

RESEARCH

Open Access





competencies might be further adapted to Canada's context to appropriately facilitate the digital transformation of public health. Here we conceptualized *digital competencies* as the essential knowledge, skills, and attitudes necessary to effectively use digital technologies for public health functions [14, 20, 21]. This definition extended beyond digital literacy (basic skills for using digital devices and applications effectively) to include technical skills for using digital technologies effectively in a work context and soft skills including understanding of ethics and equity implications of using these technologies in a public health context [22]. We asked: what adaptations may be required to apply the identified digital competency and training model recommendations to Canada's public health training and practice context? and what competencies are required to ensure the public health workforce remains responsive to new digital technologies relevant to public health services in Canada?

## Methods

### Study design

This was an interpretive descriptive study that sought to ensure our research was aligned with experiences of public health practitioners affected by our recommendations (i.e., recommendations to public health schools and agencies involved in public health competency development) [23–26]. An interpretive description was appropriate given our aim to draw on existing knowledge and frameworks to inform better understanding of Canada's public health context. We drew on Roger's innovation diffusion theory and the Concerns-based adoption model to inform our inquiry including the development of discussion guides and our analyses [19, 27, 28]. We explored structural factors within the Canadian public health context that should be considered for successful implementation of training and explored participants' concerns about the use of digital technologies within their practice. Reflecting on our motivations and experiences with this research, members of our team have experience implementing and evaluating digital public health interventions using equity-focused approaches. Team members are also educators with experience designing and evaluating public health training curricula at undergraduate and graduate levels. We sought to understand participants' contexts assuming multiple realities and contexts [29].

### Study setting, sampling and participant recruitment

This study was conducted in collaboration with faculty at the: Dalla Lana School of Public Health, University of Toronto; School of Population and Public Health, University of British Columbia; and School of Public Health and Social Policy, University of Victoria. We recruited a stratified purposive sample of participants

to represent perspectives of practitioners from western, central, eastern, and Atlantic Canadian regions and practitioners in federal and local public health agencies and health authorities. We sent recruitment emails using the research team's networks to listservs of the BC Centre for Disease Control, Public Health Agency of Canada, the National Collaborating Centres, the Canadian Public Health Association, and other similar organizations across Canada. We included participants who were currently engaged in a federal, provincial/territorial, or municipal public health institution in Canada (including ministries of health and non-governmental organizations), in their current position for at least 3 years (to account for the time since the explosion of digital technologies to support the COVID-19 response) and familiar with using digital technologies in public health – either through practice in a decision-making capacity or as a frontline public health practitioner required to work with digital technologies. We excluded participants who were interested but had no experience with digital technologies or served in an administrative capacity in health systems, with roles restricted to a solely clinical perspective (i.e., focused on “digital health” which involved digital technologies in clinical settings like personalized health records and health apps) [30].

### Data collection

For consenting participants, we sent collected demographic and professional information before focus groups. Four focus groups (FGs) were conducted online using Microsoft Teams® between November 7th and December 7th, 2023, each lasting an average of 100 min (range 84–111 min). Focus groups were created based on participants' geographical location and organizational jurisdictions (Table 1). Participants took these calls alone in private office spaces or in their homes. We followed a discussion guide (Appendix 1) which was broadly divided into two sections. While none of the interviewers had prior relationships with FG participants, we began FGs by having broad conversations about the goals of the study, the study team and then engaged in a discussion of participants' broad perceptions and experiences of digital competencies in their current practice. Then we reviewed a list of sample competency statements generated in private

by II (a physician and public health researcher with 5 years of experience and training in qualitative methods including interviewing and FG facilitation). SR and CW made detailed field notes and co-facilitated FGs as appropriate. We audio recorded FGs using the record function on Microsoft Teams® and created verbatim transcripts

described the confusing digital systems required to track respiratory infections:

