Building the workforce's capacity to support the digital transformation of public health: An environmental scan of training programs for digital technologies in public health

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Abstract

Background: The digital transformation of public health highlights the growing need for new digital competencies to tackle evolving and contemporary public health challenges. While some public health institutions and schools worldwide have begun addressing this need through various approaches, many in Canada have yet to do so. To support systematic competency and curriculum development, we mapped and explored existing digital public health (DPH) training programs, identifying common curricula content, approaches and disciplinary perspectives.

Objective: To support systematic competency and curriculum development, we mapped and explored existing digital public health (DPH) training programs, identifying common curricula content, approaches and disciplinary perspectives.

Methods: This two-stage environmental scan included a systematic search of DPH training programs and interviews with select program directors, emphasizing a transdisciplinary approach. Between March and May 2023, we conducted a search on Google and public health association directories to identify degree programs and courses (as part of degree awarding programs) focused on building capacity for using digital technologies in public health. We then conducted semi-structured interviews with four directors of identified programs exploring program characteristics and the inter/transdisciplinary partnerships essential to their design. Search data was summarized using narrative synthesis, while content analysis was applied to the interview data.

Results: Overall, 58 DPH training programs were identified, categorized into three groups: public health data science (29/58, 50%); public health informatics (16/58, 28%); and a mix of programs exploring digital competencies (13/58, 22%) related to project management and addressing the digital determinants of health. Interviews focused on four key categories: (1) Motivation for interdisciplinary DPH programs, highlighting the need to align with current job market demands for practitioners skilled in interdisciplinary practice and addressing pressures for curricular updates from professional bodies; (2) Design and delivery of interdisciplinary programs, emphasizing academic-industry partnerships aimed at developing professionals with depth in public health and breadth in DPH knowledge; (3) Characteristics of inter- and transdisciplinary partnerships, showcasing the involvement of diverse disciplinary perspectives from academia, public, and private sectors in program design and delivery; and (4) Challenges in implementing these partnerships, including difficulties in negotiating shared commitments, reconciling differing perspectives, and securing sustainable funding for such programs.

Conclusions: This global scan of DPH training programs found a strong focus on data-centric competencies, with less emphasis on digital skills for health promotion, leadership, and addressing digital determinants of health. Bridging these gaps requires a stepwise approach: integrating digital competencies into curricula, offering standalone programs for specialized skills, and

strengthening partnerships to navigate funding and administrative barriers while promoting equity-driven, interdisciplinary collaboration.

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Introduction

The rapid digital transformation of society, including public health, was significantly accelerated during the COVID-19 pandemic (1–3). Digital technologies have been adopted to enhance the efficiency, effectiveness, and reach of essential public health functions, such as real-time precision disease surveillance using big data and artificial intelligence (AI), targeted health promotion via social media, apps, and wearables, and environmental health protection informed by sensor data (2–5). Digital access and literacy have recently emerged as important determinants of health, directly and indirectly shaping public health outcomes (6–8). For example, limited digital access and literacy may restrict economic opportunities which in turn limit access to digital health services (8,9). Conversely, for those with digital access, exposure to misinformation, disinformation, and exploitative practices by big tech platforms can adversely impact health and health behaviors (8,10,11).

To harness these opportunities and address the evolving challenges, the contemporary public health workforce must develop new digital competencies (12,13). Our previous rapid review of the literature identified 45 unique digital competency statements which cut across all seven categories of the Core Competencies for Public Health in Canada framework (12). We also identified a potentially new competency category related to digital data, data systems management, and governance (12). While these competencies are not exhaustive, especially with rapidly developing digital technologies, they represent aspirations of public health practitioners and educators to address existing competency and curricular gaps (14,15). For instance, the Association of Schools for Public Health in the European Region (ASPHER) task force for digital transformation have recommended updates to the public health curriculum across themes

like digital literacy, health data collection and analysis, health data management and governance, ethics and regulation of digital transformations in society, and understanding the infosphere and spread of information over digital networks (16). They emphasize the need for interdisciplinary and transdisciplinary academic communities that understand public health, as well as computer science, data science and other sciences relevant for digital public health (16,17). Ongoing efforts by the Public Health Agency of Canada, including commissioning the National Collaborating Centers for Public Health (NCCPH) to update the Core Competencies for Public Health in Canada are also examples of work to address these competency needs (18).

It remains unclear how these competency aspirations and curricular recommendations have been implemented in public health training programs and courses. Gaining insight into how these competencies have shaped curricular updates can guide targeted recommendations for digital competency development and curriculum design in Canada. This would support the broader vision of transforming public health and enable schools of public health to make necessary adaptations (13). Additionally, with well-documented challenges in inter- and transdisciplinary practice, there is limited understanding of the disciplinary perspectives incorporated into these programs and how educators navigate diverse viewpoints in practice (17,19). Therefore, we conducted an environmental scan aimed to map and explore training programs and courses aiming to integrate and improve the use digital technologies for public health and its sub-specialties around the world. We assessed common curricular content being considered and applied, academic disciplines involved in the design and delivery of these programs and courses, and training approaches being implemented to delivery identified curricula.

Methods

Study design

The study followed a two-stage approach: a systematic search for DPH programs aligned with the study objectives, and semi-structured interviews with program directors or faculty members from programs emphasizing inter- or transdisciplinary perspectives in their curriculum planning and delivery (20,21).

