Practice analysis to validate Master of Public Health core competencies and identify education gaps in Ethiopia: a national cross-sectional study

Tegbar Yigzaw[1], Makonnen Assefa[2], Mirgissa Kaba[3], Yayehyirad Kitaw[4], Solomon Worku[5], Tesfaye Bulto[6]

Abstract

Introduction: Competency-based education has the potential to transform educational and health outcomes. The taskforce for strengthening public health education drafted core competencies for Master of Public Health (MPH) education in Ethiopia. This study aims to validate the draft MPH core competencies and identify education gaps.

Methods: A national cross-sectional survey was conducted in 2015 with public health professionals who hold an MPH degree. The required sample size was calculated using a single population proportion formula. Study participants were selected from the different regions using a convenience sampling technique. They were asked to make judgements about the 127 draft competencies organized in 11 domains. For each competency statement, respondents answered four basic questions: 1) How important is accurate and timely performance of the competency on population health outcomes? 2) How often do you perform the task? 3) How comfortable are you in performing the task? 4) When and where were you trained to perform the task? We collected data using a self-administered questionnaire. Data analysis involved calculating proportions for each competency, followed by generating an average percentage for each competency domain.

Results: A total of 350 public health professionals from academia and practice participated in the study. Over 90% of respondents said that the draft public health core competencies were important for improving population health outcomes. More than one third of the respondents indicated they performed the public health competencies rarely. A further 8.3% to 27.6% said they had never performed the public health competencies in their career. Although most respondents said they were competent, one sixth to one quarter admitted a lack of capability in the domains of financial planning and management, cultural competence, policy and program, leadership and systems thinking, and education and training. Pre-service education was the most frequent setting for learning public health competencies. However, between one quarter and one third did not have any opportunity to learn some competencies, especially in the domains of cultural competence, financial planning and management, leadership and systems thinking, policy and program, communication skills, and education and training. Public health competency domains with high 'not trained' responses also drew high 'not capable' and high 'never performed' responses.

Conclusions: The draft MPH core competencies are applicable to Ethiopia. The substantial education gaps found in our study warrant re-designing the MPH curriculum. [*Ethiop. J. Health Dev.* 2020; 34(Special issue 1):16-24]

Key words: Master of Public Health (MPH); essential competencies; postgraduate education; public health; competence gaps

Introduction

Remarkable progress has been made in improving global health in the last few decades. However, many populations, especially those in low- and middle-income countries, continue to bear unacceptably high levels of morbidity and mortality from age-old health problems. At the same time, new health challenges are emerging, presenting complex demands on health systems (1,2). A well-educated public health workforce is essential to promote population health, prevent diseases and reduce health inequity (3,4). However, attaining the ultimate public health vision of a healthy and fairer world requires a paradigm shift in the way health professionals are trained (2).

Competency-based education has the potential to transform educational and health outcomes. Competency-based education organizes learning around essential competencies that are defined based on the health needs of a population and requirements of local health systems. It shifts the attention from the acquisition of knowledge to the development of practical competencies. It promotes experiential learning and authentic assessment that support deep learning and ensure readiness for the world of work (2,5). In the past three decades, associations of schools of public health and public health agencies in USA, Canada, Europe, Australia and England have taken concrete steps to promote competency-based education, notably by defining the core public health competencies (6-11).

Although Ethiopia has made tremendous progress in improving the health of its population, the levels of mortality and morbidity are still high. According to the 2019 WHO statistics, the maternal mortality ratio in Ethiopia is 353 per 100,000 live births, which is larger than the world average by 63%. The under-5 mortality rate is 59 per 1,000 live births, which also is higher than the global average by 51% (1). Underlying these poor health indicators is a public health system unable to ensure high coverage with essential public health services. For example, the universal health service coverage index of Ethiopia is estimated to be 39, which is far behind the global index of 64. Only 49.8% of births are attended by a health professional (global

[1]Jhpiego Ethiopia. Adjunct Faculty, Jimma University. Email: tegbar.yigzaw@jhpiego.org
[2]Addis Ababa University, Addis Ababa, Ethiopia
[3]School of Public Health, Addis Ababa University, Addis Ababa, Ethiopia, E- mail mirgissk@yahoo.com
[4]Private consultant. Email: yayehyiradkitawy@gmail.com
[5]Ministry of health, human resource for health directorate Email: solomonwb@gmail.com
[6]Private consultant

average is 81%). The met need for family planning is 62.3% (global average is 75.7%). Diphtheria-pertussis-tetanus (DPT3) immunization coverage is 61% (global average is 85%). The proportion of population using safe drinking water is 11%, in sharp contrast to the global average of 71% (1, 12). Health inequity is also a persistent public health challenge in Ethiopia. According to the 2019 Ethiopian Mini Demographic and Health Survey, rural women are much less likely to use contraceptive than their urban counterparts (38% versus 50%). The percentage of women making four or more antenatal care visits is 78.9% in women with more than secondary education but only 32.4% among those without education. Skilled birth attendance is nearly four times higher among the richest quintile compared to the poorest (12). As if these public health challenges are not exacting enough, Ethiopia now faces an additional burden of non-communicable diseases and injuries (1,13).