*“During COVID, it was all [software1 name] in Ontario all the time...But now that we have other communicable diseases to work with as well, integrating [software1 name] with our [software2 name], which is just another provincial database where we enter communicable diseases is very difficult because COVID goes into one database, everything else goes into [software2 name].. In addition to that, inspectors use their own database called [software3 name], which is probably the most widely used in Ontario with the health units... and it doesn't integrate with anything.... So how do we get everyone on board with everything? So now we have three separate databases that we're trying entry into.” – FG 1.*

While these parallel systems require multiple trainings and retraining, most practitioners described self-led capacity building as the most common approach to gaining digital competencies for public health. Self-led capacity building was often described as driven by personal interest among early adopters and digitally native (i.e., gaining technological savviness because they grew up with technology around them) practitioners. Being digitally native was described more regarding younger practitioners, acknowledging the workforce's diversity and the potential for digital technology to be overwhelming for others who may be unwilling to build capacity. A 50

#### Public health systems must evolve to support new digital competencies

Public health practitioners realized and suggested that, for digital competencies to be beneficial, digital public health systems must effectively facilitate their enactment. Practitioners described their work situations where a fragmented and issue-based approach to implementing digital systems has resulted in non-integrated (non-interoperable) legacy systems that obstruct the broad vision for digital transformation of public health systems. These views were shared in all the focus groups representing organizations in Western, Eastern, and Central Canada. Practitioners provided multiple examples of legacy systems co-existing alongside modern alternatives where health workers are required to manually enter data from one system into others, or persistently using paper-based records despite existence of digital alternatives. For example, a 31 to 40-year-old health promotion specialist from Ontario

competencies to keep up with changing public expectations of public health services and digital transformation of society. This transformation was said to influence how different populations are better reached through different digital platforms and comparative efficiencies in times savings for public health workers and the public with client-led service access through digital platforms.

**Strengthen the basics before extending towards advanced digital competencies**

Yet, practitioners suggested we must prioritize basic competencies first, before proceeding to specialized digital competencies. While specialized digital competencies were used to describe advanced competencies like advanced data science and public health informatics that would not be required of practitioners in general practice, the basics were described in two perspectives. The first involved strengthening core public health competencies to ensure meaningful application of digital competencies. For example, practitioners described needing a combination of basic understanding of biostatistics and public health sciences, deep institutional knowledge of digital data generation processes, and communication skills to effectively interpret and translate digital data streams and analyses into insights that benefit public health. A public health inspector from Alberta said:

*we have an evolution of hackers. To be honest, they understand those systems as well. So, I think there should be a level of protection around these types of systems and access of individuals who are using these systems... I'm not entirely sure about a provincial level, but you know, and then when you look at in community, there really isn't a whole lot of understanding around the data, systems, governance and management" – FG4.*

Second, practitioners described the need for basic digital literacy skills like being able to use enterprise tools

*tial issues or things that need to be resolved. So, a program or something that deals... [with] case study related [training], something that makes you think, or you know develop these kinds of problem-solving skills and not necessarily thinking everything given to you... You know already clean data, and everything is just ready for full functioning.” – FG2.*

## **Discussion**

We explored how recommendations for digital competencies and training models might be adapted to Canada's public health systems and competencies required to ensure a workforce that responsively adapts new digital





In addition to a systems-approach to digital competencies, training recommendations to address this stage of the concern include integrating such digital competencies into existing public health training and establishing mentorship especially through transdisciplinary support networks and communities of practice [27, 53]. Here, we define transdisciplinary networks to include collaborations beyond traditional partnerships in public health, blending approaches from physical sciences, computer sciences, behavioral sciences, communications and other similar disciplines to create unique solutions to public health problems [54]. Examples of training programs adopting these transdisciplinary cohort-based supporting systems includes McGill's dual degree in public health data science that builds student triads that deepen experiences of public health systems and allows students to develop skills to engage in a transdisciplinary workforce.