Stage 1: Systematic search for DPH program websites

Two members of the research team (I.I. and S.R.) conducted independent searches using Google's advanced search (google.com/advanced_search) without country restrictions. Search terms included ("digital public health" OR "digital health" OR "digitalization" OR "digital transformation" OR "data science" OR "social media" OR "artificial intelligence" OR "machine learning") AND ("school of public health" OR "college of public health" OR "department of public health" OR "division of public health" OR "institute of public health") AND (degree OR program OR course). Thereafter the search was repeated, restricting returns to countries identified as prominent contributors to DPH literature including Australia, Canada, China, France, Germany, Italy, Sweden, the United Kingdom, and the United States of America (Appendix 1) (1,17). We reviewed the first 100 returns for each search. Thereafter, we searched popular global online directories of schools of public health including the Council on Education for Public Health (CEPH), ASPHER and the Public Health Agency of Canada, to identify potential programs or courses for review. All relevant returns were reviewed against the inclusion and exclusion criteria (Table 1). All searches were conducted between March 24, 2023, and May 16, 2023.

Program selection

We adopted a definition of an eligible DPH training program as any undergraduate or graduate-level degree-awarding training programs that were currently available for enrolment and entirely focused on applying digital technologies to all or to specific public health domains as defined in the Canadian Public Health Association's conceptual framework for public health (Table 1) (22). We also included course modules undertaken as requirements for a degree awarding public health program. We excluded programs and courses which are exclusively focused on clinical and clinical informatics perspectives and those offered as short courses (i.e., standalone course modules not offered as part of a degree awarding program). One member of the research team (S.R) reviewed search returns based on our inclusion and exclusion criteria (Table 1), with another researcher (I.I.) reviewing the list of included programs and courses for accuracy based on the inclusion and exclusion criteria.

Table 1: Program inclusion and exclusion criteria - Environmental Scan of DPH Training Programs (2023)

Domain	Inclusion criteria	Exclusion criteria
Population	Focus on Public health students, public health informaticians and analysts, practitioners (including public health physicians), public health researchers, decision- and policymakers.	Exclusive[$] focus on clinicians, programmers, or other related technologists, informaticians or other allied health system practitioners.

Concept	Programs focused on building capacity for designing, implementing, and evaluating digital technologies in any of the domains of public health or across public health.	Programs focused on the broader field of digital health or a mostly clinical perspective (e.g., telemedicine or virtual health in a clinical context).
Context of training program (i.e., context of application)	Population and public health	Clinical or solely clinical contexts
Program type	Established degree awarding training programs at undergraduate and graduate levels or courses undertaken as a requirement for a degree awarding public health program.[&]	Short courses, workshops, webinars, and courses not related to a public health program.
Timeline	Must be currently available for enrolment	Previously available programs that have been discontinued or truncated.

[$]Programs with a broad view of medicine will be included if they describe (even as a section) recommendations as applies to public health as part of the broad discussion; [&]Courses included due to our project's aim to explore potential additions to public health programs to improve capacity for digital technologies.