Postgraduate public health training is vital to prepare public health leaders and experts who can build a strong health system and address population health challenges effectively and efficiently. Ethiopia has more than three decades of experience with postgraduate public health training. The first Master of Public Health (MPH) education program started in Addis Ababa University in 1984; and the number of public and private higher education institutions offering MPH degrees has increased markedly in the last decade. However, the capacity of public health schools and public health graduates is unknown and arguably questionable. And there are good reasons to be skeptical. Public health education has not kept pace with global trends in curriculum design, teaching and learning, and assessment (2,14). To the best of our knowledge, Ethiopia does not have a nationally agreed competency framework to provide common standards for public health education. Public health curricula are mostly discipline-based, with little attempt to integrate and link to core public health functions. Public health teaching is largely classroom-based, with limited opportunities for practice in the world of work. Student assessment methods focus on the acquisition of facts rather than testing deep learning and ability to perform. There is no program-specific accreditation for public health schools, nor is there a national licensing examination to verify the competence of graduates from the different public health schools.

Based on a review of international trends in the education of health professionals in general and public health education in particular, the taskforce for strengthening public health education recognized that competency-based education was the dominant paradigm globally (2,4,6,8,9). Accordingly, the taskforce drafted core public health competencies for MPH education in Ethiopia. We conducted this practice analysis study to validate the draft core competencies and identify education and performance gaps. It is hoped that the results from this study will inform the re-design of MPH education, as well as the prioritization of topics for the continuing education of public health professionals.

Methods

Study design: A national descriptive cross-sectional survey was conducted from June to August 2015.

Sample size and sampling method: The participants of this study were public health professionals with an MPH degree. The required sample size was calculated using a single population proportion formula, based on the following assumptions: 50% proportion for the attributes of interest, 95% confidence level, and 5% margin of error. The calculated sample size (384) was rounded up to 400 and allocated to regions and city administrations proportionate to the distribution of the total health workforce (as we could not get a reliable estimate of the number of public health professionals): Oromia (120), Southern Nations, Nationalities and Peoples' (SNNP) (84), Amhara (70), Tigray (42), Addis Ababa (35), Somali (14), Harari (7), Gambella (7), Dire Dawa (7), Benishangul-Gumuz (7), and Afar (7). Study participants were recruited using a convenience sampling technique, although an attempt was made to maximize representativeness across geographic locations and job types (public health practice, academia and research).

Variables and measurement: Draft MPH core competencies for Ethiopia were adapted through a review of local curricula and core public health competencies in USA, Canada and Europe (6,8,9). The adaptation process focused on ensuring relevance to the Ethiopian context, adding and emphasizing competencies deemed locally important, and defining competency statements using appropriate action verbs. The final list consisted of 127 competency statements organized in 11 domains, namely: analysis and assessment (16 competencies), policy and program (12 competencies), communication skills (16 competencies), cultural competence (8 competencies), community dimensions of practice (11 competencies), public health sciences (12 competencies), financial planning and management (12 competencies), leadership and systems thinking (15 competencies), teamwork, collaboration and partnership (11 competencies), public health values (7 competencies), and education and training (7 competencies). The competency list was put in a structured self-administered questionnaire and study participants were asked to answer the following four basic questions for each competency in the list:

1. **Criticality:** How important is accurate and timely performance of the task on population health outcomes? The possible answers were **high, moderate** or **low**.
2. **Frequency:** How often do you perform the task? The possible responses were **daily, weekly, monthly, rarely** or **never**.
3. **Competence:** How comfortable are you in performing the task? The possible answers were **proficient, competent** or **not capable**.
4. **Location and timing of training:** Where and when were you trained to perform the task? The possible responses were **pre-service education (PSE), in-service training (IST), on-the-job training (OJT)** or **never trained**.

We also collected data on the background characteristics of study participants. The data collection process was facilitated by senior public health professionals serving in the regional chapters of the Ethiopian Public Health Association. They reached out to eligible public health professionals and administered the questionnaire to those willing to participate in the study. The research team monitored and supervised the data collection process.

Data analysis: Data were analyzed using SPSS to generate descriptive statistics, specifically proportions and means. First, we calculated proportions for specific competency statements to identify the magnitude and distribution of responses for each of the four basic questions (criticality, frequency, competence, and locality and timing of training). We then aggregated the results by calculating average proportions for each of the 11 competency domains.

Results

A total of 350 public health professionals participated in the study, yielding a response rate of 87.5%. Most respondents were males, below 40 years of age and had less than 10 years of work experience. In terms of employment, 45.3% were practitioners in the Ministry of Health and 47.4% were academics in the schools of public health. Study participants were recruited from all regions and city administrations except Afar (Table 1).

