous expansion of open online courses. The e-health tools, including electronic medical records (EMRs), laboratory and pharmacy information systems, and surveillance systems, are transforming healthcare. E-health has helped to extend healthcare services to remote areas and inaccessible parts of the globe. Additionally, these mobile technologies can optimize communication and support frontline health care providers to deploy training courses and medical decision-making support tools (World Health Organization, 2013).

Social platforms have yet to be fully integrated to mobilize healthcare and allied health workforce capacity building. This use of ICTs has several potential benefits to healthcare learning and training. E-learning tools can help support curriculum development and course scheduling and management in ways blended to conducive learning approaches and take advantage of multiple learning environments. These tools can be linked to state health workforce planning, management, and in-service training, providing information and support to health-related workers through their careers (World Health Organization, 2013). It can be used to optimize healthcare and allied health providers' work through the use of EHRs, clinical decision-making training, and quality control to facilitate e-health communication, continue training and education, and establish professional social networks to share information and ideas.

Training approaches based on video conferencing, webcasting, recording and localization of training can help enable global access to quality education. These tools are more economical than face-to-face educational programs. Some even provide interactive programs that engage students and allow them to interact with one another, enabling sharing of health information and ideas through enabling the development of a virtual network of learners. E-learning enables education to be community-based which enhances sharing of educational content (World Health Organization, 2013). E-learning allows for reduced education and training costs since healthcare and allied health practitioners can receive education anywhere and remain in their current role where they are most needed to promote quality health-related care.

The presence of e-health and the incorporation of ICTs in healthcare and allied health education is not an alternative to the traditional methods of public health practitioner training; rather, it helps add value and makes it possible to overcome current educational approaches' confines (World Health Organization, 2013). Any public health program's goals are to provide education and training that too enables trainees to acquire the relevant training and competencies required. The blended traditional-based strategies and incorporation of ICTs can be used to achieve this goal.

2.4. ICTs in Public Health Practitioners Preparation

The use of ICTs is imperative in health promotion and disease prevention in public health. ICTs can help guide health dissemination (World Health Organization, n.d.). Preventive care prompts can be linked through electronic medical records, electronic health risk assessments, and custom-made and personalized communications can be used to help health promotion and disease prevention interventions become even more efficient than before. Web-based strategies can offer new strategies that can be used to provide health education, while different applications can offer decision support to individuals on their specific personalized goals while giving continuous feedback about the progress on their goals. Patients who manage chronic conditions can optimize electronic portals to share their coping strategies, get emotional support, exchange ideas on health conditions, facilitate better treatments, and reduce adverse effects from their disease.

2.5. COVID 19 and ICTs

Public health emergencies are defined as emergent situations whose potential consequences can overwhelm the routine capabilities to address these health challenges (Nelson et al., 2007).

Public health preparedness refers to a range of prevention techniques, alleviation strategies, and recovery activities aimed at enabling responses to events and functioning capabilities that can help execute the preparedness of these tasks quickly (Nelson et al., 2007). The act of preparedness is a steady state, but it requires continuous improvements and steady plans that ensure the effective formulation of strategies and their execution. These activities also involve improving health among communities and the resiliency of its residents. Due to the increase in diseases that pose a threat to individuals and communities, public health specialists must be prepared to respond to these varieties of emergencies. The importance of public health preparedness is obvious today, as the world still grapples with the COVID-19 pandemic.

The preparedness of public health professionals involves various factors to access its response capability, including health risk assessment that seeks to identify the hazards and the vulnerable populations that will form the basis of the response. Incident Command System (ICS) allows for development testing and improvement of decision-making. It also allows for the engagement, mobilization, and public health education about how to be fully prepared for public health threats. Epidemiological functions include how to monitor, detect and investigate potential threats.

One of the significant efforts in public health preparedness is communication (World Health Organization, n.d.). Public health professionals have to inform populations about diseases, prevention measures, how they can adopt preventive behaviors, and limit the impact of the adverse effects. ICTs can allow for the proper dissemination of information to a specific population, ensuring that a wide range of people gets the necessary information. Thus, the need for public health professionals to be competent in the use of ICTs is clear. Indeed, proficiency in ICT utilization can help ensure that public health practitioners are

prepared to respond timely, appropriately and effectively to future health threats and emergencies.

Public health surveillance systems utilize ICTs. Surveillance systems are the methodical continuous collection, organization, and analysis of data for public health aims and the timely dissemination of analyzed information for assessment and public health response (Chandrasaker, 2012). These surveillance systems allow for time-sensitive assessment of the health status of populations and control disease outbreaks through efficient disease prevention and control actions. These allow for the timely identification of disease outbreaks, as well as longitudinal examinations of health and/or disease phenomena. Smart devices such as the use of the Internet and Cloud Computing are tools used to help identify a threat before it happens, leading to increases in public health practitioner preparedness. As examples, the recent SARs pandemic as well as the still on-going COVID-19 pandemic has drawn attention to the importance of public health surveillance systems' capacity.

With the necessary information about the pandemic, public health professionals can analyze the situation, gauge how prepared they are, and allow for effective control and containment of the outbreak. Through integrated systems enhanced by ICTs, an effective and efficient system can be developed to detect threats, risk assessment, event verification, and response at both national and global levels (World Health Organization, n.d.). Early detection of health outbreaks can be made possible through the use of ICTs in surveillance systems. Thus the importance of ICTs as a core tool for public health practitioners is clear. Yet, it is still unclear what types of ICTs are used in public health and under what contexts, as well as if and how public health practitioners receive training in ICT usage.

2.6. Study Purpose

The purpose of the present study is to identify the status of ICT as used by public health practitioners, as established in the extant literature. Thus a scoping review was conducted using the available research-based literature, with the intent of identifying what has been empirically shown to be useful specific to ICT use among public health practitioners.

2.7. Methods

This study used the five stages for conducting a scoping review, as outlined by Arksey and O'Malley (2005). The framework consists of five stages: 1) Identify the research question, 2) Identify relevant studies, 3) Study selection, 4) Chart the data, 5) Summarize and report the results (Arksey & O'Malley, 2005). The research question (Stage 1) is described above in the introduction

Stage 1: Identify Relevant Studies. Eligibility criteria for the present study were set. I focused on peer-reviewed articles that described an intervention or approach that involved a public health practitioner as an integral part of the overall treatment team; not on the periphery. Initially, the search was limited between January 2010 and February 2021. However, due to the limited amount of information in the literature on this topic, date restrictions were removed. The articles needed to 1) Include a public health practitioner as part of the care team, 2) Needed to use some aspect of telehealth in the delivery of services, 3) Published in peer-reviewed scientific journals, 4) Published in English.

Stage 2: Search Strategy. The search was conducted between January 17, 2021 and March 2, 2021. To conduct the review; articles were identified and screened based on a search using the following databases: Academic Search Ultimate, PsycINFO, Medline, Education, ERIC, and CINAHL. The keywords used in the search were: "telemedicine," "telehealth," "telecare," "telepsy," "mhealth," "ehealth," "public health," "psychiatric public health," "teleconferencing," "online therapy," teleconsultation," "telepsychiatry," "telepsychology," "curriculum," "instruction," "school," and "telerehabilitation." Synonyms and subject headings related to the keywords in various combinations were also included in the search terms. Systematic reviews found during the search were excluded. The reference list of all articles were also examined to identify relevant studies to this review but might have been missed during the database search. The articles were reviewed based on the title and abstract according to inclusion and exclusion criteria chosen before the beginning of the search. The searched initially yielded 439 articles; Details are depicted in the PRISMA diagram below.

Stage 3: Study Selection. All articles from the initial search were exported to Covidence, an online tool that was developed to assist with the screening and management of articles for literature reviews. One reviewer screened the titles and abstracts for relevance. Initially, each article was scored "yes" or "no" for inclusion. A "yes" classification indicated some alignment between the title and/or abstract with the study inclusion criteria. All articles classified "yes" were exported for a full-text review. For the full-text review, each article was critically read. Articles that met inclusion criteria were included in the final review for in-depth analysis.

Stage 4: Chart the Data. Eligible studies were analyzed using the Garrard Matrix method (Garrard, 2017) to extract the following information study characteristics when possible: author, population, health issue, type of training on ICTs, public health practitioner

involvement, type of ICT and study design. Other characteristics were also examined as other indicators evolved as important as more studies were reviewed.

Stage 5: Summarize and Report the Results. Selection phases results are described based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) (Liberati et al., 2009).

2.8. Results

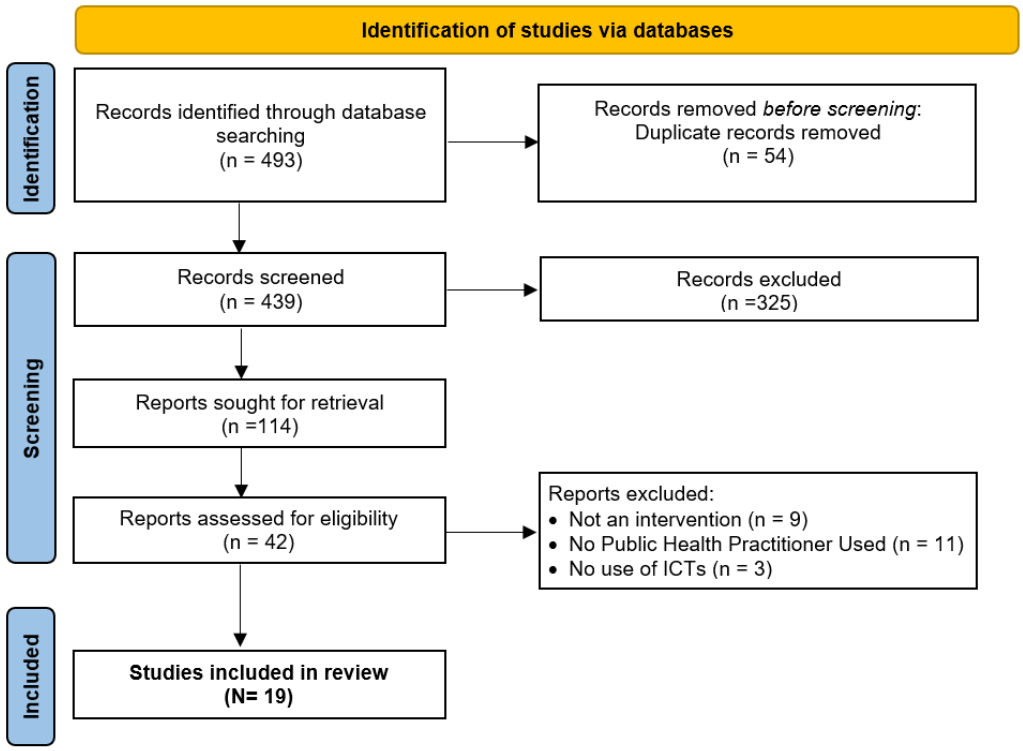
This study was guided by two questions: 1) How has telehealth been used in interventions with master-level public health practitioners, and 2) Where does the research gap lie in public health practitioners utilizing telehealth?

2.8.1. Characteristic of ICT & Health Studies

The search yielded 439 articles (after removing duplicates). Of the 439 articles, 114 articles were found relevant. Out of the 114 abstracts, 42 full-text articles were assessed for eligibility. This assessment yielded 19 articles for inclusion in the scoping review (Figure 1).

Study Designs. A variety of study designs were used, inclusive of experimental (68.42%) and non- and/or quasi-experimental (31.6%) approaches. Overall, randomized control trials were the most common study design (n=13 or 100% of experimental designs). Three studies used observational study (15.79%) design; two studies used cohort design (10.53%) while one study used the quasi-experimental design (5.26%).

Figure 2. PRISMA Diagram for search



Topics Studied. The ICT use in the majority (58%) of the reviewed articles focused on chronic diseases management. Specifically, the most common health foci of ICT-utilizing studies was weight loss (26.32%). The remaining 42% of total studies were focused on prevention of heath conditions including chronic and infectious diseases. STI prevention (21.05%) accounted for the largest proportion of prevention-focused articles. The remaining health topics (52.63 %) combined included: diabetes, mental illness, chronic illness, cholesterol-lowering diet, menopausal health, heart failure, prevention of dental caries, smoking cessation, and oral home care.

Journals and Disciplines. All 19 research articles were published in different journals. Only one was clearly a public health journal (American Journal of Public Health). All other journals represented in the review were medically or clinical research focused.

2.9. Telehealth Use with Public Health Practitioners

One objective of the present study was to assess how telehealth has been used in interventions with public health practitioners as part of the primary care team.