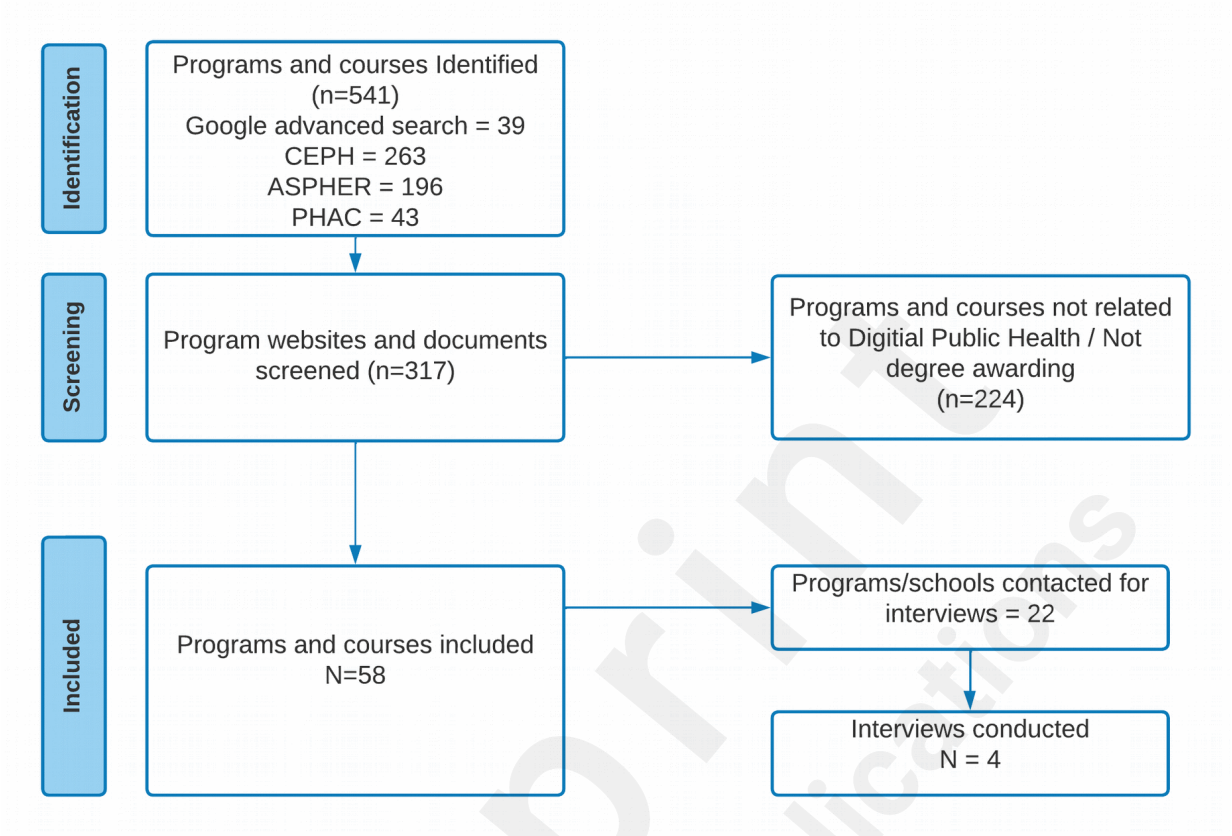

Figure 1: Flow diagram of the program search and selection process

Data extraction

We reviewed the websites for each included training program and course, identifying program documents and training curricula available on their websites. Data from these documents was extracted using pre-tested data extraction forms (Appendix 2) adapted from the guidelines for reporting evidence-based practice educational interventions and teaching (23). Extracted data included basic program information (e.g., program name, country, city, year of commencement) and program descriptors (e.g., target audience, level of training, educational materials used, characteristics of the instructor(s), and underpinning theories (i.e., educational or field-specific theory(ies) guiding the program)). For program websites not originally in English, Google Translate was used to access the documents before extraction.

Semi-structured interviews

We reviewed online documents for each included program to identify evidence of a clear mandate for inter- and transdisciplinary training. This included mission statements, faculty from diverse disciplines, and explicitly stated inter- or transdisciplinary partnerships. For each qualifying program, we invited program directors or staff involved in program design, delivery, and evaluation to participate in semi-structured interviews. Additional eligibility criteria included being an established graduate- or undergraduate-level degree-awarding program with English-speaking staff. Recruitment emails were sent using contact details from program websites, and a convenience sample of staff who responded to invitations was recruited. Each eligible program received up to three reminders. Using a snowball sampling approach, we identified an additional program that was not on the original list, as it did not have a listed degree-awarding program on its website. However, their strong emphasis on transdisciplinary DPH training and traditional public health training focused on DPH research justified their inclusion in the interviews. Interviews were conducted with consenting participants over Zoom Online using a topic guide that explored characteristics of the DPH training programs, academic and practice disciplines involved in designing and delivering the program curricula, characteristics of these inter/transdisciplinary collaborations and lessons learned from implementing the training programs and conducting these collaborations (Appendix 3). All interviews were conducted by I.I., who is trained in qualitative health research methods, supported by S.R. who received training on the data collection protocol and made detailed field notes. All interviews were audio recorded and automatically transcribed using Zoom's auto transcribe function. Transcripts were reviewed for accuracy and corrected as appropriate. Data analyses were concurrently conducted alongside interviews. Each interview lasted on

average 47 mins (range 39-53 mins).

Ethics

This study was reviewed by the University of British Columbia's Behavioral Research Ethics Board (ethics #H22-03153). We obtained written informed consent from each participant at least 24 hours prior to the interviews via email and assigned each participant an identification number (ID) which was included in all interview transcripts and field notes. All study materials were stripped of personal identifiers prior to analyses. Participants did not receive an honorarium.

Data analyses and evidence synthesis

We summarized data from the systematic search using simple descriptive statistics and a narrative synthesis. For the semi-structured interviews, we imported the transcripts and field notes into NVivo ver. 1.3 for data management and analyses (24). We conducted a content analysis exploring key descriptions of programs, inter/transdisciplinary collaborations and lessons learned from implementing such collaborations within the program context. Our analyses followed an inductive process beginning with initial coding, categorization, and interpretation of findings (25,26). Emergent codes and categories were reviewed with the research team consisting of public health educators and DPH experts who's views informed ongoing refinement and interpretation of codes and categories generated during analysis (26). Throughout the analyses, I.I and S.R made reflexive memos about our perspectives of the data (27). These memos also informed analysis and the final report draft.

Results

Initial search results

Overview of included programs

Overall, we identified 58 DPH training programs and courses offered as requirements for a degree awarding program applying digital technologies for public health functions (Figure 1). Among these, 35/58 (60.3%) were from universities and colleges in the United States (Table 2), 46/58 (79.3%) were at the master's degree level, 25/58 (43.1%) are delivered in-person (including options for applied components like practicums and internships), and 47 (81%) did not explicitly describe theoretical foundations of their programs and courses (Appendix 4). Regarding foundational theories underpinning programs, only 11/58 (18.9%) explicitly described being built on modern statistical theories, including probability and Bayesian frameworks.