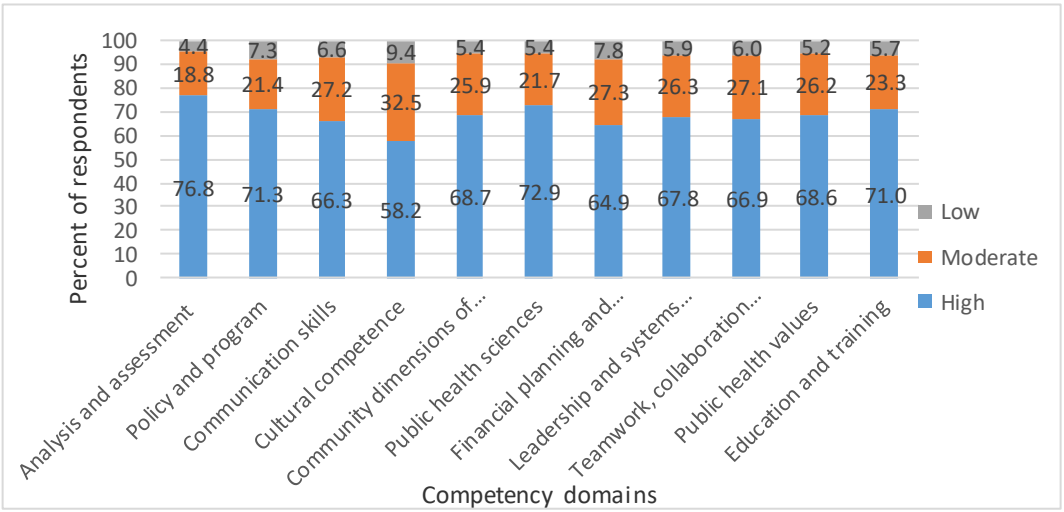
Table 1: **Background characteristics of study participants**

Variable	Number (%)
Sex (n=350)	
• Male	297 (84.9%)
• Female	53 (15.1%)
Age (n=347)	
• Less than 30 years	132 (38%)
• 30-39 years	151 (43.5%)
• 40 years and above	64 (18.4%)
Employer (n=345)	
• Ministry of Health*	154 (45.3%)
• Academic institutions	161 (47.4%)
• Research institutions	11 (3.2%)
• Civil society organizations	14 (4.1%)
Experience (n=345)	
• Less than 5 years	50 (14.5%)
• 5-9 years	179 (51.9%)
• 10-14 years	49 (14.2%)
• 15 years and above	47 (19.4%)
Region (n=350)	
• Oromia	98 (28%)
• SNNP	80 (22.9%)
• Amhara	67 (19.1%)
• Tigray	36 (10.3%)
• Addis Ababa	34 (9.7%)
• Others†	35 (10%)

* Ministry of Health includes health system management structures at federal, regional and sub-regional levels.
†Others include 13 participants from Somali, seven from Harari, six from Gambella, four from Benishangul-Gumuz and five from Dire Dawa.

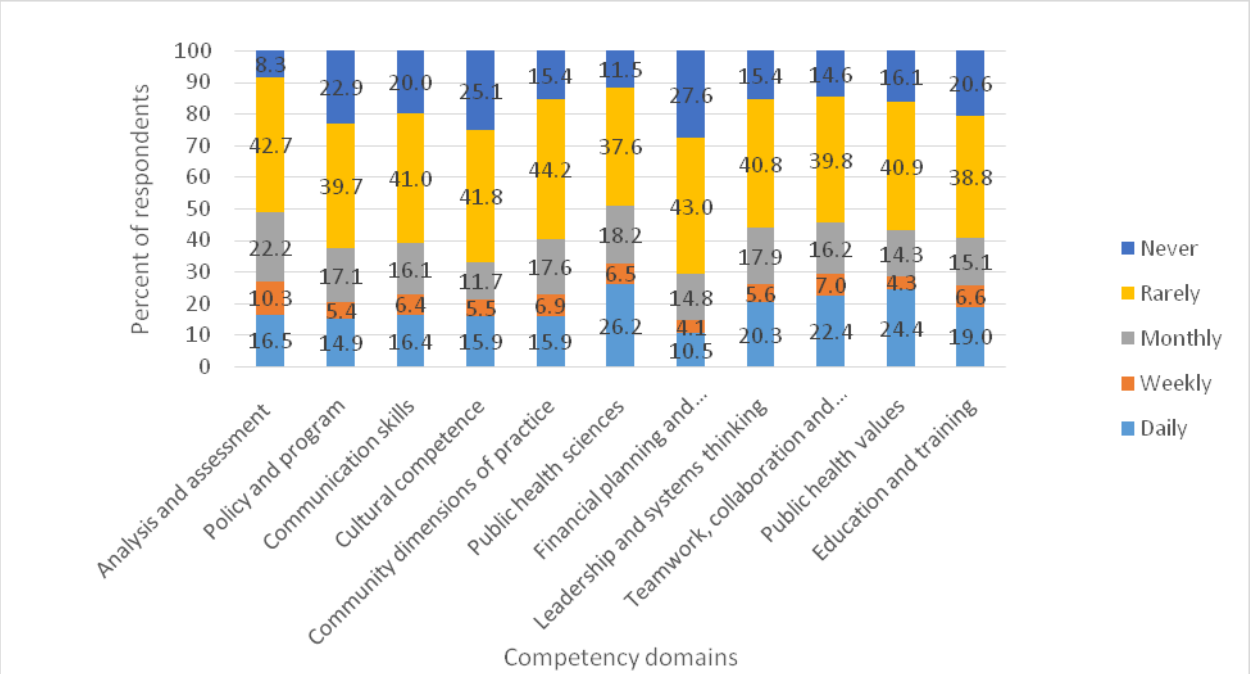
Criticality: Over 90% of respondents perceived accurate and timely performance of all core public health competencies to be moderately or highly important for population health outcomes. More than seven out of 10 respondents said analysis and assessment, public health sciences, policy and program, and education and training competencies were highly important (Figure 1).