ICT Inclusion. All 19 articles also included the delivery of services via telehealth. The most common form of telehealth that was used in intervention delivery was video conferencing (42%), followed by mobile phones (21%), texting (15.79%), interactive website (15.79%); lastly, one study used an electronic device that was designed by the research team to communicate between study participants and program staff. Note that mobile phone use in this context refers to voice calls made via mobile phone; not texting.

Master-Level Trained Public Health Professionals. Due to the inclusion criteria, all of the studies contained in the review did involve personnel they describe as public health practitioners. All (100%) clearly stated using a public health practitioner. Yet, as detailed in the matrix, studies lacked clarity in describing if the practitioner had at least a master's degree. Indeed, there were no details or operational definition of "public health practitioner" in any of the studies reviewed.

Public Health Professionals Trained in ICT. The qualified articles were also examined for indication that staff (overall and public health specific) received training to utilize ICTs for their respective studies' purposes. Findings were coded as follows: Yes=Clearly Stated; Probably Yes = Implied; No=Clearly stated, Probably No= Implied; Unclear - Not enough information to determine. More than half of the studies (53%) lacked enough detail to ascertain if and what types of ICT trainings were provided. While 32%

included enough details for us to deduce training took place, only 3 (16%) explicitly stated and provided details.

The matrix includes full details of the examination of these studies.

	Title	Author	Date	Journal	Discipline of the Journal	Population	Health topic	Type of Health Condition	PHP Involved?	PH Background of Practitioner
1	Diabetes self-management support using mHealth and enhanced informal caregiving	Aikens	2014	Journal of Diabetes and Its Complications	Chronic disease: diabetes	50+	Diabetes	Chronic	Yes	Unclear
2	Acceptability and Preliminary Efficacy of a Tailored Online HIV/STI Testing Intervention for Young Men who have Sex with Men: The Get Connected! Program	Bauermeister	2015	AIDS & Behavior	Primary Prevention: STIs	13-24	STI prevention	Prevention of Infection	Yes	Unclear
3	The SMARTER Trial: Design of a trial testing tailored mHealth feedback to impact self-monitoring of diet, physical activity and weight	Burke	2020	Contemporary Clinical Trials	Clinical trials	18+	Weight loss, self-monitoring of diet and physical activity	Chronic	Yes	Unclear
4	Improving adherence to a cholesterol-lowering diet: a behavioral intervention study	Burke	2005	Patient Education and Counseling	Primary Prevention	50+	cholesterol-lowering diet	Chronic	Yes	Unclear
5	Validation of an integrated service model, Health-RESPECT, for older patients in long-term care institution using information and communication technologies: protocol of a cluster randomised controlled trial	Choi	2020	BMJ Open	?	50+	chronic illness	Chronic	Yes	Unclear
6	Intent-to-treat analysis of a simultaneous multisite telehealth diabetes prevention program	Ciemins	2018	BMJ Open Diabetes Research and Care	Chronic disease: diabetes	50+	Diabetes	Chronic	Yes	Unclear
7	Efficacy of a Telephone Delivered Sexually Transmitted Infection/Human Immunodeficiency Virus Prevention Maintenance Intervention for Adolescents	DiClemente	2014	JAMA Pediatrics	Pediatrics	14-20	STI prevention	Prevention of Infection	Yes	Unclear
8	Using Videoconferencing to Deliver a Health Education Program to Women Health Consumers in Rural and Remote Queensland: An Early Attempt and Future Plans	Faulkner	2001	Australia Journal Rural Health	Rural Health	50+	menopausal health	Primary Prevention	Yes	Unclear
9	The Development and Testing of a Relationship Skills Intervention to Improve HIV Prevention Uptake Among Young Gay, Bisexual, and Other Men Who Have Sex With Men and Their Primary Partners (We Prevent): Protocol for a Randomized Controlled Trial	Gamarel	2019	JMIR Research Protocols	Research Protocols	15-19	STI prevention	Prevention of Infection	Yes	Unclear
10	Results from an Online Computer-Tailored Weight Management Intervention for Overweight Adults: Randomized Controlled Trial	van Genugten	2012	Journal of Medical Internet Research	Internet Research	18+	Weight loss	Chronic	Yes	Unclear

	Master's Level PH?	Type of telehealth used	Study Design	Aim of Study	Training for Staff	ICT-SPECIFIC Training for PH Staff?	ICT Use Successful?	Study Outcomes
1	Can't Determine	Mobile phone	Observational	The overall goals of the intervention were to monitor patients' symptoms and self-management, provide patients with tailored messages about diabetes self-management, provide guidance for patients' informal caregivers via emails and provide clinicians with feedback on patient-reported health problems.	No	Unclear	Yes	After program recruitment; 39% of those asked agreed to participate in the study with an informal caregiver. Researchers report that attrition was low and that a majority of attempted weekly phone calls were successfully completed. Call completion was not affected by comorbidities. This shows that an mHealth mobile phone intervention may improve access to disease monitoring and self-management among patients with multiple chronic conditions.
2	Can't Determine	Interactive website	randomized controlled trial	The aim of the study was to test the feasibility, acceptability and efficacy of an online intervention focused on encouraging young MSM to participate in HIV/STI testing.	No	Probably Yes	Yes	The primary outcome was HIV/STI testing behavior. At the thirty-day follow-up one-third of program participants reported making an appointment to get tested for HIV/STI. During the follow-up period over 90% of participants who scheduled and took a test; stated that the intervention helped them identify clinics that met their unique needs. Secondary outcomes included changes in sexual behavior and self-efficacy to test for HIV/STI. Researchers observed an overall decrease in the number of sexual partners for those in the intervention arm as well as an increase in self-efficacy; in being comfortable with discussing HIV/STI testing with their partner.
3	Can't Determine	Texting	randomized controlled trial	The aim of this study was to measure the efficacy of an m-health intervention using text messages to impact self-monitoring of diet, physical activity and weight.	No	Unclear	Unclear	This was a randomized control trial designed to test the efficacy of a weight loss intervention. Participants in the intervention arm self-monitored their diet, physical activity and weight; however they also received tailored real time text messages up to 3 times a day for 12 months.
4	Can't Determine	Mobile phone	randomized controlled trial	This study examined the efficacy of a telephone delivered intervention designed to improve adherence to a cholesterol lowering diet among those diagnosed with hypercholesterolemia.	No	Unclear	Yes	Over 37% of all program participants had heart disease for an average of ten years, 17% reported having hypertension and 46% were taking lipid-lowering medication. After the intervention participants in the intervention arm reduced their intake of total fat, saturated fat and cholesterol while those in the control arm increased their consumption.
5	Can't Determine	Video conferencing	randomized controlled trial	The aim of this study was to evaluate the effectiveness of Health-RESPECT intervention. The researchers used video-conferencing to treat patients in long term care institutions who were diagnosed with either hypertension, diabetes and heart failure. Health-RESPECT provides treatment goals and recommendations on additional evaluations, test needed and medications.	No	Unclear	Unclear	Pilot Study No Results Reported
6	Can't Determine	Video conferencing	cohort	The aim of this study was to determine the effectiveness of a diabetes prevention program delivered via video-conferencing to rural communities. This study also evaluated the minimization of staff costs in rural communities with limited resources.	No	Probably Yes	Yes	The purpose of this study was to evaluate the effectiveness of a 16 week modified diabetes prevention program administered via telehealth to rural communities and compare results with those who received the intervention face-to-face in an urban location. Researchers found that they were able to successfully deliver the intervention using telehealth and that the weight loss results were comparable to those in the face-to-face setting.
7	Can't Determine	Mobile phone	randomized controlled trial	The aim of this study was to evaluate the effectiveness of a telephone counseling intervention on STI preventive behaviors.	No	Probably Yes	Yes	Behavioral change intervention designed to have short-term efficacy in reducing STIs. Results: For every telephone contact completed there was an exponential reduction in chlamydia infection. Participants in the intervention arm also reported a higher proportion of condom use and fewer episodes of sex while high on drugs and alcohol.
8	Can't Determine	Video conferencing	Observational	The aim of this study was to use video-conferencing to deliver a health education program on menopausal health to women in rural and remote areas.	No	Unclear	Probably Yes	Researchers delivered an intervention on menopausal health using videoconferencing. The intervention was delivered to participants in rural and remote areas using videoconferencing while those in urban areas received the intervention face-to-face. Those receiving the intervention via videoconferencing where asked to provide feedback on intervention delivery. Feedback was positive about both the content and method.
9	Can't Determine	Video conferencing	randomized controlled trial	The aim of the study was to develop and test a relationship skills focused HIV prevention intervention for young MSM using video-conferencing (two-sessions) .	No	Probably Yes	Unclear	Pilot Study No Results Reported
10	Can't Determine	Interactive website	randomized controlled trial	The aim of the study was to evaluate an online interactive website that used a tailored weight management intervention.	No	Unclear	Unclear	Pilot Study No Results Reported

	Title	Author	Date	Journal	Discipline of the Journal	Population	Health topic	Type of Health Condition	PHP Involved?	PH Background of Practitioner
11	Targeting pregnancy related weight gain to reduce disparities in obesity: Baseline results from the Healthy Babies trial	Herring	2019	Contemporary Clinical Trials	Clinical trials	18+	minimize excessive gestational weight gain	Chronic	Yes	Unclear
12	Exploring Sex Differences in the Effectiveness of Telehealth-Based Health Coaching in Weight Management in an Employee Population	Johnson	2021	American Journal of Health Promotion	Primary Prevention/Health Promotion	Age not reported	Weight loss	Chronic	Yes	Unclear
13	Impact of a Telehealth and Care Management Program on All-Cause Mortality and Healthcare Utilization in Patients with Heart Failure	Kao	2016	Telemedicine and e-Health	Telemedicine	50+	heart failure	Chronic	Yes	Unclear
14	Does Telephone Care Management Help Medicaid Beneficiaries with Depression?	Kim	2011	The American Journal of Managed Care	Health Promotion	18+	mental illness	Chronic	Yes	Unclear
15	Brushing RemInder 4 Good oral HealTh (BRIGHT) trial: does an SMS behaviour change programme with a classroom-based session improve the oral health of young people living in deprived areas? A study protocol of a randomised controlled trial	Marshman	2019	Trials	Clinical trials	11+	dental caries (tooth decay)	Primary Prevention	Yes	Unclear
16	Evaluation of a Stepped-Care eHealth HIV Prevention Program for Diverse Adolescent Men Who Have Sex With Men: Protocol for a Hybrid Type 1 Effectiveness Implementation Trial of SMART	Mustanski	2020	JMIR Research Protocols	Research Protocols	13-18	STI prevention	Prevention of Infection	Yes	Unclear
17	Clinical Efficacy of Telemedicine Compared to Face-to-Face Clinic Visits for Smoking Cessation: Multicenter Open-Label Randomized Controlled Noninferiority Trial	Nomura	2019	Journal of Medical Internet Research	Internet Research	50+	smoking cessation	Primary Prevention	Yes	Unclear
18	Social Impact Analysis of the Effects of a Telemedicine Intervention to Improve Diabetes Outcomes in an Ethnically Diverse, Medically Underserved Population: Findings From the IDEATel Study	Shea	2013	American Journal of Public Health	Primary Prevention/Health Promotion/Health Education	50+	Diabetes	Chronic	Yes	Unclear
19	Oral Home Telecare Tutorials for the Community-Dwelling Elderly	Tomuro	2004	Journal of Medical and Cental Sciences	Medicine	50+	Oral home care	Primary Prevention	Yes	Unclear