Table 2: Characteristics of included DPH training programs and mandatory courses - environmental scan (2023)

Program Characteristic	Frequency (n=58)	Percent (100%)
Country of Program		
USA	35	60.3
Canada	6	10.3
UK	4	6.9
Australia	2	3.4
Germany	2	3.4
India	2	3.4
Others	7	12.1
Level of Training		
Undergraduate	4	6.9
Masters	46	79.3
PhD (Doctoral level)	1	1.7

Combined Masters and Doctoral training	4	6.9
Others	3	5.2
Foundational Theories		
Not stated	47	81.0
Biostatistics/statistics, probability, or related theories	10	17.2
People-centeredness*	1	1.7
Partnerships reported (i.e., public, and private sector partners)		
Not stated	51	87.9
Industry partners (e.g., health departments and health analytics consulting groups)	4	6.9
Health industry and University partnerships	3	5.2
Delivery		
Not stated	12	20.7
Online*	9	15.5
Blended	12	20.7
In-person	25	43.1

Identified programs focused on three main DPH categories: Public health data science (29/58, 50%) programs focused on using modern statistical and analytic approaches to harness digital data streams to provide evidence for public health decision making; Public health informatics (16/58, 28%) programs focused on using information, computer science, and technology to create and manage the infrastructure and systems needed for digital data streams and analytic techniques; and a mix of programs and courses (13/58, 22%) focused on various digital competencies including digital leadership, project management, digital health communication, digital transformation leadership, digital design and implementation, digital monitoring and evaluation, and tackling the digital determinants of health. There was significant overlap between programs across all three categories. However, the first two focused on a previously identified competency category related to digital data, data systems management, and governance.

Curricula content and training approaches

Identified programs had diverse learning objectives, foundational components, and emphasized various public health domains and functions. The majority of the public health data science programs and courses explored subjects related to public health sciences, biostatistics, computer science, and variants of these core content areas as presented as data science training. Most of these programs focused on public health and health services research, epidemiology, disease surveillance, and prevention. Public health informatics programs leveraged information science, computer science, data management, and health management information systems as applied to public health generally. The mixed bag of programs and courses leveraged varied digital content applied in health promotion, program development and evaluation, epidemiology, disease surveillance, and public health more generally. The majority of the programs (33/58) were

delivered online, while others used blended learning (12/58) or in-person training (12/58). Most of the in-person training involved a blend of coursework and internships or practicums in real-world settings. The majority of these were focused on public health data science and public health informatics. Importantly, courses within the mixed-bag category leveraged industry-academic partnerships to facilitate content delivery as appropriate.

Disciplines involved in training programs

While most programs highlighted their multi, inter, or transdisciplinary perspectives using broad statements, 17 programs (29.3%) did not clearly describe the disciplinary perspectives involved in the design and delivery of the training programs and courses. Where specified, programs predominantly indicated specific disciplines including public health sciences (including specific fields like epidemiology and biostatistics). Beyond public health sciences, programs highlighted the involvement of statistics, computer science, information technology and informatics, healthcare administration, mathematics, life and health sciences, media and communication, health economics, law bioethics, psychology, anthropology, management, etc. (Appendix 4).

Qualitative interview results - Considerations for interdisciplinarity

A total of four program directors and/or faculty representing four of the included programs participated in interviews. Interviews were with program directors of programs in Canada, Australia, Germany and the Netherlands. From the interviews, we identified four main qualitative categories that characterize interdisciplinary partnerships and offer insights into implementing transdisciplinary digital public health programs in real-world settings. Each category is supported by exemplar quotes.

Motivation for interdisciplinary digital public health programs: reflected program directors' impetus for developing programs focused on interdisciplinarity. First, programs recognize the need to align their curricula and training with evolving digital trends in public health, responding to job market competency requirements and current course offering gaps based on previous research and professional experiences that emphasize the need for applied skills in inter and transdisciplinary settings. Moreover, program directors' interdisciplinary training was also a key motivation for developing and implementing interdisciplinary programs that reflect their understanding of the current job market. For example, one participant said:

"I am pure technologist by training, and being a digital health researcher, my research findings suggested that there is a need to have consumer education in public health… So, I wouldn't say that I'm an expert in public health that's not my area of expertise, but I've learned a lot in the past few years since I've been here" … Participant 2

Program directors emphasized the need to align their programs with curricular updates from professional bodies, (such as ASPHER and the Australian Digital Health Agency), that have issued recommendations for digital competencies. They also noted that interdisciplinary programs were designed to address students' expressed learning needs, emphasizing the importance of experiences that closely reflect real-world working conditions.

Design and delivery of interdisciplinary programs: Program directors primarily designed their programs with a focus on desired student outcomes. A common aspiration was to develop "T-shaped professionals" – individuals with broad knowledge across digital technology fields and deep expertise in at least one public health discipline. For most programs, their design was informed by active partnerships with industry practitioners, including private sector partners. For

example, some program directors described program design supervised by an advisory board consisting of public and private industry partners that highlighted competencies needed in the workplace. Programs were structured around competencies aimed at fostering interdisciplinary collaboration, as well as practical understanding of digital regulatory frameworks, leadership in digital technology, design thinking, and advanced analytics.

While directors acknowledged the limited availability of competency frameworks in this area, they often described building curricula based on their vision for student outcomes. This involved inviting key partners to contribute and leveraging their various disciplinary expertise areas to align with the program's goals.

"I think what really helped us work together was having this clear vision of you know this is who the ideal graduate is. This is what we want them to be able to do in the workplace, and then taking that vision and really breaking it apart, right? And then the data scientists could really say, okay, if I put myself in a position of having to work with this person, what would I want them to know? And I could put myself in the position of okay. If this is a person that's going to advise me on governance issues, you know, hospital policy, these kinds of things. What would I want them to tell me about technology, right? … So, that allowed us to again retreat in our, you know, disciplinary silos. But at least work on the curriculum as a team, right? But again, it was from our perspectives" … Participant 1

Regarding training approaches all interviewed programs described prioritizing experiential learning using a combination of foundational class-based courses and practicums or internships within public health organizations demonstrating interdisciplinary work. For instance, one of the public health data science programs is implemented with triads within the program, combining

students of varied backgrounds (e.g., public health sciences, computer science and biostatistics) to solve real-world problems within health systems.