Figure 1: **Perceived criticality of public health core competencies for population health outcomes, summarized by domain**



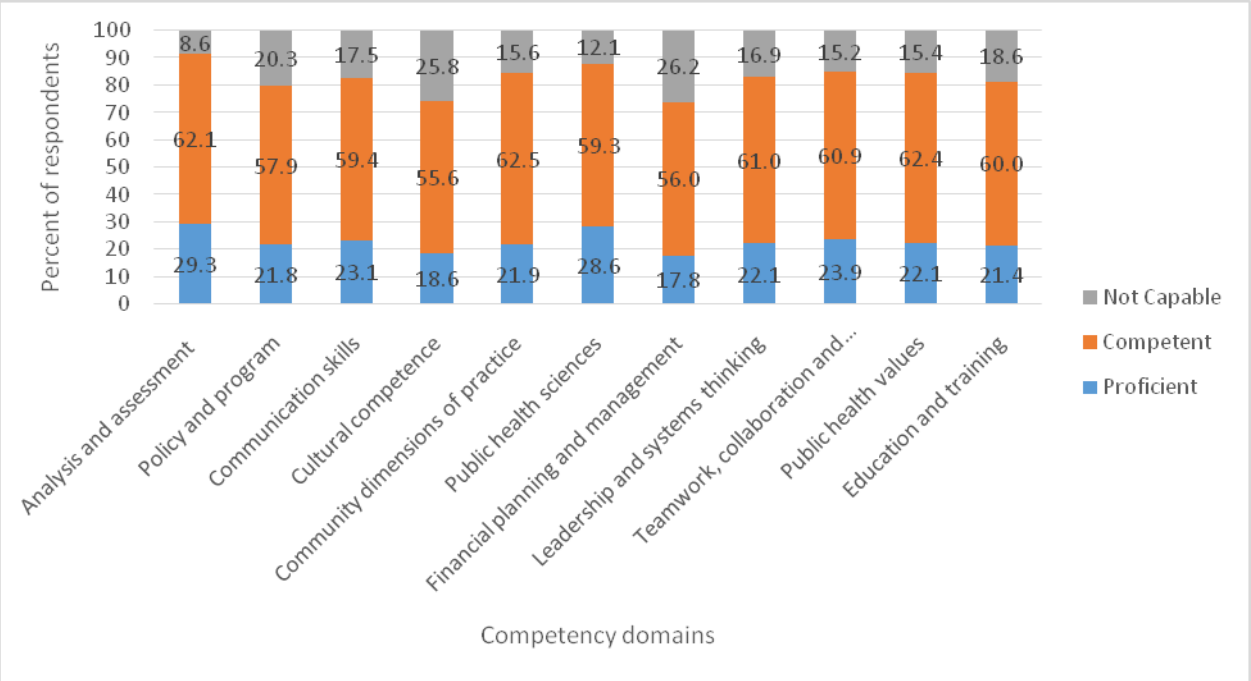
Frequency: More than one third of respondents (range: 37.6% to 44.2%) said that they performed core public health competencies rarely. About one fifth reported they had 'never performed' financial planning and management, cultural competence, policy and program, communication skills, and education and training competencies in their career (Figure 2).

Figure 2: **Self-reported frequency of performance of public health core competencies, summarized by domain**