	Master's Level PH?	Type of telehealth used	Study Design	Aim of Study	Training for Staff	ICT-SPECIFIC Training for PH Staff?	ICT Use Successful?	Study Outcomes
11	Can't Determine	Texting	randomized controlled trial	The objective of this study was to prevent excessive gestational weight gain in African American women. The researchers used interactive self-monitoring text messages.	Yes: Health coach were trained in the behavioral treatment of obesity through required readings and role play.	Yes	Unclear	Pilot Study No Results Reported
12	Can't Determine	Video conferencing	quasi-experimental	The purpose of this study was to explore differences between males and females in the effectiveness of a telehealth (video-conferencing) intervention on weight management/weight loss.	No	Unclear	Yes	The goals was to evaluate a telehealth based weight loss program. The primary outcomes of interest were weight loss and program satisfaction. While there was no significant difference in weight loss between sex there were significant differences in weight loss overall from pre to post program. The program was initiated via a weight management program for employees. Employee participants did report high levels of satisfaction with the overall intervention content.
13	Can't Determine	alth (electronic d	cohort	The objective of this study was to determine if the Health Buddy Program (a content-driven) telehealth system along with care management was associated with improved outcomes. The telehealth system consists of a high-resolution screen and four large buttons located in the patients' homes and connected to remote care managers.	No	Unclear	Yes	Researchers designed an electronic medical device for at home use for patients with heart failure. Over a three year follow-up period participants enrolled in the program had lower risk-adjusted all-cause mortality rates. Patients enrolled in the program also had fewer hospital admissions.
14	Can't Determine	Mobile phone	randomized controlled trial	The aim of this study was to examine a one year telephone care management intervention designed to reach a low income population.	Yes: PHP received on-site training in providing telephone care management of depression including motivational enhancement.	Yes	Probably No	Researchers designed a randomized control trial using telephone encounters to establish relationships, start treatment, make referrals for in-person therapy and medication management and monitor patient progress. The intervention saw mixed outcomes. Those in the treatment arm had a higher rate of enrollment in mental health services than those in the control arm. However, there was no significant reduction in either group of depression severity.
15	Can't Determine	Texting	randomized controlled trial	The aim of this study was to examine the cost-effectiveness of a text messaging behavior change intervention to improve the oral health of young people.	No	Probably Yes	Unclear	Pilot Study No Results Reported
16	Can't Determine	Interactive website	randomized controlled trial	The aim of this study was to test the effectiveness of and HIV prevention intervention for adolescent MSM. The intervention used an interactive website that tailored messages for study participants.	No	Probably Yes	Unclear	Pilot Study No Results Reported
17	Can't Determine	Video conferencing	randomized controlled trial	The aim of the study was the evaluate the efficacy of an internet based (video-counseling) smoking cessation program compared with the standard face-to-face program.	No	Unclear	Probably No	Researchers sought to compare the delivery of an intervention with the traditional face-to-face format with a videoconferencing format. There were no significant differences in the two groups in regards to smoking cessation.
18	Can't Determine	Video conferencing	randomized controlled trial	The aim of the study was to compare the effectiveness of a diabetes intervention delivered via videoconferencing vs. the face-to-face mode of delivery.	Yes: PHP trained in diabetes management and iuse of computer-based tools to facilitate the intervention via videoconferencing.	Yes	Yes	Researchers sought to improve diabetes management in a medically underserved population. Results showed that lower SES participants benefited as much as higher SES participants from the intervention. Participants in the telemedicine group at the lower SES had the greatest reduction in A1c when compared with control arm. There were no significant differences between the two groups in terms of low-density lipoprotein cholesterol levels. Participants in the telemedicine group at the lower SES had the greatest reduction in systolic blood pressure when compared to the treatment arm.
19	Can't Determine	Video conferencing	Observational	The aim of the study was to examine the experiences of community dwelling elderly of an oral health intervention delivered via videoconferencing.	No	Unclear	Yes	Researchers used videoconferencing to deliver oral health care tutorials for community dwelling elderly. Clients reported that they had acquired broader knowledge and practical skills.

2.10. Discussion

To the author's knowledge this is the first study that attempts to identify how telehealth has been used in interventions with master-level public health practitioners as part of the primary care team. It is important to note the small sample size; approximately 19 studies met inclusion criteria and were included in this review.

In this review the role of public health practitioners' was not clearly defined. For example, while all included studies had a public health practitioner involved in the intervention it remains unclear; how the public health practitioner was trained. Was the practitioner someone with a bachelor's degree, master's degree or doctorate? Was the practitioner specifically trained in a public health program? There was also very little information on specific on-the-job training for public health practitioners' training on delivering health related services using information and communication technology. This points to the research gap on how public health practitioners are being trained in the delivery of telehealth services. Only three studies mentioned staff training: Kim et. al., Herring et. al., and Shea et. al. (Kim et al., 2011), (Herring et al., 2019), (Shea et al., 2013). While all three studies stated that staff were trained, specific details on training content and dosage were not included. This made it impossible to test the association between public health practitioner training on ICTs and program outcomes.

The review does provide an overview of how ICTs are being used in delivering public health interventions. The ICTs found in this review included videoconferencing, mobile phones, interactive websites, text messaging and one team designed their own electronic devices that was specific to program needs. This shows that there is potential in using ICT based interventions; which is particular important as we continue to deal with the COVID 19 pandemic; where many people are unable to attend "in-person" interventions. This is also important for those living in

rural areas where program access may be a problem. Due to the growth of the Internet and access to telehealth/telemedicine; interventions can now be delivered remotely and with fidelity.

Overall, across all studies, participants who received the intervention via telehealth reported high satisfaction with the overall intervention content and mechanism of delivery. Participants in Tomuro's study on oral health care stated they had acquired broader knowledge and practical skills. This points to the potential for using ICTs in intervention delivery as equally effective as the traditional face-to-face format. These studies point to participants feeling comfortable about receiving interventions using ICTs. Research shows that when it is feasible to provide healthcare services in the patient or participant's own environment that this increases the chance for improving program participation (American Occupational Therapy Association, 2014). Thus, if there are opportunities to provide interventions with the option of incorporating ICTs this seems to be a viable option.

This review points to several areas for future study. First, while it is clear that public health practitioners were involved; research teams' training and background need to be included. Secondly, more information on overall program effectiveness is needed to compare whether ICT based interventions are a cost effective and feasible option. Lastly, expanding the review to include ICT based interventions outside of the public health arena to include those in medicine, therapy and mental health could point to ways to improve services as well as make cross discipline collaborations a reality as we move to the patient-centered medical home care model.

2.10.1. Limitations

This review had several limitations. One limitation is the "terminology" considered for review. Information and Communication Technology (ICTs) search may have missed articles that used a different or more specific term for this broad topic area. Given the myriad of terms that are used to describe relatively common forms of ICTs (e.g., tablet, iPad), as well as context and/or discipline specific ICTs (e.g., hand-held devices used by surveyors vs physicians), this may warrant a different approach to conducting reviews in the future. Nevertheless, given the vacuum of empirical information in this realm, a broad and overly inclusive strategy was warranted for the present study.

A second limitation is that this review only included articles published in English. Thus, telehealth interventions done in other countries may have been left out because they were not published in English. Given there are several nations with access to highly sophisticated ICTs, as well as healthcare and public health systems that may be more centralized, limiting to English-language publications may have excluded a wealth of information from non-English sources. Duplicating the present review to include other languages, with appropriate tailoring for context, may enrich what we learn.

2.11. Conclusion

This scoping review gives an overview of studies where a public health practitioner used telehealth to deliver public health interventions. All studies included in the review used some aspect of telehealth in service delivery. This points to the fact that existing interventions delivered in the traditional face-to-face format may be able to take advantage of information and communication technologies in the delivery of their services. When asked, most study participants felt comfortable using technology, and some said that having the intervention

delivered in their home helped them complete the study and helped create long-term sustainable lifestyle changes. This review highlights the need for training master's level public health practitioners in delivering services using ICTs. While three studies stated staff was trained, no details on training were provided.

Lastly, there was no way to compare the differences between outcomes (effectiveness) across the different modes of telehealth delivery.

3. THE STATUS OF ICT TRAINING IN PUBLIC HEALTH EDUCATION

3.1. Information and Communication Technology

It has been argued that the healthcare sectors are undergoing a paradigm shift from the "Industrial Age" to the "Information Age" and that healthcare and allied health systems cannot remain oblivious to the rapidly changing technological landscape (Lupiáñez-Villanueva et al., 2010). This paradigm shift is set to shape the healthcare and allied health systems and transforms how healthcare and allied health personnel (e.g., public health practitioners) interact with patients and populations, and has a tremendous impact on outcomes related to effectiveness and quality. The World Wide Web changed how the public engages with health information and revolutionized health informatics systems and service delivery. As the population continues to age and healthcare costs increase, the focus is turning towards methods that can enhance service delivery and increase effectiveness.

Several tools have been developed that help in information and communication technology (ICT) integration into healthcare and allied health practices. These include computers, smartphone technology, software programs, the Internet and cloud computing. These technological tools help connect stakeholders such as healthcare providers, allied health practitioners such as public health practitioners to the people they serve in order to provide quality, affordable and accessible care (Lupiáñez-Villanueva et al., 2010).

The use of ICTs in healthcare and allied health research has made it possible for evidence-based medical and public health practice, helping integrating research from past studies with patients' information with physician's expertise and patient's preferences and values. For example, the integration of electronic health records to document patient’s history has enabled

effective and timely care for patients (Borycki & Kushniruk, 2017). It is a source of significant practice evidence that can aid in deciding the best course of action of patient's care (Borycki & Kushniruk, 2017). The use of new technology has effectively reduced the cost and time of diagnosis (Atrash & Carpentier, 2012), which has saved countless individuals through appropriate treatment (Atrash & Carpentier, 2012). ICTs have also facilitated the elimination of traditional models of care and led to the implementation of new models that have facilitated effective quality care (Lupiáñez-Villanueva et al., 2010).

There is no doubt that information and communication technologies have helped to improve the healthcare, allied health – including public health - systems. However, these field have more opportunities to increase the effectiveness of ICTs if these technological advances are adopted, and then adapted to the needs of the professions. Meanwhile, the number of trained ICT experts is currently insufficient (World Health Organization, n.d.). The number of experts who can offer knowledge of ICTs is limited, which hinders the transfer of knowledge from these experts to public health trainees. The scale-up of ICTs in health programs is also hindered by the lack of appropriate strategies, policies, and standards.

3.2. The Role of Public Health Practitioners in Using ICTs

The WHO recognizes that a well-functioning healthcare system seeks to improve individuals, families, and communities' healthcare while defending the population against health threats and emergencies (Atrash & Carpentier, 2012). Healthcare is typically provided by numerous multidisciplinary practitioners and teams, which are comprised of allied health professionals. Per the Department of Labor, public health practitioners are categorized as members of the allied health professions (Asemahagn, 2015). Furthermore, the WHO definition

encompasses medical and public health care delivery, irrespective of setting. Thus, public health practitioners are essential contributors to effective healthcare systems.

While clinical care focuses on a person, public health entails a broader spectrum that works on communities' wellbeing to achieve a healthy nation and better health globally (Atrash & Carpentier, 2012). Quality public health practice moves beyond educating patients and the public. Rather it includes the provision of support at all socioecological levels, including but not limited to formulating policies, financing, intervention programs, and offering administrative support to all those involved in improving the health of people. Further, public health practitioners are often involved in healthcare delivery teams. Thus for public health practitioners in healthcare settings, their responsibilities may require them to utilize ICTs.

According to the Institute of Medicine (IoM) the core functions that public health agencies provide include the assessment and monitoring of communities and populations that are at risk and the identification of priority health problems (Institute of Medicine (U.S.) & Field, 1996). The development of policies in collaboration with community and government stakeholders can help solve the nations' healthcare challenges. Public health practitioners provide knowledge, education, and assurance to the general public about appropriate care methods and use culturally appropriate health promotion and disease prevention interventions. Public health practitioners play a critical role in ensuring the realization and achievement of these public health goals. The principles underlying public health practitioners' role include empowerment, participation in community health-based projects, equity, and working together. Public health practitioners also work to improve individuals' knowledge and how they can prevent illnesses. Public health practitioners also increase competence by addressing the external and environmental factors hindering public health.

The current public health sector has evolved to reflect the constant changes in the health needs of the population. Additionally, due to the rate of increase in ICTs in healthcare sectors, public health has had to revolutionize how it facilitates its goals (Atrash & Carpentier, 2012). This means integrating ICTs into public health practice to help improve the practice quality effectiveness. Public health practitioners have had a significant role in facilitating and utilizing ICTs, and in some sense, at the forefront of this shift. Given that public health practitioners play an essential role, they are fundamental in integrating ICTs. Thus, they have a significant influence on the adoption of these new technologies. Yet it remains unclear where ICT skills are learned, adopted and disseminated by public health practitioners.

Today, more than ever, educators, public health students, and other stakeholders must attain new skills to remain current and be effective in this new landscape. Indeed, a scoping review revealed public health professionals were using ICT in healthcare delivery settings (Lee, unpublished ND). The same study found inconsistencies in if and how public health professionals were trained in ICT utilization. In sum, there clearly exists a need for public health professionals to be competent in the use of ICTs. Yet, there is little data available on what ICT-related training is included in the preparation of public health professionals.