Characteristics of inter- and transdisciplinary partnerships supporting identified programs: Program directors suggested that interdisciplinary partnerships are built off a core group of leaders who can engage other disciplines based on the goals for the "T-shaped professional". Partnerships span multiple disciplines, including public health and medicine (e.g., biostatistics, epidemiology, public health sciences, clinical medicine, psychology); applied sciences and technology (e.g., computer science, data science, human-computer interaction, informatics, and cybersecurity); and the arts and humanities (e.g., law, bioethics, media and communications, and anthropology). These partnerships essentially were prioritized based on the competencies for the envisioned T-shaped professional, starting within the internal academic environment first, extending to public and private sector partners as needed, including the formation of advisory boards as described. In addition, these partnerships are leveraged for curricular content delivery to align student experiences with real-world experiences and expectations.

***"We have a what we called a stakeholder advisory board as well where we have some people from industry and we had different workshops where we invited people to present you know what they had been doing what they're forward or line of thinking is"* … Participant 4**

Challenges with implementing inter- and transdisciplinary partnerships – Program directors highlighted a range of challenges associated with establishing transdisciplinary partnerships, as well as those stemming from administrative processes or the implementation of innovative programs within established schools. In terms of partnerships, challenges included negotiating

shared commitment and perspectives among diverse experts with differing methodologies, views on knowledge, and levels of commitment to public health principles. These issues were particularly pronounced in academic-industry collaborations, especially with private entities. Concerns centered on the potential for non-critical, techno-optimistic implementation of technologies and the risk of exploitation within such partnerships. Participants emphasized the importance of having a clear understanding of the principles driving the operations of private entities. For example, one participant stated,

"I mean, they're [private entities] obviously a big player in this because they are substantially driving the field if we think about all these health apps. So far, they are actually shaping some of the stuff that perhaps others should shape but it's just because they're doing it and they're not asking too much too many questions… They just want to produce products…. Nevertheless, we would certainly continue also to, you know, aim to work with them. You find some yeah enlightened groups there to work with [and] not get this feeling of you know exploitation in some ways or going on their own in the wrong direction this is really important" … Participant 4

Program directors also described difficulties in establishing a shared vocabulary and a common definition of "digital public health" among partners. Funding and resource challenges were frequently mentioned, with some programs relying heavily on grant funding to support their programs. These resource constraints influenced decisions regarding the depth-versus-breadth trade-offs in curriculum design and the need to compensate instructors for their time. Additionally, resourcing challenges impacted decisions to limit the number of partnerships pursued for curriculum implementation.

Additional challenges included difficulties in gaining accreditation, particularly within traditional

public health education systems that may undervalue the goal of developing T-shaped professionals. These challenges were addressed by securing leadership buy-in and institutional support. Program directors also emphasized the difficulty of creating curricula responsive to the rapid evolution of digital technology. To address this, they focused on fundamental principles such as systems thinking, privacy, and data governance, while incorporating applied training. This approach ensures students interact with current tools to better understand and apply these foundational principles.

Discussion

In this environmental scan of DPH programs, we found 58 programs and courses exploring digital competencies across three main areas. The first two were related to public health data science and public health informatics which build competencies for digital data, data systems management, and governance consistent with our previous research showing this as a focus for digital competencies in public health (12). Further, we identified a third category of DPH programs and courses leveraging varied digital content applied in health promotion, program development and evaluation, epidemiology, disease surveillance, and public health. This category also included programs and courses aimed at understanding and addressing the digital determinants of health. For the interdisciplinary programs, most have aligned with external pressures from job market trends, student demands, and curricular recommendations for interdisciplinary practice. While most programs emphasize applied learning within interdisciplinary frameworks to develop T-shaped professionals, challenges such as funding constraints and difficulties in achieving shared public health commitments and vocabulary remain significant barriers.

To the best of our knowledge, this is one of the first global scans of Digital Public Health programs and courses. Previous jurisdiction-specific scans, such as one in Germany, indicated that only about 20% of public health programs integrate digital competencies across their curricula (28). While the German scan highlighted a strong focus on digital data analytics and informatics, it noted limited attention to social and equity perspectives in DPH—findings consistent with our scan. However, our global scan identified a few programs beginning to address these social perspectives, including understanding and tackling the digital determinants of health (28,29). In Canada, while no specific environmental scans have been conducted, literature reviews emphasize the need for competency updates to support the deployment of artificial intelligence and other DPH interventions in public health (12,30). Our study extends the literature by characterizing the nature of inter- and transdisciplinary partnerships, which are critical for designing and delivering such training programs (17,28,31).

Given global recognition of the public health implications of societal digital transformation, our study offers valuable guidance to update public health workforce training programs (8). In Canada, the Chief Public Health Officer's vision for transforming public health prioritizes the use of digital technology (13). Our findings show that schools of public health are adapting to this global vision in non-standardized ways, focusing primarily on data-centric fields like data science and public health informatics for surveillance, epidemiology, and research through biostatistics and computer sciences (12,28,30). However, these programs are geographically limited, with few available in countries like Canada. Furthermore, few programs have comprehensively addressed broader DPH issues, such as digital health promotion, program evaluation, leadership, new media communications, and the digital determinants of health (12,28,32). Contemporary challenges, such as mis- and disinformation exacerbated by digital

transformation, underscore the need to expand efforts in these areas (31–34).