Additional research is needed to understand faculty perspectives about needed digital competencies and current barriers to implementing suggestions and recommendations outlined in this study. We acknowledge that integrating digital competencies in the curriculum requires significant upskilling among public health faculty and formation of transdisciplinary partnerships. Research is required to understand faculty concerns with designing and delivering such curricula, evaluate the level of training required for public health faculty and to determine the configuration of partnerships needed to optimize learning environments. While we have provided initial recommendations, additional competencies may need to be considered in contemporary public health curricula to address emergent technologies, such as generative artificial intelligence and other similar modern tools.

#### Strengths and limitations

This study explored pan-Canadian perspectives through focus groups with practitioners across Western, Eastern, and Central Canada, working at regional, provincial and federal health authorities and agencies. This broad perspective ensured our study findings account for the differing attributes of public health systems across Canada and provided practical insight about potential changes necessary for public health training to keep up with contemporary practice. Our team includes education leads at schools of public health in Canada to help ensure our interpretations were grounded in their reality. However, we were limited by the number of focus groups we could conduct per region and organizational characteristics and by the distribution of participant roles within focus groups. While our sampling strategy allowed us to reasonably explore the breadth of codes (issues) related to our topic of interest, we were unable to sufficiently gain

depth and meaning saturation that routinely requires two or more groups per strata [55]. Further, we were limited by the sample size and could not sufficiently explore regional differences in perspectives. This is important given regional differences in the organization of public health services in Canada. While having 74% of the sample as women is representative of the gender distri-

II drafted the manuscript; MG secured funding for the study and all authors critically reviewed and approved the final version of this manuscript.

#### **Funding**

This research was supported by the Canadian Institutes for Health Research (CIHR) through the Chief Public Health Officer Catalyst Grant for Transforming Public Health (Grant number: AWD-022946). II. is supported by the CIHR post-doctoral fellowship (Grant number: AWD-028829) and the CIHR Canadian HIV Trials Network post-doctoral fellowship.

#### **Data availability**

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

#### **Declarations**

##### **Ethics approval and consent to participate**

Ethics approval was obtained from 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 h prior to FGs using Qualtrics and assigned each participant an identification number (ID) which was included in all FG transcripts and field notes. All study materials were stripped of personal identifiers prior to analyses. Each participant was offered a \$ 50 CAD honorarium and study protocols adhered to the principles and requirements laid out in the Declaration of Helsinki.

##### **Consent for publication**

Not applicable.

##### **Competing interests**

II serves on the editorial board of BMC Public Health Journal and on the Board of the Public Health Association of British Columbia (PHABC).

##### **Author details**

<sup>1</sup>School of Population and Public Health (SPPH), University of British Columbia (UBC), 2206 East Mall, Vancouver, BC V6T 1Z3, Canada. <sup>2</sup>BC C25otualText(by )>>ing interests