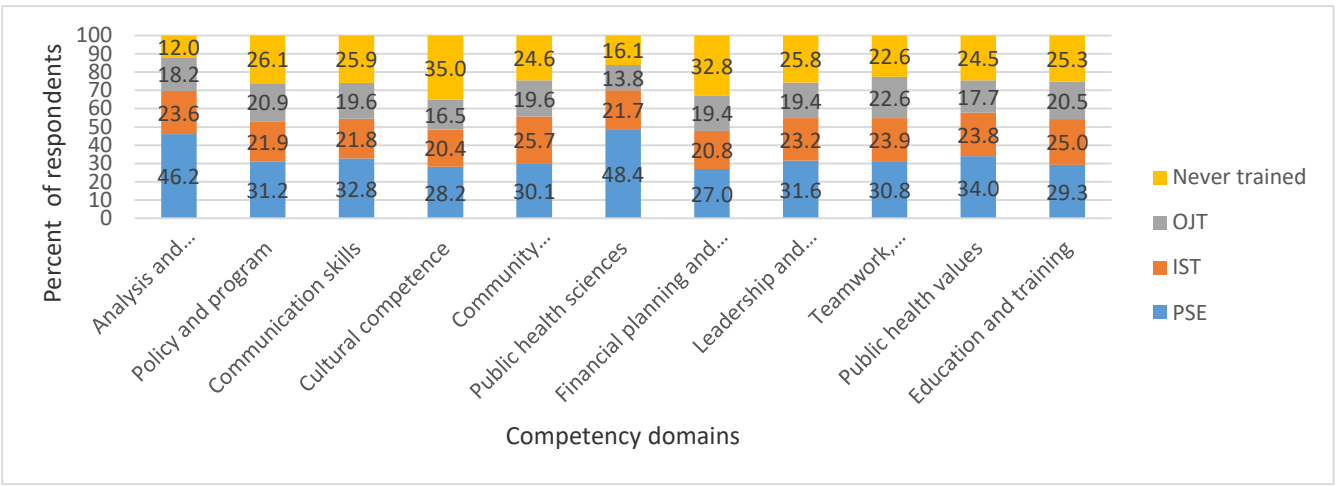
Competence: The vast majority of respondents (range: 73.8% to 91.4%) said they were able to perform core public health competencies. However, one quarter admitted a lack of capability in the domains of financial management and cultural competence. One sixth to one fifth acknowledged they were not competent in the domains of policy and program, leadership and systems thinking, and education and training (Figure 3).

Figure 3: **Self-reported capacity to perform public health core competencies, summarized by domain**



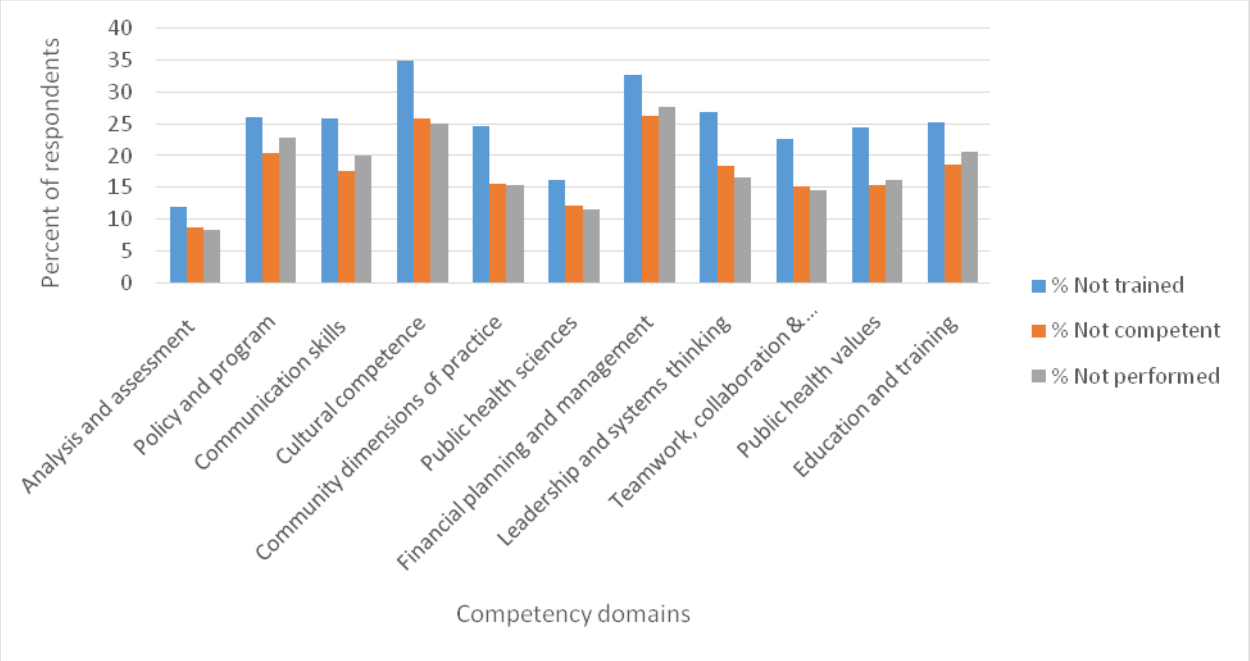
Location and timing of training: Pre-service education (PSE) was the most frequent setting for learning public health competencies. However, in no case did PSE reach a majority proportion. Between one fifth and one quarter of respondents said in-service training (IST) was the source of learning. There was a high 'never trained' response across the board, especially for the domains of cultural competence (35%), financial planning and management (32.8%), policy and program (26.1%), communication skills (25.9%), leadership and systems thinking (25.8%), and education and training (25.3%) (Figure 4).