While the ASPHER task force on digital transformation has recommended integrating digital determinants of health into curricula, their suggestion to avoid standalone courses does not fully support the development of inter- and transdisciplinary skills required for specialized DPH roles (16,35). Public health professionals require both foundational knowledge through curricular integration and deeper expertise through standalone programs or courses (35). A stepwise approach is needed to review and integrate digital competencies into existing public health curricula as core competencies for all professionals, while also offering specialized training opportunities (35). This approach must prioritize inter- and transdisciplinary frameworks to develop “T-shaped professionals” equipped to navigate complex challenges while ensuring opportunities for applied training in real-world contexts (Figure 2) (35–37).

However, adopting this inter- and transdisciplinary paradigm requires addressing challenges such as partnerships, administrative barriers, and funding constraints within schools of public health (37,38). Funding is essential for baseline integration and the design of specialized DPH programs. Advocacy and collaboration with organizations aligned with transdisciplinary public health goals can catalyze this process as has been demonstrated by programs like the Canadian Health Systems Impact Fellowship (39). Establishing transdisciplinary programs requires engaging motivated partners first, gradually expanding to include other collaborators with clearly defined roles and expectations based on desired graduate competencies (36–38). Engagement with public and private health sectors and digital actors must follow a principles-driven approach that prioritizes equity and health over commercialization and techno-optimism (9,40).

Reflexivity, ongoing dialogue, and program co-creation with partners are essential for the

effective development and implementation of these programs. Public sector collaboration is crucial to ensuring programs align with health system needs. Educators must clearly define the value and roles of program graduates to enhance their real-world impact. Additionally, curricula should prioritize evaluation, using clear indicators to measure effects on partner organizations and public health outcomes. This evidence base is key to sustaining funding and long-term support (38).

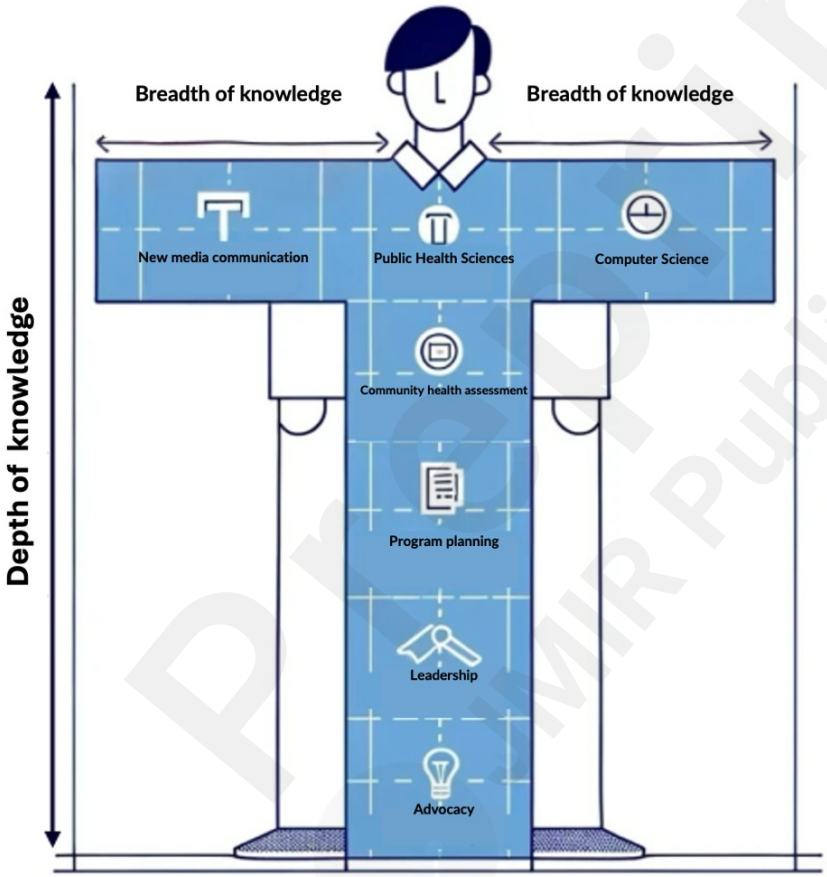

Figure 2: Depiction of a T-shaped professional

Strengths and limitations

Findings from this study should be interpreted considering its strengths and limitations. To our knowledge, this is the first systematic documentation of digital public health training programs

globally. Our approach combined a review of available programs with interviews with training program staff, ensuring both rigor and a deeper understanding of program contexts. We also aimed for an expansive review by including all eligible programs worldwide. However, our reliance on Google Search and the use of English-only terms in the search strategy may have introduced bias, as search algorithms are location-specific and prioritize popular programs. To mitigate this, we used Google translate where appropriate to ensure returns in languages other than English were not excluded. Additionally, this study did not comprehensively review all non-digital courses in public health training programs to assess whether current coursework incorporates digital public health perspectives. Other similar environmental scans adopted this approach and showed about 20% of programs have considered DPH mainly using similar approaches as identified in our review (28). Our assumptions of digital programs and courses being hosted within the schools of public health as demonstrated in our search may have inadvertently missed important DPH programs hosted in other allied schools or programs leveraging cross-listed courses. We also acknowledge limitations in the sample size for the interview with only 4 participants responding out of 22 invitations sent. This limited us from making any inter-jurisdictional comparisons. However, the breadth and depth of conversations in the interviews ensures that we can gain useful insights from other programs while encouraging careful appraisal of readers' own context when considering transferability of findings. Further research could include more broad qualitative inquiry of international perspectives, but our work represents an important first step.