Information and Communication Technology as a Public Health Competency

The role of ICTs in the future of health-related practices will be significant, and professionals will need to be up to date and efficient with these technologies. It is estimated that 30% of public health practitioners' time will be spent using these technologies (Rowe, 2008). Given the requirements for ICT skills in public health, it has become a major focus of interest in recognizing the need for education of the public health workforce about public health informatics of computing and communication technology that applies to public health activities. It is

essential to train both new and existing public health professionals. The extent to which information and technology transform public health practice will be determined by their willingness to recognize and participate in technical training and education. In 2001, the American Medical Informatics Association brought together the health and informatics communities to develop a national agenda for Public Health Informatics (PHI). These programs recognized that the public health workforce required training on information and technology, and skills could be provided through various educational programs. Other recommendations included developing new strategies, strengthening existing educational programs, and developing national competency education programs among all public health workers (World Health Organization, n.d.).

The Council of Education for Public Health (CEPH), is an independent agency that the US Department of Education recognizes to accredit the institutions of public health and the programs that are outside schools of public health. The most recent criteria for accreditation includes language indicating CEPH has also recognized information and technology as a core competency in public health education (Criteria & Procedures – Council on Education for Public Health, accreditation criteria schools of public health & public health programs, 2016, p.26). n.d.). While the competency model releases schools/programs from providing subject-focused training, it also renders it more difficult to ascertain if and how knowledge and skills required to demonstrate cross-cutting competencies such as ICT skills, are delivered to public health students. Further, while the World Health Organization has identified the benefits from ICTs incorporated in public health practitioners' education (World Health Organization, n.d.), no data has been published in this realm.

It is evident there are gaps in the research literature regarding if and how public health practitioners are trained in ICT use. From Lee's (2021 unpublished) previous study, training is provided at times during practice. Yet to achieve true competency, the ideal would be to receive formal and intentional training while a student, and therefore be able to demonstrate ICT competency prior to graduation. What remains unclear is if public health educational programs have incorporated ICT training into their curricula, in order to provide didactic training to rising public health professionals.

3.3. Study Purpose

The purpose of the present study is to assess if and how ICT-related knowledge, skills, and training are provided to public health students as preparation to meet ICT-related competencies. As an initial step we use a case study, specifically the public health curriculum of an accredited public health training program to answer the research question pertaining to ICT didactic training. We also use a case study approach to review and test our method and approach, as well as to inform subsequent efforts to systemically examine public health curricula for ICT-related training.

3.4. Methods

3.4.1. Approach and Design

Given the paucity of literature or even lay information available about ICT skill inclusion in public health training, we determined a quantitative approach would be most appropriate in order to generate data needed to induce theories to guide subsequent studies. Thus, a single case study approach was utilized for the present study. For this study, the case was a single accredited MPH program. However, the units of analyses include a) publicly published curriculum, and b) all of the syllabi from required MPH courses per the curriculum.

There are two types of content analysis: both quantitative and qualitative. I will be using quantitative analysis for this study. The overall purpose of quantitative analysis is to develop themes based on how many times relevant information occurs in the data (Schreier, 2014). The researcher first identifies the relevant data and then codes/tallies the evidence from the data (Schreier, 2014). The resulting product is both reliable and context free (Schreier, 2014).

3.4.2. Case Selection

For our case study, we required a MPH program to meet the following criteria: 1) with full and valid accreditation status per CEPH, 2) large enough program to offer multiple concentrations in the MPH program, and 3) access to all syllabi for required masters courses designed to address any of the required CEPH competencies. We identified a CEPH-accredited school of public health meeting all criteria embedded in a large public university in Texas. The Case-School offers concentrations in several traditional public health disciplines (i.e., epidemiology, biostatistics, health promotion, health policy and management, environmental health and occupational health).

A complete list of all required public health courses were determined from each program's degree plan/curriculum via the university website. Syllabi were obtained by contacting each department's administrator via email requesting the course syllabi for all required courses.

3.4.3. Constructs and Variables

For purposes of this study, the standard is CEPH's competency deconstructed into domains. The domain directly related to information and communication technology states "basic concepts of public health-specific communication, including technical and professional writing and the use of mass media and electronic technology" must be addressed in the

curriculum and learning experience of public health students (Criteria & Procedures – Council on Education for Public Health, accreditation criteria schools of public health & public health programs, 2016, p.26). n.d.).

3.4.4. Instrumentation

Curriculum Scan Tool (CST). In order to determine if the MPH curriculum and syllabi met the information and communication technology competencies established by CEPH quantitative content analysis was used. Quantitative content analysis counts frequencies in the text. The curriculum outlines the courses that students will be taught to meet program standards. Course syllabi help provide students with the structure and format of the course. Course syllabi state the learning outcomes and course objectives. These outcomes are guided by competencies set forth by accrediting bodies in the discipline while course objectives specifically point to skills students will learn during the course of the semester. A scale was used to count the frequencies of occurrences of information and communication technology mentioned in the curriculum of courses and all required courses' course objectives.

3.4.5. Curriculum Scan Procedure

The MPH curriculum was reviewed using two sources. The publicly available website available for anyone to review (https://public-health.tamu.edu/degrees/) and the Curriculum Sheet and Degree Plan provided to enrolled MPH students. Using the CST described earlier, the curriculum was reviewed to determine the existence of any words in the course title or brief description that either explicitly stated, or implied the incorporation of ICT as part of the course.

3.4.6. Syllabi Extraction and Coding Procedure

Using the CST, we identified explicit and implicit ICT references in course syllabi. Ideally, both the Curricular and Syllabi analyses will utilize multiple coders to reduce

measurement error. I used two coders for this study. Using multiple coders enables the calculation of inter-rater reliability and/or concordance/discordance. Further, if and when coder incongruence is identified, the affected syllabi will be re-coded by each coder. If the incongruence persists, a resolution will be reached through deliberation between both coders.

3.5. Results

One public university in the state of Texas was identified for inclusion in this study. The institution has a school of public health with four departments (Environmental and Occupational Health, Epidemiology and Biostatistics, Health Promotion and Community Health Sciences, and Health Policy and Management). As part of the curriculum at this university, all master's level public health students also participate in the Core. The Core serves to provide all incoming students with a public health foundation before students branch off into their respective public health disciplines.

A total of 88 syllabi and 435 objectives were analyzed for this study. Only required courses and their syllabi were included for review. Across all departments, we see from quantitative content analysis frequency count that information and communication technologies were mentioned only three times across course curriculum and 60 times across all course syllabi. In terms of curriculum; Biostatistics and Epidemiology each offer Data Management and Computing as required courses in their degree plan. Occupational Safety and Health offers Occupational Biomechanics as part of their degree plan. Despite CEPH's competency requirements; ICTs were only mentioned 60 times across 88 syllabi and 435 course objectives. Examples of ICTs from course syllabi include: "develop and print a 3D ergonomic aid tool", "create and test low-fidelity prototypes of solutions for a work system," "use Microsoft Excel," "develop balanced score cards, dashboards, and strategy maps for performance measurement and

strategic management feedback," "analyze and interpret data using a variety of advanced analytical tools," "acquire computing skills using different models," "perform statistical analysis using statistical software," "analyze environmental data and articulate the characteristics of a chemical hazard," and "analyze survival data using SAS or R."

It should be noted that the department with the highest frequencies of ICTs in their course objectives were Epidemiology and Biostatistics. These two disciplines more than the others use statistical software in most of their course offerings; which could contribute to their higher frequency count of ICTs.

Table 1
Table 1 CEPH's ICTs competency frequency of links across all departments from curricula

Department	In Curriculum?	How?
DEPT A	Not mentioned	Not mentioned
DEPT B	Not mentioned	Not mentioned
DEPT C	Concentration C1	In text describing degree plan and courses
	Concentration C2	In text describing degree plan and courses
DEPT D	Concentration D1	In text describing a require course for a degree. Shared by both departmental concentrations, so mentioned once.
	Concentration D2	
Core	Not mentioned	Not mentioned

Table 2
Table 2 CEPH's ICTs competency frequency of links across all departments from syllabi

Department and/or Unit	Frequency of ICTs in course objectives	Total number of syllabi	Number of objectives
DEPT A	6	10	75
DEPT B	41	43	159
DEPT C	8	12	80
DEPT D	4	18	76
Core	1	5	45
Total	60	88	435

3.6. Discussion

This study aimed to assess the existence of ICT-training in MPH curriculum and compare the alignment between the Council on Education for Public Health competencies regarding Information and Communication Technologies (ICTs) against the curriculum in a school of public health. In order to accomplish this, the strength of each objective was compared against the competency. The results showed that while ICT competencies are being included in the course curriculum, they have not been fully integrated across all departments and all courses evenly.

This study also revealed that this curricular scan tool was not sufficient to capture the ICT training in public health schools and programs. The deeper I went, the more I found that a deeper drive would be needed. While the goal was to conduct a quantitative content analysis of the curricula and syllabi; I was also testing the curricular scan process. During the testing of this

process I found that adjustments need to be made. It will be important to have a tool that can identify both explicit and implicit references of ICTs.

There were a few courses that the content analysis revealed that were in alignment with the accreditation competencies set forth by CEPH. However, these courses were small in number. As ICTs become more and more critical in delivering health care services faculty may want to adjust the curriculum and ask themselves if they are teaching students content or are they teaching students the required skills.

The school I choose as my case school was one of the first to undergo a full review under the new CEPH criteria. I believe that other schools and programs of public health will be able to utilize the lessons learned from the case school as they undergo their accreditation process. Moving forward I would like to replicate this process with other schools and programs from around the nation. I think that this will paint a more comprehensive picture of what's being done well and what we need to improve.

Because ICTs have not always been a part of the competencies set forth by CEPH; many current public health practitioners have had to "make do." From the scoping review it is clear that public health practitioners are utilizing ICTs however without training in their academic program how they are acquiring the ICT skills is what lead me to my next study.

3.6.1. Limitations

One limitation is that syllabi were collected for the 2020-2021 academic year. Learning objectives are updated yearly. There may be semesters where more emphasis is being placed on incorporating information and communication technologies into course curriculum and syllabi. Future studies may include the curriculum and syllabi for more than one academic year. Another limitation is that professors designing curriculum and syllabi are incorporating ICTs into their

coursework; however it is not clearly stated in the syllabi's learning objectives. This could lead to under-reporting. The last limitation is that only required courses were included in this analysis. Elective courses and internship experiences may provide public health students ICT training that would have been missed in this analysis.

3.7. Conclusion

While this study shows that Information and Communication Technologies (ICTs) are being taught in public health courses, it is not consistently being taught across all courses and public health disciplines. Faculty may need financial and infrastructure support in order to include ICT competencies in their courses. Incorporating ICTs into courses may look different. While most course time is often dedicated to lectures, simulated client encounters, role-playing, and assigned readings may help. Faculty and student development resources, including training and opportunities for hands-on practice, may help faculty and students feel comfortable utilizing ICTs in delivering health services. Schools of public health may need to be more intentional in developing measurable objectives on ICTs course content and delivery. Moving forward, there is still much to learn. For example, what are the most effective ways of training public health students on ICT delivery, and at what point during training should ICTs be introduced. Lastly, an evaluation plan must be in place to measure what students are learning about ICTs and linking this data to see if we see improvements in public health outcomes.

4. ICT EXPERIENCES OF VETERAN PUBLIC HEALTH PRACTITIONERS-A CASE STUDY

4.1. Information and Communication Technologies (ICTs)

Technology is currently changing the landscape of the global world. From the beginning of 1990, Information and Communication Technology (ICTs) took center stage, driven by the rise and success of the internet. ICTs embody all digital technologies that support electronic capture, storage, processing, and information exchange to promote health, prevent diseases, treat, and manage and intervene in chronic diseases (Rouleau, et. al., 2015).

4.2. ICTs in Health Profession

In the health sector, ICTs are defined as projects that allow for telehealth, clinical support among inter-disciplines, and knowledge transfer (Aceto et. al., 2018). This emerging role of ICTs in healthcare has dramatically helped the healthcare sector and created extensive opportunities for health promotion and impact in healthcare provision. ICTs have assisted in enhancing the quality of care, increases patient security, and reduces operating and administrative costs (Aceto et. al., 2018). ICTs also play a significant role in increasing accessibility to healthcare services and improving the efficiency, quality, and effectiveness of any healthcare process. The cooperation among healthcare personnel has improved collaboration efforts to effectively work together by coordinating activities and sharing knowledge, ensuring that they provide the best-coordinated care. For example, chronic illnesses are now better managed and leveraged through digital monitoring, and patients can receive patient-centered and evidence-based care. Health care systems have now enabled patients to control their well-being by increasing personalized, tailored health information.