Figure 4: **Percentage distribution of timing of training for public health core competencies, summarized by domain**



Examining responses to location of training, frequency of performance and competence in combination revealed that public health competencies for which there were high 'not trained' responses also had high 'not capable' and 'never performed' responses (Figure 5).

Figure 5: **Patterns of 'not trained', 'not capable' and 'never performed' responses, summarized by domain**



Discussion

Our study sought to validate MPH core competencies for Ethiopia and identify gaps in the education of public health professionals. Our results clearly showed that the draft public health core competencies were deemed important by the vast majority of study participants. However, the performance of core public health tasks was found to be infrequent, especially in such critical domains as financial planning and management, cultural competence, policy and program, communication skills, community dimensions of practice, and education and training. A significant proportion of respondents also lacked the capability to effectively execute core public health activities, especially financial planning and management, cultural competence, policy and program, leadership and systems thinking, and education and training. Furthermore, a substantial number never had any opportunity to learn some of the public health competencies, most notably cultural competence, financial planning and management, leadership and systems thinking, policy and program, communication skills, and education and training. Not surprisingly, infrequently performed activities tended to be the competencies that were not learned or mastered.

The high approval ratings of the draft core competencies demonstrate their relevance to serve as the basis for strengthening the education and practice of public health professionals in Ethiopia. The infrequent involvement in core public health activities, along with the observed overlap in 'not trained', 'not capable' and 'never performed' responses, suggest that the probable reason for not performing many core public health tasks is the lack of capability due to gaps in education and training. Needless to say, gaps in the education and performance of public health professionals will affect the effectiveness of public health actions, be they related to health promotion, health protection, or disease prevention.

The MPH core competencies validated in our study are similar to other existing frameworks, illustrating the universality of professional public health competencies. However, there are notable differences, emphasizing the importance of critical adaptation of global resources and serious consideration of local priorities. A six-country study that sought to validate MPH core competencies for low- and middle-income countries generated eight competency domains comparable to ours: public health sciences, assessment and analysis, policy development, communication, context-sensitive, community and inter-sectoral, planning and management, and leadership and systems thinking. However, there were fewer competencies and the authors merged some competency domains (e.g. community with inter-sectoral collaboration competencies), proposed new competency clusters (e.g. context-specific competencies cluster), and replaced financial planning and management with the broader planning and management domain (15). The proposed Ethiopian public health competency framework is also congruent with that of the Association of Schools of Public Health in the USA (7), which identified 119 MPH core competencies organized in 12 core domains: five discipline-specific (biostatistics, epidemiology, environmental health sciences, health policy and management, and social and behavioral sciences) and seven cross-cutting competency domains (communication and informatics, diversity and culture, leadership, public health biology, professionalism, program planning, and systems thinking). However, in the latter case, the five core disciplines stood as content domains instead of the one broader public health sciences domain in the Ethiopian framework.

European and Australian MPH core competencies are organized differently, even though there are large overlaps in specific competency statements. European MPH core competencies have six categories, namely: methods in public health; population health and its

social and economic determinants; population health and its material environmental determinants; health policy, economics, organizational theory and management; health promotion; and ethics. Each competency domain is sub-divided into intellectual and practical competencies (9). The Australian MPH graduate competencies are organized under six areas of practice: health monitoring and surveillance; disease prevention and control; health protection; health promotion; health policy planning and management; and evidence-based professional population health practice (10).

The major difference of the Ethiopian competency framework from other similar models is the addition of the 'education and training' competency domain. It is the taskforce's conviction that public health professionals trained at postgraduate level must understand and apply evidence-based instructional design and teaching/learning methods to advance the pedagogy of professional public health education and training. Our draft competency model also considers 'public health values' to be a critical public health competency domain that warrants an explicit category. The Associations of Schools of Public Health in the USA (7) and Europe (9) have also established 'professionalism' and 'ethics' as core public health competency domains, respectively. We believe no matter how technically competent public health professionals might be, they will not have the desired impact on population health without understanding and embodying public health values and ethics (8). Moreover, while the draft Ethiopian MPH competency framework lists knowledge competencies mostly under the 'public health sciences' domain, the European (9) and Australian (10) MPH competency frameworks define knowledge competencies under each domain, allowing a more detailed treatment of cognitive competency outcomes. The MPH core competencies endorsed by the Association of Schools of Public Health in the USA (7) also provide a thorough coverage of knowledge outcomes under the discipline-specific domains. This should be considered in the next iteration of Ethiopia's MPH core competencies.

The significant education and performance gaps across several public health competencies found in our study is concerning, but not surprising, in view of the traditional curricula and lack of practice opportunities in the public health system. Our findings are in agreement with global reports, which lamented concerns about the current state of public health education and provided recommendations for improving it. The Institute of Medicine report on education of public health professionals for the 21st century recommended additional competencies beyond the traditional content expertise (including, but not limited to, cultural competence, communication skills, policy and law, and public health ethics), practice rotations, and integrated teaching to prepare competent public health professionals (4). The influential *Lancet* article on the education of health professionals recognized that current education systems were not enabling graduates to address public health challenges of the 21st century, and called for instructional and institutional reforms (2). A survey of employers conducted by the Association of Schools of Public Health in the European Region reported significant gaps between current and desired levels of performance for all essential public health operations (16). A South African study reported that MPH students lacked confidence in some of the critical public health competencies, notably context-sensitive issues, planning and management, research and development, and leadership competencies (17). A perspective article from India described a number of challenges surrounding public health education, including traditional curricula, disconnect between academia and health systems, shortage of faculty, lack of structured faculty development program, and weak regulation (18).