Conclusion

This environmental scan of DPH training programs highlights the predominance of data-centric competencies, such as public health data science and informatics, while identifying critical gaps

in addressing competencies for digital health promotion, program evaluation, leadership, and digital determinants of health. Despite efforts by schools of public health to align with global and national priorities, progress remains fragmented and geographically limited. To address these gaps, we recommend a stepwise approach that integrates digital competencies as core elements in public health curricula while developing standalone programs to cultivate specialized skills. Emphasizing inter- and transdisciplinary frameworks is essential for building “T-shaped professionals” capable of navigating complex public health challenges, but overcoming barriers related to funding, administrative constraints, and partnerships will require sustained advocacy, principles-driven collaboration, and robust evaluation frameworks. These efforts must prioritize equity and health outcomes over commercial imperatives, ensuring that DPH training equips the workforce to respond effectively to the challenges and opportunities of societal digital transformation.

Declarations

Ethics approval and consent to participate

This study was revised by the University of British Columbia's Behavioral Research Ethics Board (ethics #H22-03153). Written voluntary informed consent was obtained from each participant at least 24 hours prior to interviews via email and assigned each participant an identification number which was included in all transcripts and field notes. All study materials were stripped of personal identifiers prior to analyses. Participants did not receive an honorarium.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests Statement

None to declare.

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Authors' contributions

I.I and M.G conceptualized the study and drafted the study protocol which was reviewed H.J.C, A.K, A.B, F.I.C, H.D, and G.M; I.I and S.R conducted data collection; I.I and S.R analyzed the data and reviewed outputs with all authors; S.R and I.I drafted the manuscript; M.G secured funding for the study and all authors critically reviewed and approved the final version of this manuscript.

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Abbreviations

AI	Artificial Intelligence
ASPHER	Association of Schools for Public Health in the European Region
CEPH	Council on Education for Public Health
DPH	Digital Public Health
NCCPH	National Collaborating Centers for Public Health