4.3. ICTs in Public Health

ICTs have revolutionized healthcare at national and global levels, allowing for effective dissemination of public health information and facilitation of consultation in healthcare. Patients can access diagnosis and treatments effectively and gain education about disease prevention. Various healthcare professionals can now communicate more efficiently, promoting collaboration and enhanced sharing of learning and ideas and better patient care.

4.4. ICTs Utilization

New and advanced technologies continue to change communication and treatment among healthcare and medicine. Some of the intentions of this technology were not initially designed for healthcare but have been extremely beneficial, while others have been designed specifically for healthcare management. These tools have effectively provided efficient ways to organize people and ideas, increase knowledge and education among communities, and increase teamwork and collaboration among multidisciplinary teams to achieve healthy populations (Rouleau et al., 2015). There are various examples of tools that have been used in healthcare and how they have helped explicitly in the evolution of healthcare services.

Mobile health, also known as m-Health, is additional technology that has improved healthcare and public health. This growth in modern technology and the advent of smartphones and tablets presenting portable technology has enhanced communication among healthcare providers. Healthcare workers can now access their patients' electronic health records (EHR), review their medical history, develop follow-up emails, and send prescriptions to pharmacies. Mobile technology has helped to allow public health practitioners to complete their tasks no matter their physical location (Singh et. al., 2011). ICTs have also redefined the use of research in the field. Together with internet access, these tools can be used in public health. Public health

practitioners can conduct basic biological measurements and utilize video and digital transmission, making on-the-spot analysis promising. These individuals can also connect with other healthcare professionals worldwide, making sharing of information and communication easier. Telehealth, also commonly known as telemedicine, is another growing technology. It refers to a two-way video consultation of the transmission of healthcare data (Rouleau et. al., 2015).

Another growing trend is the use of sizable data and cloud technologies in medicine and public health. Big data, which is often intertwined with EHRs, refers to the enormous data records collected, processed, and used in analytics (Dash et al., 2019). When data experts analyze this data, it offers information such as how organizations can reduce healthcare costs, helps in predicting epidemics and the transmission rate of outbreaks which leads to the avoidance of preventable mortalities and morbidities. Cloud technology has allowed for better and safe data storage at low costs without limitations and additional expenses (Kant & Krishan, 2010). It has also increased the reliance on EHR systems and protects against the huge loss of sensitive data through its strong backup and recovery services.

It also acts as an invaluable tool that facilitates medical research and sharing of medical information. These tools effectively mobilize workforces by sharing big data and providing accuracy in research studies (Dash et al., 2019). As a result, public health practitioners can develop evidence-based practices through research to mitigate diseases that have changed the medical landscape. Geospatial and spatial translation of data are other ways that ICTs have revolutionized the way public health officials work. It has helped them identify, track, contain, and resolve public health problems (Yoder, 2016). When combined with cloud storage, these tools provide a decisional advantage where individuals can respond in real-time to public health

issues. These tools have proven to be effective, and each healthcare professional should focus on ensuring that they are up-to-date with ICTs to maximize optimal treatment and care for patients (Dash et al., 2019)

4.5. Public Health and ICTs

Public health is a facet in our health system that focuses on improving and protecting community health well-being by emphasizing prevention in large groups of individuals (World Health Organization, n.d.). Information and Communication Technologies (ICTs) act as an essential tool in helping to achieve this goal. The World Health Organization (WHO) recognizes information and communication technology's importance in public health management through the technical collaboration of existing institutions and networks to pool human, technical, and technological resources together (World Health Organization, n.d.)

A previous study involving a curriculum review found little formal pedagogical preparation in ICT use specific to public health (Lee, et. al., n.d.). While the formal inclusion of ICT-related professional competencies is relatively recent (2016), the need for skills and competencies in ICT use has long existed among public health professionals. What remains unclear is how formally-trained and experienced public health professionals acquired training and skills in ICT use.

In order to inform the future ICT-specific training needs of MPH-level practitioners, a critical first step is to understand better how ICT is utilized by experienced public health professionals, particularly those whose educational programs did not include ICT instruction at the time. Pedagogical or curricular modifications to public health training programs should be empirically based and theoretically driven. In the case of ICT and public health, the recent

development of the new professional competencies means very little research is available in this particular area, and points to the need to pursue a qualitative research plan.

4.6. Methods

4.6.1. Why Qualitative?

The research question required a qualitative approach for many reasons. First, I needed different types of information on a specific topic. Secondly, I could not narrow the scope further until I collected more data to better gage the current status. Lastly, I needed data from more than one case to get a sense of commonalities. While reaching a point of information saturation would be ideal, this area of inquiry is so new that my initial foray required an open approach to allow a scan more than an in-depth analysis.

In comparison to quantitative research where the goal is to make generalizations from the study sample to the population, the goal of qualitative research is to understand a phenomenon (Forman & Damschroder, 2007). Qualitative approaches are ideal in circumstances in which there is little existing theoretical basis nor data available in a topical area (Ritchie & Lewis, 2014). According to Merriam qualitative methods are useful in helping the researcher understand the meaning that people give to events (Merriam, 1998). One of the early pioneers of qualitative research Dr. Yvonna Lincoln stated that qualitative approaches are ideal for inquiries into areas where we need to know about a real-life situation, but there's virtually no information that has been collected in a systematic way (Lincoln & Guba, 1985). This specific type of qualitative research methods will yield data to inform an inductive approach to understand the phenomenon (i.e., navigating ICT-use as a public health practitioner not trained in ICTs).

As the researcher I was able to collect the data directly from the participants via one-on-one interviews. I believe this method of data collection would provide me a preview of sorts into

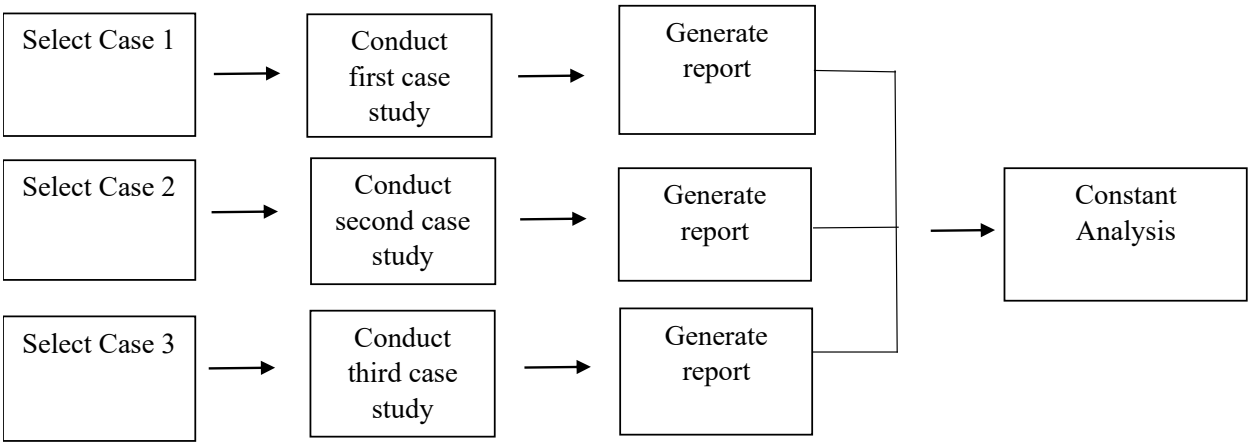
participants' thoughts and attitudes, which would help determine starting place for a more in-depth inquiry. Also, because the data were collected in "real-time" and not in a controlled environment such as a laboratory I believe the results can be both rich and descriptive.

4.6.2. Qualitative Case Study Approach

This study sought to better understand public health practitioners' (who holds- a master of public health degree-MPH) perceptions and experiences concerning the integration of information and communication technologies (ICTs) into their current roles and previous academic experiences. Case studies can be described as an intensive investigation within a single individual or group where the research hopes to gain an understanding of a particular phenomenon (Chang et.al., 2002).

I determined that the Interpretivists/Constructivist approach was best suited for the goals of my study. Constructivists' approaches to research is performed with the intention of "understanding the world of human experience" (Mackenzie & Knipe, 2006). This method allows for the researcher to rely upon the participants' views of the situation being studied. It does not begin with a theory, rather a theory is eventually developed (Mackenzie & Knipe, 2006). The goal is to identify patterns and develop meanings from patterns, which is one of the preliminary steps in theory development (Mackenzie & Knipe, 2006).

Figure 3. Three-case Case Study Diagram



4.6.3. Selection of Cases

Three cases were selected. The inclusion criteria for the cases were that they must have earned a master of public health degree from a university in Texas holding Council on Education for Public Health (CEPH) accreditation. The earned MPH is a requirement because the MPH is an applied and practitioner focused degree, compared to the Master of Science (MS) or Master of Science in Public Health (MSPH) which are research focused degrees. Cases must also have five years of post-master's work in the field of public health. The exclusion criteria for cases are a MPH degree from a university not in Texas, nor from a university without CEPH accreditation, and having less than five years post-master's experience in the field of public health.

4.6.4. Instrumentation

A semi-structured interview guide with seven questions was developed by the researcher with detailed feedback from committee members (see Appendix for the full interview guide). The guide was informed by published literature on public health practitioners, educators, and information and communication technologies. During the interview, participants reflected on their academic preparation and their practice experience with ICTs. The first part of the interview was designed to help participants feel comfortable with the interview process and gauge their preparation and current practice. The next part of the interview sought to gauge participants' attitudes on ICTs and how they shape their current work. The interview's conclusion was reflective, asking participants to reflect on what material they learned in their master's training on ICTs and what training would have been beneficial in their current roles. Follow-up questions and prompts were included as needed for clarity and a deeper understanding.

4.6.5. Procedure

Study participants were interviewed via Zoom. Zoom is a communications application that allows you to set up virtual video and audio conferencing. Zoom is cloud-based and has both recording and transcriptions functions and the ability to screen-share with other Zoom participants. The Texas A&M University institutional review board approved the study protocol IRB2021-0354M. All participants received a $25.00 Amazon gift card after interview completion to compensate for travel and time expenses.

4.6.6. Data Collection

Purposive sampling was used for data collection and is also known as judgmental, selective, or subjective sampling. This form of non-probability sampling is where I relied on my

judgment when choosing participants to participate in interviews. An email was distributed via a social media site that only graduate-level alumni of the public health program at the university have access; in order to recruit study (cases) participants. Due to the high response rate, only one email announcement had to be sent out.

Individuals interested in participating in the study were screened for eligibility. Participants meeting inclusion criteria were scheduled for interviews where the informed consent process was documented. Interviews were expected to last a minimum an hour in a half. Each participant was provided with a unique identifier to protect their confidentiality. Interviews were audiotaped by Zoom and transcribed verbatim by the researcher. The transcribed interviews were emailed to study participants to ensure the data collected is an accurate reflection of their thoughts and experiences. To protect participants' confidentiality, their names have been replaced.

4.6.7. Data Analysis

The data for this study consisted of transcribed interviews. Interviews were analyzed using a qualitative content analysis approach. Hsieh & Shannon define qualitative content analysis as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon, 2005, p.1278). I believe this type of analysis was appropriate because it goes beyond counting words to exam patterns and pulling out themes. When using content analysis, the researcher takes the raw data. In the case of this study, the transcribed interviews and through inductive reasoning categories and themes have emerged. After the interviews were conducted and fully transcribed I developed a coding scheme. Due to the small sample size, I was only able to test the coding scheme on one interview. After testing the coding scheme on the interview

sample, I coded all of the transcribed text. From there I was able to draw conclusions and four themes emerged.

4.6.8. Rigor

Rigor is defined as "the criteria for trustworthiness of data collection, analysis and interpretation" (Prion & Adamson, 2014, p.e107). The criteria for establishing rigor has been outlined by Lincoln and Guba. These criteria include -credibility, transferability, dependability and conformability (Lincoln and Guba, 1985). Credibility is the truthfulness of the data and its interpretation (Prion & Adamson, 2014). There are several ways of ensuring credibility. These include -validating the data and results as well as confirming my interpretations with study participants and experts in the field (Prion & Adamson, 2014). Transferability is the ability to transfer the study's findings to other populations (Prion & Adamson, 2014).

For transferability to occur the researcher must provide a very thorough background and description of research methodology (Prion & Adamson, 2014). Dependability occurs when another researcher can understand and follow the decision-making process and draw similar conclusions as the original researcher (Prion & Adamson, 2014). Dependability is also enhanced by a thorough background and description of research methodology (Prion & Adamson, 2014). Lastly, conformability is the absence of researcher bias (Prion & Adamson, 2014). Reviewing the analysis and interpretations by study participants and other experts can help minimize researcher bias (Prion & Adamson, 2014).