The good news is that calls for reforming public health education are being heeded and Ethiopia can take lessons from the trailblazers. The Harvard School of Public Health adopted competency-based education with an emphasis on experiential learning, and three levels of learning (informative, formative and transformative) and integrated instructional design, which develop generic competencies along with discipline-specific expertise (19). Washington University designed an MPH program centered on transdisciplinary problem-solving that involves competency-based learning, partnerships and teaching innovations (20). Boston University revised its MPH curriculum to make it relevant, authentic and practical, notably via integrated courses and expanded practicums (21). Universities have also designed innovative competency-based Doctor of Public Health programs (22-24). The development of core competencies is also gaining momentum. Six schools teaching MPH programs have proposed core public health competencies for low- and middle-income countries (15). A consortium of South Asian universities has developed core competencies for monitoring and evaluating tracks in MPH programs (25). Professional core competencies have been proposed for health promotion in the European region (26). A national panel of experts in the USA has identified a broad range of cross-cutting competencies (such as communication, community health development, leadership, cultural competency, evaluation, and strategic planning) for the continuing education of health educators (27).

Appreciation of the need to assure and improve the quality of public health education has also led to the development of accreditation systems for public health schools and competency-based credentialing of graduates. The Council on Education for Public Health (CEPH) in the USA (28) and the Agency for Public Health Accreditation in Europe (29) accredit MPH programs. The USA has also established the National Board of Public Health Examiners for testing public health graduates (28). Accreditation of MPH programs is worth considering, as it can ensure education standards are met and stimulate continuous quality improvement in schools of public health. A national licensing examination should also be considered to verify that MPH graduates from different schools have

mastered the essential knowledge and skills relevant for the practice of public health in Ethiopia.

Limitations of this study

Our study has some important limitations. The first is that we did not apply a probabilistic sampling method to select study participants. However, we tried to improve representativeness by recruiting study participants from most regions of the country and covering public health professionals from practice, academia and research. The second limitation is our reliance on self-report to measure the key outcome variables. Self-report is exposed to social desirability bias, especially in measuring respondents' competence. However, we tried to mitigate this challenge by using a self-administered questionnaire and a more respectful question (how comfortable are you to do the task?) to elicit an honest answer. Recall bias is also a concern, especially in assessing the frequency of performance and location/timing of training.

Conclusions and Recommendations

This is the first attempt to validate core public health competencies in the country. The draft MPH core competencies were perceived relevant for Ethiopia. The endorsement of Ethiopian MPH core competencies would provide a common standard to design and evaluate public health education and practice. It goes without saying that the substantial education and performance gaps reported in this study warrant raising the standards of MPH education and practice. MPH education needs to be re-designed using a competency-driven model that incorporates the essential public health competencies and includes planned practice rotations in the public health system. Realization of this goal would require collaboration between the Ethiopian Public Health Association, schools of public health, Ministry of Health and other organizations implementing public health programs. It is also time to develop an accreditation and national licensing examination to assure and improve the quality of postgraduate public health education. Last but not least, continuing professional development for public health professionals should fill the education and capability gaps identified in this study.