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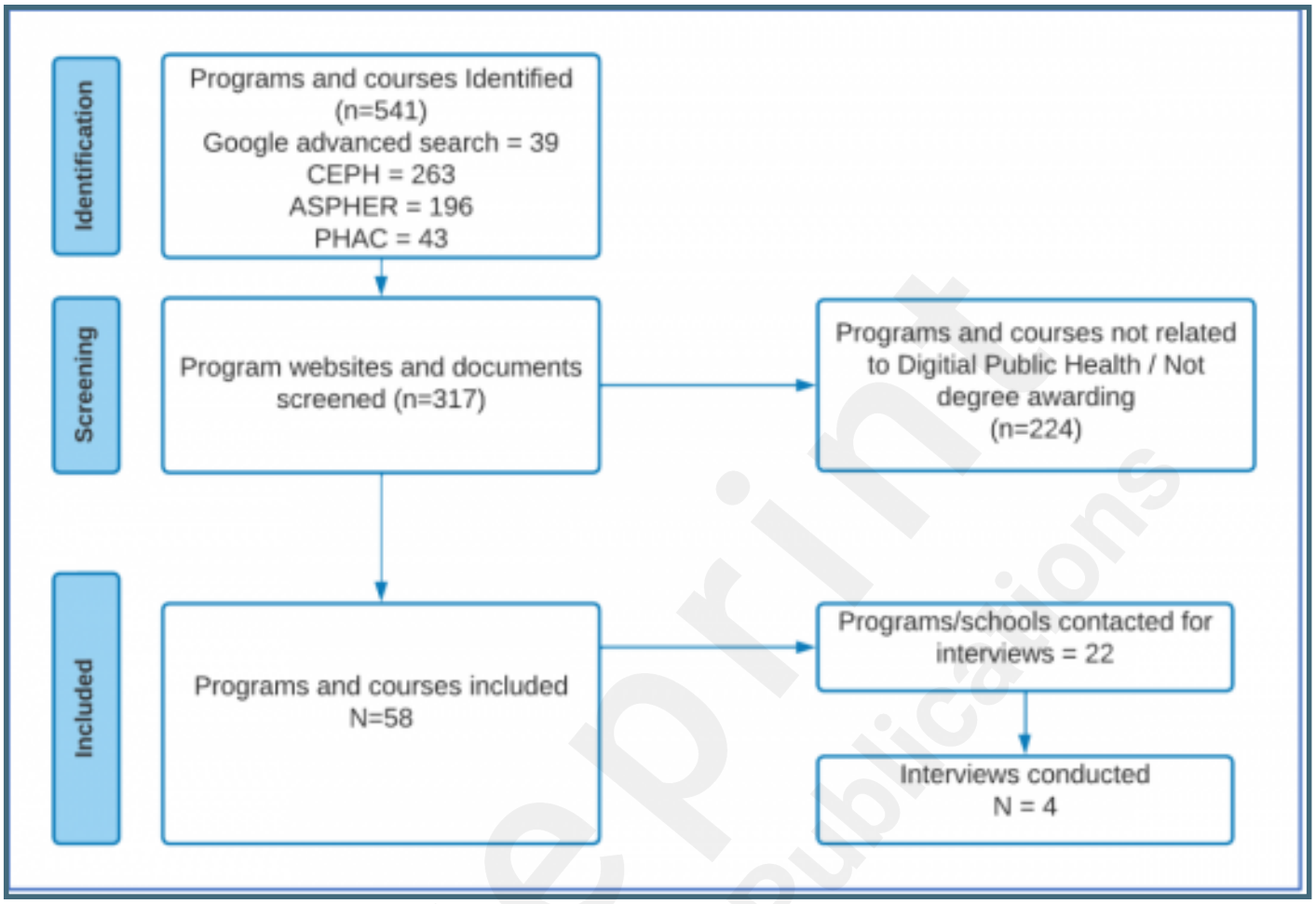
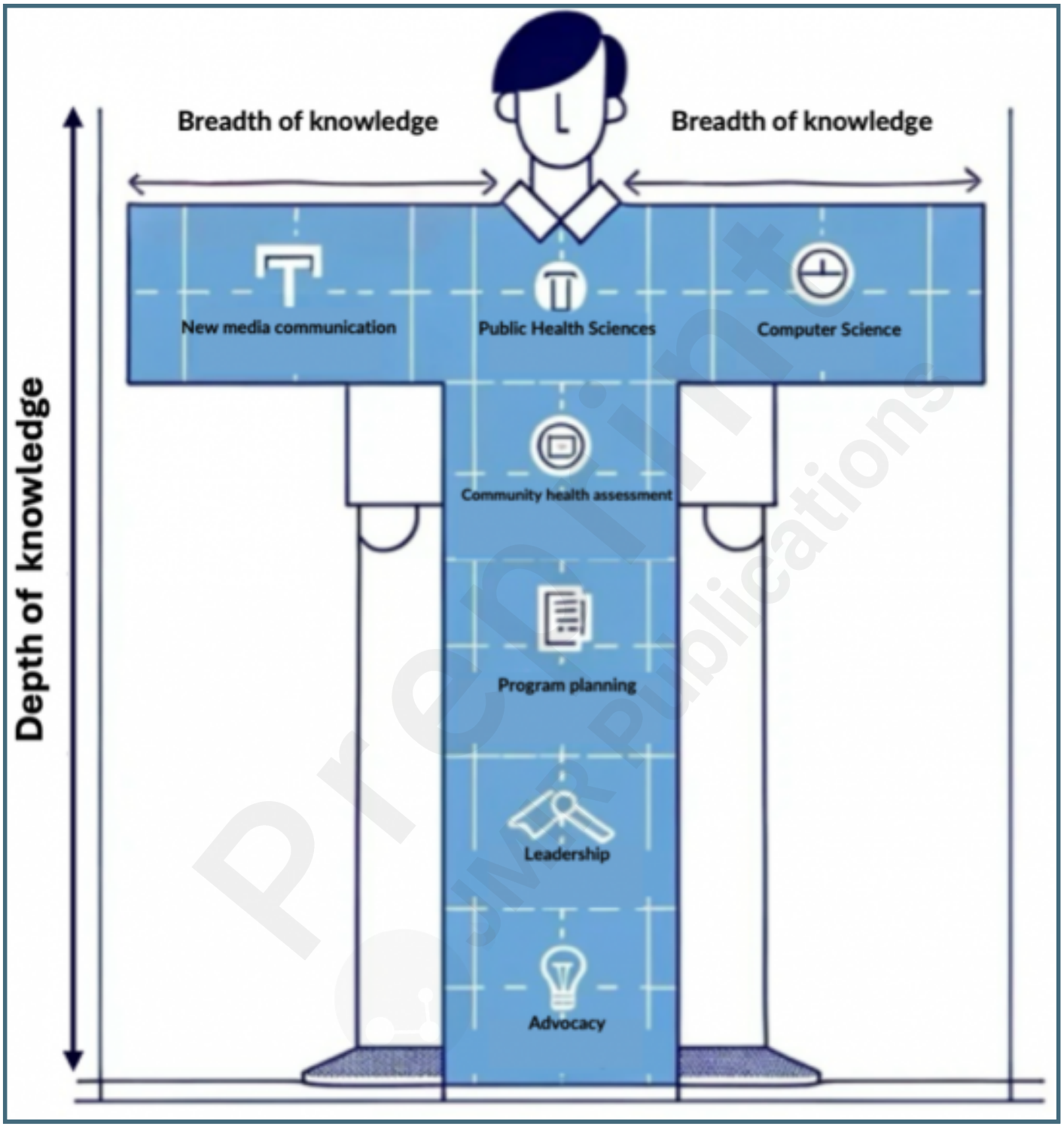
Supplementary Files

Figures

Flow diagram of the program search and selection process.



Depiction of a "T-shaped" professional.



Multimedia Appendixes

List of countries included in Google advanced search.
URL: http://asset.jmir.pub/assets/72da306479b9756892c2f5ee46a9643d.docx

Data extraction form for environmental scan.
URL: http://asset.jmir.pub/assets/9298fb8b9e5c36f5fa59eb2ea34af2ef.docx

Interview guide for semi-structured interviews.
URL: http://asset.jmir.pub/assets/49f958c423d18765f05fe9adc7320140.docx

Summary of all included programs.
URL: http://asset.jmir.pub/assets/548da398be9b70751923ece366024f40.docx