I chose three strategies to improve rigor. Member check: this is when data, codes, and categories, interpretations, and conclusions are tested with study participants. I believe that this is an appropriate method because it provides participants an opportunity to correct any errors and correct any misinterpretations. Next, I used a reflexivity journal: this is a type of diary where I

make notes throughout the entire research process. This diary includes notes about decisions that I have made during the research process and constant reflection on the process. This is appropriate because by having a reflexivity journal, I can constantly check my own bias. I also believe that the process of putting one's feelings onto paper is cathartic. Lastly, I used peer debriefing. Peer-debriefing is where I worked with another research colleague who is impartial to my research topic. My colleague examined transcripts as well as final reports. I think that this is appropriate because since my colleague is impartial, they are able to spot any of my own biases that I may have overlooked or taken for granted.

4.7. Findings

4.7.1. Program Participants

Case 001 Steve. Steve identified himself as a Caucasian male. He holds a Master of Public Health (MPH) degree in Occupational Safety and Health. He received his MPH in 2015 and has been working in the field since graduation. He currently works as a senior health safety specialist project coordinator. The interview was conducted via Zoom with both the camera and video on and recording. Steve was dressed very casually; almost as if he was headed out to play a baseball game once the interview ended. His outfit was complete with the long-sleeved baseball shirt and cap. Our conversation was very pleasant. Steve decided to have the interview in what has been serving as his home office since the pandemic hit. Steve's home office was set up like the typical home office with his desk, computer and printer. He sat behind his desk in a rolling chair for the interview. During the interview I could hear his dogs barking for his attention at times. Out of all three of my participants Steve finished his master's program most recently.

Case 002 Dan. Dan identified himself as a Caucasian male. He holds a Master of Public Health (MPH) degree in Social Behavioral.. He received his MPH in 2004. He is currently a director of quality improvement, and relatively new to the role. His experience in public health is quite varied, and ranges from research evaluation, quality performance improvement, and grant applications. As he career evolved Dan decided to go back to school and received his doctorate. Just like Steve's interview Dan's interview was conducted via Zoom with both the camera and audio on for recording. Unlike Steve, however Dan was not in a comfortable home office. He has been working in his new position in a new state for only three months and before that he and his family lived together in Texas. Dan is currently living in a camper and working "from home from his camper," while he and his wife sell their Texas home. He did warn me that because of his location the wi-fi might drop out and if it did; not to worry he would log back on. During the interview Dan was very upbeat and energetic. He answered all of the questions and probes in detail.

Case 003 Kate. Kate identified herself as a Caucasian female. She holds a Master of Public Health (MPH) in Environmental and Occupational Health. She received her MPH in 2007. She performs health inspections of hospitals, daycare centers, restaurants, grocery stores, and convenience stores in her current role. Due to her work schedule and assignments Kate wanted her interview to be as early as possible so we decided on 8 a.m. Just like Dan and Steve, Kate's interview was conducted via Zoom. She said she was in her office at her desk; heading out once the interview ended. Even though it was early morning I could hear the hustle and bustle of other employees as they too prepared for their workday ahead. I believe the interview went well and I felt a connection. Kate was very engaging and very excited about the work that she is currently doing.

This study aimed to understand the information and communication technology (ICT) experience of skilled public health professionals. In order to do this, I performed a three-case qualitative case study design. The interviews produced 50 pages of transcript typed in 12 point Times New Roman font.

After using content analysis to evaluate the transcripts, four themes emerged: 1) how the delivery of health-related services using information and communication technology was covered in their masters' training, 2) the role information and communication technology have in their current position, 3) the role they see information and communication technology having in public health currently and in the future and lastly, 4) what they wish their master's program had covered during their training on delivering services using information and communication technology.

Theme 1: Lack of systematic training in information and communication technology utilization in delivering health care services in their master's program.

An overarching theme among all the participants in regard to the master's program was the lack of systematic training in information and communication technology utilization in delivering health care services. The participants stated they did have exposure to ICT during their coursework, they did not feel they had formal training on how to use it.

When talking about how the training they received while in their master's program, they highlighted the lack of skill development, lack of knowledge development, and limited embedded ICT education in coursework. The lack of skill development was mostly around understanding and using software and other applications. Steve stated *"I don't remember any exact classes or coursework, or sections that said; hey if you have to train somebody with this*

program or that software here's how to do it. Or here's the best way to do it. I don't recall that it was pretty much learning on the fly."

While the lack of knowledge development was described as the absence of educational content on ICT utilization in health care. Kate describes her experience as *"I cannot think of any specific trainings on information and communication technology."* When probed further, Kate stated: *"I cannot think of any specific item that they talked about."* The participants spoke to a lack of both knowledge and skills in ICT training. Steven stated, *"My academic training in ICTs was very little."*

When participants talked about how they felt ICT was slightly embedded in their coursework they said ICT utilization was never formally taught. For example, Steve said they were required to do online coursework and in-class presentations using ICTs. Dan spoke about how students at the satellite campus were able to watch their class lectures in real-time via telecommunications.

Theme 2: Information and communication technology play an essential role in their current position, due to COVID 19 ICTs are here to stay, however there is concern about ICT access.

The second overarching theme participants spoke to was the importance of and the role information and communication technology has in their current position. Participants stated that because of COVID 19 ICTs are not going away. Participants also spoke, to having the necessary infrastructure in place in order to be able to effectively use ICTs. The participants all stated that they utilize ICTs daily and feel they are here to stay. Participants are utilizing ICTs in a variety of ways. Electronic messaging (emails) has replace the need for phone calls and applications such as Skype and Zoom have replaced the need for in-person staff meetings.

When asked about how they were utilizing information and communication technology in their current roles; all three participants not only stated that ICTs were necessary for their jobs but how ICTs have become essential due to COVID 19 and so many people working from home.

Dan stated, *"I think, it's pretty much a permanent structure now. Yeah certainly COVID since the last year. We found, certainly from the hospital setting. You know telemedicine was still relatively new. It wasn't in a lot of places clinics weren't really using it, but the advent of COVID basically meant we're going to see you, unless I need to see you in person and. Every clinic basically rolled out telemedicine."*

Despite participants feeling that ICTs play an essential role in their current positions there was also concern about ICT access. To utilize ICTs companies, institutions and patients must have the available network and equipment. While, COVID 19 has provided an opportunity to work from home; not all employees and especially not all patients have the necessary support in place. One problem is that not all areas have been outfitted for wireless communications. Thus, making it difficult for those in rural areas.

Dan commented *"And so you have another idea on how those Wi-Fi components, or at least connectivity exists in rural underserved and lower income areas, and so this idea that we can just implement telemedicine, and we can start to get our volumes backup. That can be true, but you're going to get the volumes up with people that are more affluent in better areas with Wi-Fi and your underserved areas become essentially, even more underserved so you can have this idea that it works which is true, but you still have problems within that."*

Theme 3: The role they see information and communication technology having in public health currently and in the future.

Another theme that was common among all three participants was that information and communication technologies have a role to play in delivery of services currently and in the future. One participant highlighted the role of ICTs for helping reduce health care delivery cost.

Dan states *"I think it'll be a I think it'd be a staple. it's going to be if if there's a way to keep it. Moving forward if there's a way to keep it effective if there's a way to keep costs down, I think it'll be a staple in health care moving forward. I think it's best use is going to be for low level care suppose you have check ins for ADHD which all you really need to do is. get your medication bill in if you're not changing anything you don't need to do anything physical you don't need to see anything, then I think you'll find opportunities to kind of see that there."*

When talking about the role of ICTs currently and in the future, they spoke to how ICTs would play a role in improving patient outcomes.

Dan stated *"As far as caregivers, liberty management and things like that I think it's a wonderful tool and has wonderful applications in local communities, if it's used appropriately and you know if you can, if you can really understand patient need."*

All three participants are using ICTs daily and feel that ICTs has helped make some job functions easier to manage. All three participants utilize ICTs differently on their job. For example, Dan uses ICTs for research evaluation and to keep up with performance metrics, while Kate using ICTs to document food safety violations. Steve is using ICTs to stay in touch with employees and participate in company meetings while working from home.

Theme 4: What they wished their master's program had covered during their training on delivering services using information and communication technology.

The last theme that was common among all three participants was that they felt that they were ICT skills that after graduating and moving into the workforce they wished their master's training would have provided.

When asked what they wished their master's program had provided in terms of delivering health care services using ICTs; all three participants identified different platforms and ways for students to learn these necessary skills. One participant pointed to self-efficacy. For example, one participant feels that students should practice in simulated environments that will mimic their future work environments. So that once they are working on a job they are already familiar with the ICTs being utilized in that job function.

Steve states *"I feel like there just needs to be a way for them to experience maybe what it's like to be an actual worker or an employee in the field."*

Different platforms were also mentioned in terms of lessons they wished they learned. One platform that was mentioned was website development.

Kate stated *"Maybe just even, I think it would be great to have just some general web training as far as web development, you know some general web development because. I think that's become such a huge part of our society and such a huge part and I think we've definitely seen it with getting information out for COVID."*

Participants also identified different software applications that they would have like to have been trained on prior to graduation. For example, one participant identified lean six sigma black belt while another participant spoke to wanting training on presentation software such as Microsoft PowerPoint.

Kate said *"I almost feel like you know, even in the master's program it definitely would benefit to. literally have some type of Microsoft all office, training of how to you know do really great PowerPoint presentations, because I feel like those have like the protocol."*

Table 3 Program Participants Characteristics

Name (Pseudonym)	Gender	Race	MPH concentration	Graduation Year
Steve	Male	Caucasian	Occupational Safety and Health	2015
Dan	Male	Caucasian	Social Behavioral Health	2004
Kate	Female	Caucasian	Environmental and Occupational Health	2007

4.8. Discussion

The purpose of this case study is to gain knowledge and have an understanding of public health practitioners' (who hold a master's in public health) perceptions and experiences concerning the integration of information and communication technologies (ICTs) in their current roles and previous academic experiences. Three cases were identified. All three cases graduated from a master of public health program with Council on Education for Public Health (CEPH) accreditation located in Texas. Four themes were identified after transcript analysis: (1) How the delivery of health-related services using information and communication technology was covered in their master's training, (2) The role information and communication technology have in their current position, (3) The role they see information and communication technology

having in public health currently and in the future and (4) What they wished their master's program had covered during their training on delivering services using information and communication technology. All three cases worked in different fields and had various years of professional work experience.

All participants graduated from a CEPH accredited program. One of the foundational competencies is for students to be trained in delivering services using information and communication technologies. The new competencies were released in August of 2016. Steve graduated in 2015, Dan graduated in 2004, and Kate graduated in 2007. The most recent graduate is Steve, who finished in 2015; however, the updated competencies were not released until 2016. The date the updates were made to the competencies may be one reason why none of the study participants were explicitly trained on delivering services using information and communication technologies.

All three participants pointed to precise ways that information and communication technologies training could have been incorporated into their master's program. While ICTs are indeed here to stay; technology is always evolving. Public health educators must address this challenge by being willing to increase their level of understanding and comfort of integrating ICTs into their classrooms.

Health plays a major factor in the quality of our lives. Healthy individuals have increased productivity and lower healthcare cost. Public health has the potential to use information and communication technology to address various health care challenges. All three participants agreed that ICTs are and will continue to play an important role in the delivery of health care services.

While all three participants hold the master of public health degree; they are all utilizing ICTs differently in their current positions. Interviews highlighted these differences but also spoke to how the COVID 19 pandemic has made ICT knowledge and skill a necessary component in their daily job functions.

4.8.1. Limitations

One limitation is that information and communication technologies come in many different forms. Many of us are accustomed to using the most common or familiar ICTs such as: computers, cellular phones, printers, scanners, Zoom, Skype, etc.; however, information and communication technologies encompass much more. Study participants may have learned more in school or maybe utilizing ICTs more in their profession; however, they may not be aware that they are utilizing ICTs due to their many different forms and names. This may result in participants under-reporting what they learned in their master's program and what ICTs they are currently using. Another limitation is recall bias. One of the inclusion criteria stated that participants had to have five years post master's experience in their field. This means that quite a bit of time has passed since study participants graduated. Due to this passage of time, participants may not accurately recall if they were taught on delivering services using ICTs. Lastly, due to the small sample size I was unable to reach data saturation.