References

1. World Health Organization. World health statistics 2019: monitoring health for the SDGs, sustainable development goals. Geneva: WHO; 2019.
2. Frenk J, Chen L, Bhutta ZA, Cohen J, Crisp N, Evans T, *et al.* Health professionals for a new century: Transforming education to strengthen health systems in an interdependent world. The Lancet. 2010;376(9756):1923-58.
3. Institute of Medicine (US). The future of public health. Committee for the Study of the Future of Public Health, Division of Health Care Services, Institute of Medicine; 1998.
4. Gebbie K, Rosenstock L, Hernandez LM (eds.). Who will keep the public healthy? Educating public health professionals for the 21st century. Institute of Medicine, Committee on Educating Public Health Professionals for the 21st Century; 2003.
5. Frank JR, Snell LS, Cate OT, Holmboe ES, Carraccio C, Swing SR, *et al.* Competency-based medical education: Theory to practice. Medical Teacher. 2010;32(8):638-45.
6. Council on Linkages between Academia and Public Health Practice. Core competencies for public health professionals version 2014. Council on Linkages between Academia and Public Health Practice; 2014. www.phf.org/resourcestools/Documents/Core_Competencies_for_Public_Health_Professionals_2014June.pdf
7. Calhoun JG, Ramiah K, Weist EM, Shortell SM. Development of a core competency model for the Master of Public Health degree. Am J Public Health. 2008;98:1598-1607.
8. Public Health Agency of Canada. Core competencies for public health in Canada. Release 1.0. Ottawa: Public Health Agency of Canada; 2007. https://www.canada.ca/content/dam/phac-aspc/documents/services/public-health-practice/skills-online/core-competencies-public-health-canada/cc-manual-eng090407.pdf
9. Birt C, Foldsbang A. European core competencies for public health professionals. ASPHER's European Public Health Core Competencies Program. Association of Schools of Public Health in the European Region; 2011.
10. Genat B, Robinson P, Parker E. Foundation competencies for Master of Public Health graduates in Australia. Australian Network of Academic Public Health Institutions (ANAPHI); 2009. http://caphia.com.au/documents/Competencies-MPH-Graduates-Australia-ANAPHI-2009.pdf
11. Public Health England. Public health skills and career framework. Public Health Resource Unit and Skills for Health. April 2008 (updated March 2009).
12. Ethiopian Public Health Institute (EPHI) and ICF. Ethiopia mini demographic and health survey 2019: key indicators. Rockville, Maryland, USA: EPHI and ICF; 2019.
13. World Health Organization. Global status report on non-communicable diseases 2010. Geneva: WHO; 2011.
14. Bransford JD, Brown AL, Cocking RR, Donovan MS, Bransford JD, Pellegrino JW, (eds.). How people learn: Brain, mind, experience, and school. Expanded edition. Committee on Developments in the Science of Learning and Committee on Learning Research and Educational Practice, Commission on Behavioral and Social Sciences and Education, National Research Council. National Academy of Sciences; 2000.
15. Zwanikken PAC, Alexander L, Huong NT, Qian X, Valladares LM, Mohamed NA, *et al.* Validation of public health competencies and impact variables for low- and middle-income countries. BMC Public Health. 2014;14:55.
16. Bjegovic-Mikanovic V, Otok R. Preparation of European public health professionals in the twenty-first century. Frontiers in Public Health. 2017;5(18):1-6.

17. Tshitangano TG. An exploratory study of the need for curriculum review of Master of Public Health degree at a rural-based University in South Africa. Afr J Prm Health Care Fam Med. 2016;8(2): a993.
18. Zodpey SP, Negandhi H, Yeravdekar R**.** Future directions for public health education reforms in India. Frontiers in Public Health. 2014;2(68)1-6.
19. Frenk J, Hunter DJ, Lapp I. A renewed vision for higher education in public health. Am J Public Health. 2015;105:S109-S113.
20. Lawlor EF, Kreuter MW, Sebert-Kuhlmann AK, McBride TD. Methodological innovations in public health education: Transdisciplinary problem solving. Am J Public Health. 2015;105:S99-S103.
21. Sullivan L, Galea S. A vision for graduate public health education (editorial). Journal of Public Health Management and Practice. 2017;23(6):553-5.
22. Berman P, Frenk J. The new Harvard Doctor of Public Health: Lessons from the design and implementation of an innovative program in advanced professional leadership. Public Health Reports. 2018;133(6):759-66.
23. Lenihan P, Welter C, Brandt-Rauf P, Neuberger B, Pinsker E, Petros M, *et al*. The University of Illinois at Chicago School of Public Health Doctor of Public Health program: An innovative approach to doctoral-level practice leadership development. Am J Public Health. 2015;105:S55-S59.
24. DeBate RD, Petersen DJ, Wathington D, Wolfe-Quintero K. Our practice is our passion: Development and delivery of a 21st-century Doctor of Public Health program. Am J Public Health. 2015;105:S27-S33.
25. Negandhi H, Negandhi P, Tiwari R, Sharma A, Zodpey S, Kulatilaka H, Tikyani S. Developing core competencies for monitoring and evaluation tracks in South Asian MPH programs. BMC Medical Education. 2015;15:126.
26. Mereu A, Sotgiu A, Buja A, Casuccio A, Cecconi R, Fabiani L, *et al.* The Health Promotion Working Group of the Italian Society of Hygiene, Preventive Medicine and Public Health (SItI). Professional competencies in health promotion and public health: What is common and what is specific? Review of the European debate and perspectives for professional development. Epidemiol Prev. 2015; 39(4 Suppl 1):33-8.
27. Allegrante JP, Moon RW, Auld ME, Gebbie KM. Continuing-education needs of the currently employed public health education workforce. Am J Public Health. 2001;91:1230-4.
28. Council on Education for Public Health. Organizational info & policies [home page on the internet]. c. 2018 [cited 12 March 2019]. https://ceph.org/about/org-info/
29. Agency for Public Health Education Accreditation. History of APHEA & European Public Health Accreditation [home page on the internet]. c. 2014 [cited 12 March 2019]. www.aphea.be/Pages/A1.ABOUT/History.html
30. Gebbie K, Goldstein BD, Gregorio DI, Tsou W, Buffler P, Petersen D, *et al.* The National Board of Public Health Examiners: Credentialing public health graduates. Public Health Reports. 2007;122:435-40.