32. Braun V, Clarke V. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qual Res Psychol*. 2021;18:328–52.
33. Byrne D. A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Qual Quant*. 2022;56:1391–412.
34. Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol*. 2006;3:77–101.
35. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care*. 2007;19:349–57.
36. Longhini J, Rossetini G, Palese A. Digital Health Competencies Among Health Care Professionals: Systematic Review. *J Med Internet Res*. 2022;24:e36414.
37. Albrecht J, Maaß L, Tokgöz P, et al. Wie viel Digital Public Health steckt in Public-Health-Studiengängen? Eine systematische Modulhandbuchanalyse von Vollzeitstudiengängen an öffentlichen Hochschulen und Universitäten in Deutschland. *Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz*. Epub ahead of print 4 March 2024. <https://doi.org/10.1007/s00103-024-03844-2>.
38. Australian Digital Health Agency, Australasian Institute for Digital Health. Australasian Digital Health Capability Framework: A standard framework in digital capabilities for those working in healthcare. Sydney, NSW: Australian Digital Health Agency, [https://digitalhealth.org.au/wp-content/uploads/2024/01/Australian-Digital-Health-Capability-Framework\\_v1.1.pdf](https://digitalhealth.org.au/wp-content/uploads/2024/01/Australian-Digital-Health-Capability-Framework_v1.1.pdf). (2023, Accessed 28 Jun 2024).
39. Maaß L, Zeeb H, Rothgang H. International perspectives on measuring national digital public health system maturity through a multidisciplinary Delphi study. *Npj Digit Med*. 2024;7:92.
40. Iyamu I, Gómez-Ramírez O, Xu AX, et al. Challenges in the development of digital public health interventions and mapped solutions: Findings from a scoping review. *Digit Health*. 2022;8:20552076221102256.
41. Wholey DR, LaVenture M, Rajamani S, et al. Developing Workforce Capacity in Public Health Informatics: Core Competencies and Curriculum Design. *Front Public Health*. 2018;6:124.
42. MacKay M, McAlpine D, Worte H, et al. Public health communication professional development opportunities and alignment with core competencies: an environmental scan and content analysis. *Health Promot Chronic Dis Prev Can*. 2024;44:218–28.
43. Maaß L, Badino M, Iyamu I, et al. Assessing the Digital Advancement of Public Health Systems Using Indicators Published in Gray Literature: Narrative Review. *JMIR Public Health Surveill*. 2024;10:e63031.
44. Gómez-Ramírez O, Iyamu I, Ablona A, et al. On the imperative of thinking through the ethical, health equity, and social justice possibilities and limits of digital technologies in public health. *Can J Public Health*. 2021;112:412–6.
45. Richardson S, Lawrence K, Schoenthaler AM, et al. A framework for digital health equity. *Npj Digit Med*. 2022;5:119.
46. Purnat TD, Nguyen T, Briand S (eds). *Managing Infodemics in the 21st Century: Addressing New Public Health Challenges in the Information Ecosystem*. Cham: Springer International Publishing. Epub ahead of print 2023. <https://doi.org/10.1007/978-3-031-27789-4>.
47. Rubinelli S, Purnat TD, Wilhelm E, et al. WHO competency framework for health authorities and institutions to manage infodemics: its development and features. *Hum Resour Health*. 2022;20:35.
48. Caputo F, Cillo V, Fiano F, et al. Building T-shaped professionals for mastering digital transformation. *J Bus Res*. 2023;154: 113309.
49. Demirkan H, Spohrer JC. Commentary—Cultivating T-Shaped Professionals in the Era of Digital Transformation. *Serv Sci*. 2018;10:98–109.
50. The Digital Communications Coordination Unit, Privy Council Office. Best practices for communicating in a digital world. Government of Canada, <https://www.canada.ca/en/treasury-board-secretariat/topics/government-communications/communications-community-office/communications-101-boot-camp-canadian-public-servants/communicating-digital-world.html>. (2024, Accessed 14 Aug 2024).
51. Council on Linkages Between Academia and Public Health Practice. Core Competencies for Public Health Professionals. [http://www.pfh.org/resourcestools/pages/core\\_public\\_health\\_competencies.aspx](http://www.pfh.org/resourcestools/pages/core_public_health_competencies.aspx). (2021, Accessed 18 Jan 2023).
52. World Health Organization. WHO-ASPHER competency framework for the public health workforce in the European Region. World Health Organization. Regional Office for Europe. Geneva, Switzerland: World Health Organization, <https://iris.who.int/handle/10665/347866>. (2020, Accessed 29 Jun 2024).
53. Hollingshead B. The Concerns-Based Adoption Model: A Framework for Examining Implementation of a Character Education Program. *NASSP Bull*. 2009;93:166–83.
54. Wickson F, Carew AL, Russell AW. Transdisciplinary research: characteristics, quandaries and quality. *Futures*. 2006;38:1046–59.
55. Hennink MM, Kaiser BN, Weber MB. What Influences Saturation? Estimating Sample Sizes in Focus Group Research. *Qual Health Res*. 2019;29:1483–96.
56. Gupta N, Balcom SA, Singh P. Gender composition and wage gaps in the Canadian health policy research workforce in comparative perspective. *Hum Resour Health*. 2022;20:78.

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.