4.8.2. Future Directions

Due to my small sample size I was unable to analyze my data with my first choice the constant comparative approach. Two researchers Glaser and Strauss presented constant comparison as a method of analyzing data and eventually generating/developing theory. Constant comparison analysis, also known as the method of constant comparison, was first used in grounded theory research (Glaser, 1978)(Glaser, 1992)(Glaser & Strauss, 1967). Overall, I

believe that the process is cyclical in nature. For future studies I will increase the sample size which will allow for the use of constant comparison analysis which I think will increase the richness of my data and results and allow for cross comparisons. Lastly, I was unable to use triangulation which in the social sciences means observing the research issue from at least two different points. Triangulation allows for the researcher to test the consistency of the results. For future studies I will incorporate, data, investigator, and methodological methods for triangulation purposes.

4.9. Conclusion

Health education cannot be overlooked when it comes to building and achieving a healthy community. Health education refers to the process of enlightening people about health. It can be defined as the value by which individuals and groups learn to behave favorably to promote, preserve, and renew health (Tudor Car et al., 2019). The World Health Organization (WHO) defines health education as the assembled opportunities of learning that involve various forms of communication intended to improve health literacy, knowledge, and life skills to promote health (Mitic et al., 2012). The organization identifies the promotion of a healthier population as one of its central goals, which can only be achieved through health education. Its overarching mission is to promote health, combined with keeping the world safe and serving vulnerable populations and disease prevention; WHO recognizes the ultimate need to ensure healthy lives and promote well-being regardless of age (Mitic et al., 2012).

Heath education has impacted the wellness of communities, which includes awareness and prevention of chronic diseases, promotion of infant and maternal health, awareness about drug and substance use, prevention of injury and violence, education about mental and behavioral health, nutrition, and exercise (Tudor Car et al., 2019). In addition to helping

individuals learn about how they can promote their health, public health practitioners promote health equity, ensuring that all community members have access to wellness resources and healthcare services. It looks at the health issues going through the community through a social justice lens to ensure the realization of healthy communities among everyone. Health education is critical in the promotion of health and the prevention and control of disease.

The use of Information and Communication Technology (ICT) has been widely explored in different sectors to achieve various goals in the current decade. It is impossible to ignore the numerous benefits that ICTs have had over time. The healthcare sector is no exception to the tremendous advantages that the technological landscape has ushered in. Much more is envisioned to change healthcare as ICTs are fully integrated to enhance the quality and safety of care offered to patients. ICTs in health clinics have helped improve the quality of healthcare delivered by implementing accurate patient records (Kreps, 2017). Enhanced communication has increased collaboration among multiple healthcare professionals in the delivery of care. Cloud computing and the Internet have allowed for the earlier detection of health threats, thus enhancing the prevention and control of public health emergencies. Social media platforms have allowed easy access to health information to communities, making it possible for communities to take better care of themselves and practice healthy lifestyles.

It has also been easier to manage health pandemics and emergencies, as was proven during the current health pandemic. ICTs helped spread awareness about COVID 19, the number of ways people can prevent themselves from contracting the disease, including; wearing masks, regular hand sanitization, and social distancing. While numerous measures were put in place, such as lockdowns and banning people from crowded workplaces, individuals could stay updated about the disease through ICTs. Through the interconnected web networks, researchers

managed to share thoughts, ideas, and solutions that helped curb the fast spread of the disease (Manco-Chavez et al., 2020). It is undeniable that ICTs are of great importance to health education and ensuring that populations are healthier. There is no doubt that ICTs will continue to revolutionize the healthcare sector and enhance quality care among patients.

5. DISCUSSION

While information and communication technologies (ICTs) provide efficient and effective ways to increase access to knowledge and education, they can also increase efficiency for public health practitioners in providing services to their patients, while collaborating with team members from other disciplines (Perron et. al., 2010). This dissertation comprises three studies to address an overarching research question related to the status of ICT as a professional competency among public health professionals. Each of the three mini-studies addressed a different dimension of the problem, and their respective findings highlight the need for well-documented training on delivering services utilizing information and communication technology for public health practitioners.

The first study (Sub-Study 1) was a scoping review of the literature. Inclusion criteria for the review clearly stated that the intervention must use a public health practitioner as a primary member of the care team. However, while all studies included a public health practitioner, details on their academic background and training were missing across all studies. When looking at how public health practitioners utilized ICTs, the review showed that videoconferencing, mobile phones, interactive websites, text messaging, and an electronic device design specifically by the research team were used to deliver program interventions.

It is not a surprising finding that videoconferencing was the most common ICT utilized, albeit the data were collected pre-COVID 19. Technology has seen an explosion over recent decades; this has resulted in smaller, faster, and cheaper ICTs. Videoconferencing has been a feature of ICTs early on and is considered an acceptable form of treatment for both practitioners and clients. The ease of videoconferencing; the reduced cost as well as patient and provider not needed to travel makes this one of the most practical uses of ICTs. We expect even higher rates

of reliance on videoconferencing currently due to the COVID-19 pandemic. The consequence of the COVID 19 pandemic was a hastened transition of many services from doctors' offices and clinics to patients' homes. With video applications such as Zoom and Skype and platforms designed specifically for patients to receive virtual visits from their health care provider, patients are becoming more comfortable receiving care from the comfort of their own homes.

In terms of health, topics explored; a majority of studies focused on chronic disease management. Other topics included STI prevention, diabetes, mental illness, cholesterol-lowering diet, menopausal health, heart failure, prevention of dental caries, smoking cessation, and oral home care. It is not surprising that chronic disease was the most common topic studied. Indeed, the leading causes of morbidity and mortality in the US are attributed to chronic rather than infectious diseases (Leading Causes of Death and Injury-Pdfs|injuryCenter|cdc, 2021). Thus the findings from this sub-study are consistent with the current state of the public's health.

The findings from Sub-study 1 also point to a need to more clearly report the preparation, training and credentials for the public health practitioners included in the reviewed studies. Due to the lack of an operational definition of public health practitioner, we could not determine if the public health practitioner involved in the delivery of ICT meets the profession's definition of a public health professional. For example, it is possible that the team utilized another type healthcare worker (e.g., nurse, social worker) who had merely one or two courses in public health, and consider that to meet the criteria of a public health professional. Further, even among those with full public health credentials, their role in the ICT-related intervention may have been more central to their other allied health training than to public health. For example, I hold both a Master of Social Work degree and a Master of Public Health degree. It is common for me to utilize my social work training in clinical settings. It then makes it possible for me to be

categorized as a public health professional, despite my not utilizing public health training in the delivery of care.

The lack of clear outcomes in the research literature regarding the success of ICT-related interventions was alarming. This renders it difficult if not impossible to evaluate the ICT intervention as well as the influence of public health practitioners on intervention outcomes.

The findings from Sub-study 1 provided the rationale for the subsequent study which established a gap in terms of the clarity of training and educational opportunities in ICT for public health practitioners. Given the inclusion of ICT among public health competencies, it became evident that ICT training ought to be intentionally included in public health practice training. Therefore, an examination of public health educational curricula was an empirically based and rational next step.

Sub-study 2 aimed to clarify the status of existing ICT-related training opportunities in public health education, with the intent to better understand if and how educational preparation of public health professionals incorporate ICT-related competencies in the curriculum. Sub-study 2 utilized quantitative content analysis to assess the existence of, and the alignment between the accrediting body for schools and programs of public health, the Council on Education for Public health (CEPH) foundational competencies regarding ICTs, and the curriculum in a school of public health.

A public university in Texas was selected for analysis. The entire curriculum, along with 54 syllabi and 392 learning objectives were analyzed. Data revealed that across all seven departments in the school, information and communication technology was mentioned only three times in the curriculum, but 60 times in the learning objectives derived from course syllabi.

While ICTs were mentioned, it was still unclear to what extent the competencies set forth by CEPH have been fully integrated into the course curriculum. This requires a deeper examination of each assignment, activity, lecture, etc. for every required course, as ICT-related instruction may be embedded but not obvious from examination of learning objectives.

From the two previous sub-studies, we learned that (a) ICT-related skills are needed for public health practitioners in healthcare delivery settings, and (b) an existing curriculum at a large public health graduate program has limited inclusion of ICT in the educational program. Thus, it leaves the question – how did MPH-level practitioners become trained and/or proficient in the use of ICTs if formal training via their graduate program was not available? The lack of data and theoretical basis for this phenomenon required a qualitative investigative approach.

Sub-Study 3 aims were to address the issue of experiences and contexts, i.e., try to understand public health practitioners' perceptions and experiences in their current roles and academic training in incorporating ICTs into practice. Three cases were selected. While all three cases study different disciplines in public health, graduated at different times, and worked in different fields, they all felt they received little to no training on delivering services using ICTs. While cases stated they received little training, they did point to the importance of ICTs in their current roles as well as things they wished their masters' program had covered. All three of my participants had to learn on the job on utilizing ICTs in healthcare delivery. While one participant furthered their education and received a doctorate; this participate still pointed to a lot of hands on learning even now.

The results from these studies must be interpreted in their proper context. While all three studies pointed to a lack of systematic training on using ICTs, it is essential to note that this study does have limited generalizability. For example, for the quantitative content analysis, only

one university in Texas was examined. While that one school was examined, only courses that were required were included in the study. Elective courses and internships, and practicum experiences may provide students with more training on ICTs. Also, other schools may take a much more deliberate approach to incorporate ICTs into their training curriculum. Lastly, all three cases from the case study graduated from the same school. Again, graduates from other schools may have had different experiences.

5.1. Implications and Future Directions in Public Health Practice and Leadership

Given the importance of ICTs in healthcare promotion, it becomes critical to ensure that healthcare and allied health practitioners are competent and understand the core concepts of ICTs to facilitate optimal utilization in health and allied care provision. Having health and allied health practitioners qualified and competent in ICTs will also facilitate efficient, quality, and effective services to patients. However, the major challenge is that despite the growing need for health-industry workers to be competent in ICTs, most of the profession and universities have not yet adopted the universal integration or education of these services.

All three studies point to a lack of systematic training, especially at the master's level of public health practitioners, to utilize ICTs to deliver health care services. ICTs will help to achieve effective communication among different professionals and multidisciplinary teams in hospital and community settings. The use of traditional communication methods to pass information from one provider to another increases the amount of time spent, which may be crucial for successful outcomes.

Public health-trained professionals are often members of healthcare delivery teams. The practice of public health extends beyond traditional healthcare settings. The lack of proper training in ICTs hinders public health's goal of disease prevention and control. Some of the

reasons for the existence of unsystematic training methods of ICTs among professionals in health-related professions (including public health professionals) are the poor infrastructure to support ICTs, lack of proper management, skills-related issues, shortage of resources, lack of funding, and poor ICT access (Asemahagn, 2015). Therefore, currently, most current healthcare and allied health healthcare-related providers cannot apply the necessary skills and knowledge to take advantage of ICTs' in enhancing and facilitating public health's goals. Public health practitioners must have an adequate basic understanding of ICTs and their roles to utilize these technologies effectively to enhance patient care.

5.2. Implications and Future Directions in Public Health Research

The Council on Education for Public Health has set forth foundational competencies to be included in training public health students at the master's level. However, findings from Sub-Study 2 (Chapter 3) reveal these competencies are not being integrated into the curriculum of at least one university preparing public health practitioners. Given the preliminary perspective of this study, which utilized a scan rather than an in-depth review of curricula, there are many recommendations toward improving the research in this realm.

5.2.1. Full Inventory of ICT-Education in Public Health

Future research should focus on conducting a more comprehensive inventory of educational and training offered in public health programs specific to ICT. This study utilized one university as a starting point. While this sample is not generalizable, this program also is large and prepares a significant number of MPH-level practitioners for the state. Further, the program was among the first to be accredited under the new CEPH-criteria, thus underwent a thorough curricular review of its own. Using this rationale, the use of this institution as a preliminary case is sound.

Future research should focus on the pragmatic/practical aspects of ICT-use as applied to public health. The present study examined the core courses shared across concentrations. However, given that ICT use can be concentration-specific, examination of ICT-related training should delve into specialized courses that are unique to each respective public health sub-field.

5.2.2. Public Health Practitioners

Again, all three studies point to a lack of systematic training even at the master's level of public health practitioners being trained in the delivery of health-related services using ICTs. Moving forward public health practitioners can assist with incorporating ICTs into public health programs by identifying and tracking the ICTs that are needed to continue to provide health care services and interventions. As part of the training for a master of public health a student must usually complete a practicum experience or internship. While we wait for schools and programs of public health to incorporate ICTs into the curricula; practicum and internship supervisors can provide opportunities for students to gain on-the-job training on utilizing ICTs. This will be especially useful because instead of hearing about the techniques through standard lectures students will be able to get hands-on and job specific training.

5.2.3. Public Health Leaders

Public health practitioners who serve in leadership roles are uniquely positioned to help facilitate the integration of ICTs into the education and training of public health students, as well as public health staff who fall under their supervision. Public health leadership will need to take an inventory of the current ICT needs for their particular departments/units. Then any gaps in trainings on ICTs will be identified and it will be up to public health leadership to address these deficiencies through interdepartmental trainings, conferences and professional development opportunities. Public health leaders who provide practicum and internship experiences for

students can give feedback to the school/program on the type of ICT preparation that they feel that graduates will need in order to be both competitive and successful in their work.

5.2.4. Interprofessional Education Opportunity

The World Health Organization defines interprofessional education as: "when students from two or more professions learn about, from, and with each other to enable effective collaboration and improve health outcomes" (World Health Organization, 2010, p. 7). As health care continues to evolve we will see more and more interdisciplinary teams of health care providers working to improve patient outcomes. To see successful outcomes interprofessional education (IPE) opportunities are an important piece in ensuring that success. No matter the professor's home discipline helping students work collaboratively across departments can transform their learning experience. How much can be gained from dialogues with colleagues from other campus departments whom you would normally never meet? While ICTs need to be a part of IPE; they can also help facilitate cross campus collaborations. In both clinical and academic settings we see the integration of ICTs. Due to the advances in ICTs; practitioners, educators and students are in a place to take advantage of these new technologies. Universities can provide opportunities for IPE by bring together students from different programs and having them participate in case simulations.

Nursing, medical, pharmacy, occupational therapy, physical therapy, veterinary and public health faculty, staff, and students need opportunities to work in teams with professionals outside of their discipline to enhance team-based health care delivery. Not only will this increase their ICT competencies but also help students learn how to work in team settings. It is important that universities provide opportunities for interdisciplinary team-based projects that are developed and delivered collaboratively across campus for students as they develop

professionally. IPE can be facilitated through online discussions and modules as well as in the traditional in-class format. However, we can also look to professional organizations such as the American Telemedicine Association (ATA) and the American Medical Informatics Associations (AMIA) to provide learning experiences for IPE through conferences and workshops.

6. CONCLUSION

This dissertation aimed to understand the education, training, and pedagogical strategies that are part of professional preparation for entry-level public health practitioners in utilizing ICTs. In order to do this, three studies were conducted. The first study aimed to understand what the literature says about ICT use in public health interventions. Findings from this study pointed out that while ICTs are being utilized in public health interventions, it remains unclear how public health practitioners are being trained as well as general ICT use being effective in program outcomes. The second study sought to understand existing ICT-related training in a school of public health. Findings from this study point to the absence of ICTs being fully integrated into the school's program of study for master's students. The last study looked at the ICT experiences of current public health practitioners. While all cases are utilizing ICTs in their current roles, they could not point to specific training in their academic programs.

The findings from all three studies highlight a lack of systematic training for public health practitioners on delivering services using ICTs and a lack of documentation on ICT effectiveness in public health interventions. While cases from the last study could not remember being trained on ICTs in their master's program, they were all very firm that ICTs are here to stay.

Moving forward in face of an ever-changing landscape of the digital revolution, that public health practitioners be included in developing, training, implementing, and evaluating interventions utilizing ICTs. Public health practitioners must be comfortable moving from face-to-face learning and public health interventions and treatment to distance learning and program delivery. As determined by Sub-Study 1, the competency is especially important because ICTs have been used mainly used to treat chronic diseases. The appropriate and effective use of ICTs

will help address the burden of chronic disease by providing home-based healthcare and allied health delivery that is effective and less expensive.

While ICTs can improve healthcare and allied health services delivery, it is important to note that this too comes with its challenges. Moving to digital platforms raises questions about both privacy and confidentiality. It will be necessary for guidelines to be in place about who owns, maintains, controls, and has access to health care data. Another challenge will be the cost as we continue to implement ICTs in health care services. We must ask: Who will pay the cost for these new technologies? However, regardless of any challenges, the consensus that ICTs will help improve health care will result in better health is worth the investment.

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APPENDIX A

INTERVIEW GUIDE

1. Please describe your role in your current position
2. Please tell me about your academic and professional preparation
3. What do you remember from you academic training about the delivery of services using information and communication technology?
4. How do you feel about the role that information and communication technology plays in your current position?
5. How comfortable are you in utilizing information and communication technology?
6. What role do you see information and communication technology playing in public health currently and in the future?
7. Has information and communication technology impacted your public health practices? If yes, how?

8. What do you wish your master's program had covered during your training about providing services using information and communication technology

APPENDIX B

CODEBOOK

Theme	Sub-Themes	Examples from
• Lack of systematic training in information and communication technology utilization in delivering health care services in their master's program	• Lack of skill development • Lack of knowledge • Limited ICTs embedded education in coursework	• That's been our number one way to communicate. • Now I mean I did take courses that were online and we had to watch presentations and stuff so I mean that just, you know, I had that experience of being around it I guess that would be the only thing but I don't think there was any, I don't remember any exact classes coursework, or sections that said "hey if you have to train somebody with zoom here's how to do it. Or here's the best way to do it" I don't recall that its pretty much learning on the fly. • To the yes side of that and I don't know how things are now, but we had sites in mcallen and another location I can't remember where that third location was, and so we use telecommunications for those sites. is very different than I think how things are now where you can take classes and grown

		home on your own computer via zoom and how things are there, he was different because it was more of A forget what it's actually called but. almost like telecommuting, I guess, so we had a site that the students still had to go to the site and you're still in classroom you're just in a classroom. You know, a couple hundred miles away and you've got your video camera there and multiple students within that so just kind of an extension of it, so we utilized that technology, even in our own classrooms we were connected to macallan and. • Now I cannot think of any specific. You know, know, am I can't think of any specific item that they we talked about that. • I don't remember any exact classes or coursework, or sections that said; hey if you have to train somebody with this program or that software here's how to do it. Or here's the best way to do it. I don't recall that it was

		pretty much learning on the fly. • My academic training in ICTs was very little.
• Information and communication technology play an essential role in their current position, due to COVID 19 ICTs are here to stay, however there is concern about ICT access	• Because of COVID ICT are here to stay • Must have necessary infrastructure in place • Necessary for their job function • ICT access (equity)	• Yeah so i mean i, this whole past year I didn't go into the job I didn't go into the field one time. So for March of 2020 to actually now so a whole year later, I have not traveled to a service center I've not gone to a job site or anything like that. • So, it is daily has been through zoom Skype, Microsoft Teams, email. • You know we've had to do everything remotely. • So, that's pretty much what I've done this whole past year. • I mean daily I am on anywhere from three to seven different Skype meetings or Microsoft Teams meetings. • No, I think it's gonna definitely take a role I mean, obviously, you know COVID. So my company was actually there working on a flexible work from home type schedule precovid.

		• They were trying to say hey this is human resources was like hey we would like to try to come up with the flex schedule. Well COVID just made them do it faster. • But I mean I do think it's gonna it's, it should be around to stay for a while, I would think, moving forward. • It varied so everything from research evaluation quality, performance improvement in grants fell on to my table, and so the day very drastically. • And so you have another idea on how those wi fi components, or at least connectivity exists in rural underserved and lower income areas, and so this idea that we can just implement telemedicine, and we can start to get our volumes backup.can be true, but you're going to get the volumes up with people that are more influence in better areas with wirefly and your underserved areas become. Essentially, even more

		underserved so you can have this idea that it works which is true, but you still have problems within that and so you still gotta be able to explore and understand. How do we change the things that you're trying to do to still meet those needs if they can't reach us, you know in. • You know telemedicine was still relatively new IT wasn't in a lot of places clinics weren't really using it, but the advent of covert basically meant we're going to see you, unless I need to see you in person and. Every clinic basically rolled out no medicine, at that point. • yeah anytime soon, I mean even once the pandemic is gone I think it's going to be a staple moving forward and the the challenge with it is how do you maintain it so that it becomes a cost effective solution. • I think it'll be a I think it'd be a staple. it's going to be if if there's a way to keep it. Moving forward if there's a way to keep

		it effective way to keep costs down, and I think it'll be a staple in moving forward. • I think, it's pretty much a permanent structure now. Yeah certainly COVID since the last year. We found, certainly from the hospital setting. You know telemedicine was still relatively new. It wasn't in a lot of places clinics weren't really using it, but the advent of COVID basically meant we're going to see you, unless I need to see you in person and. Every clinic basically rolled out telemedicine
• The role they see information and communication technology having in public health currently and in the future	• Improve patient outcomes • Makes job functions "manageable"	• Okay i'm really using data to understand what the problem is and really being able to create an intervention that is effective. • As far as character liberty management and things like that I think it's a wonderful tool has wonderful applications in local communities, if it used appropriately and you know if you can, if you can really understand patient me. • I think it'll be a I think it'd be a staple. it's

		going to be if if there's a way to keep it. Moving forward if there's a way to keep it effective way to keep costs down, and I think it'll be a staple in moving forward. I think it's best use is going to be for low level care suppose you have check ins for ADHD which all you really need to do is. • Keep your medication don't if you're not changing anything you don't need to do anything physical that need to see anything, then I think you'll find opportunities to kind of see that there. • Sure, and so I my official title is environmental health specialist and I would say, my main job duty is.Okay, and and so you know a lot of people call us health inspectors and, but of course we do a lot more than just that, but that is definitely one of our main goals is to you know inspect the restaurants in town and by restaurants, I mean.Hospitals daycares restaurants grocery stores Convenience Stores you know we

		anything that sells food to the public we're going to be inspecting and then and. • Our food inspections, we do everything and with paper, and we, we have an actual just you know paper copy of our inspection report that we hand over to them.And that me as well as two other inspectors are actually in the process of helping to develop a online program where we will use. • Our we have surface pro's that we will go out in us and do our inspections and we've been testing that and it's a program that the county purchased and but it's. • Okay, and as far as like what we are currently using before the program, and so we do all have we all carry a. county issued iPhone and and with those iphones and you know we take a lot of pictures and such violations that occur during our inspection, especially, and you know if we're somewhere and we have you know because.

		• And I see it, being a very, very big role I think it's one of the main sources of information and that's available, right now, even with us having paper copies for everything, and we still direct people to our website a lot. So we do have for the county we have a website it's browsers health.org and all of our guidance documents for our establishment are linked on that website. And so we have a lot of guidance documents related to food safety regulations and because the our inspections are based off of • I think it'll be a I think it'd be a staple. it's going to be if if there's a way to keep it. Moving forward if there's a way to keep it effective if there's a way to keep costs down, I think it'll be a staple in health care moving forward. I think it's best use is going to be for low level care suppose you have check ins for ADHD which all you really need to do is. get your medication

		bill in if you're not changing anything you don't need to do anything physical you don’t need to see anything, then I think you'll find opportunities to kind of see that there. • As far as caregivers, liberty management and things like that I think it's a wonderful tool and has wonderful applications in local communities, if it’s used appropriately and you know if you can, if you can really understand patient need
• What they wished their master's program had covered during their training on delivering services using information and communication technology	• Platforms • Software • Self-efficacy • Job preparation	• I feel like I think one thing that did allow me to be successful, I might, This might digress a little bit but I think what allowed me to be successful prior to getting my degree is that I actually worked in the field. • That i've done post graduation is ever in my my lean six Sigma black belt, where you look at a lot of root cause analysis and the performance of things and the data and you've got a different process for how you develop an intervention, and so I

		think root cause is something that. • Maybe just even, I think it would be great to have just some general like web training as far as web development, you know some just general web development because. • : And so just being able to you know not always have to depend on an IT person to you know do that for you and we do have people at the health department that are just naturally gifted at you know it type work, and so you know we have people that are able to. Add stuff to our website pretty easily and stuff but I mean I definitely think that would have been really nice to just kind of have that training going into and then, and also in general, I feel like you know in high school you go through some very basic. • Just you know computer office work, and I feel like you kind of lose some of that along the way, and so I almost feel like you know, even in the master's program it definitely

		would benefit to. literally have some type of Microsoft all Intel office, training and of how to you know do really great PowerPoint. • presentation, because I feel like those have like the protocol for those have changed so much from when I was in school and what's acceptable and what's. what's considered a good PowerPoint presentation and versus what's not and and just of course technology changes so much and stuff that I definitely think. • I feel like there just needs to be a way for them to experience maybe what it's like to be an actual worker or an employee in the field.