ELSEVIER

From the American College of Epidemology

Competencies acquired in epidemiology doctoral programs

WayWay M. Hlaing, PhD, MS, MBBS, FACE *

Division of Epidemiology and Population Health Sciences, Department of Public Health Sciences, Miller School of Medicine, University of Miami, Miami, FL

ARTICLE INFO

ABSTRACT

Purpose: The purpose of the study was to compile and describe the range of competencies imparted by doctoral programs in epidemiology using publicly available information.
Methods: Through the Council on Education for Public Health database, institutions conferring doctoral (PhD, ScD, DrPH) degrees in epidemiology were identified. The competencies listed on the corresponding institutions' websites were extracted and summarized.
Results: Forty-eight PhD and thirteen DrPH institutions indicate that their graduates will gain 11 common competencies. The most frequently noted competency for both PhD (93.7%) and DrPH (100%) degrees is related to the communication domain, reflecting the need for graduates to be able to effectively communicate epidemiologic information to others (epidemiology peers, other scientists, policy makers, students).
Conclusions: Although variations in the listed competencies exist among doctoral programs in epidemiology, there are common competencies across programs. Further examination of these programs is required to capture information beyond that conveyed on the websites. This preliminary report, along with those findings presented in previous reports on doctoral education, may stimulate further discussion with a group of faculty teaching at the doctoral level, employers of doctoral graduates, and/or the Association of Schools and Programs of Public Health representatives.

Introduction

Epidemiology as a discipline is evolving in its concepts and principles. As epidemiology is the core component of public health (PH), education in this field is continually being reexamined (as it should) to ensure that learners receive appropriate training and become competent epidemiologists on graduation, ready to join the PH workforce [1,2].

A competency-based approach to teaching has been used in PH education. In this context, competency is defined as an active statement describing what the learner will be able to do after completion of an educational program such as PhD in Epidemiology [3,4]. It is a cluster of related knowledge, essential skills, and abilities important for job performance [5].

Epidemiology competencies at different levels

Parallel to teaching the ever-changing subject of epidemiology, an important educational movement aims to initiate epidemiology teaching early in life. Some early education initiatives are either completed [6] or are still in development [7,8]. The epidemiology instruction at the secondary school level [9] and undergraduate epidemiology courses are increasingly being taught with the aim of imparting specific competencies [10–12].

For the Master's level, competencies have been developed, modified, and revised by the Association of Schools and Programs of Public Health (ASPPH) [13]. In addition, applied epidemiology competencies have been developed to link academic curricula with PH practice [14].

As the voice representing SPPH accredited by the Council on Education for Public Health (CEPH), ASPPH currently has two degree-specific councils—Master of Public Health (MPH) and Doctor of Public Health (DrPH) [15]. Available evidence indicates that 54 DrPH competencies across seven domains are specified for general (i.e., not discipline specific) degree [16,17].

Although clear competency sets are outlined for the MPH and DrPH graduates, competencies pertaining specifically to research/science-focused (PhD/ScD) degrees in epidemiology are presently not defined by the ASPPH. Sponsored by the American College of Epidemiology (ACE) and ASPH (the former name of ASPPH), a workshop was convened in 2002 to improve doctoral education in epidemiology. The workshop report summarized 12 core domain areas, with 30 core competencies, 7 additional

* Corresponding author. Department of Public Health Sciences, University of Miami, 1120 NW 14th Street (R-669), DSCRC – Suite 914, Miami, FL 33136. Tel.: +1 305 243 3693; fax: +1 305 243 3051.
E-mail address: whlaing@med.miami.edu.

competencies for research, and 7 suggested competencies for PH practice [18].

Since the 2002 ACE/ASPH workshop, a number of published reports relating to doctoral-level competencies have emerged. The Education Committee of the ACE conducted a survey of established epidemiologists and recent masters and doctoral graduates representing various work settings. They identified 17 important/very important and 8 unimportant competencies for all those who earned postgraduate degrees in epidemiology [19]. In recent reports, Brownson et al [1,2] outlined 12 macro trends and corresponding educational competencies that should be included in the training of future epidemiologists and PH professionals. These reports were generated based on a consensus of 12 senior epidemiologists employed in diverse work settings, as well as the findings of 15 key informant interviews with experienced epidemiologists. Although these competencies were pertinent to doctoral-level students, they should be applicable to all levels of graduate training, while also being relevant for researchers and practitioners that have already joined the workforce [1,2]. Baseline information on doctoral epidemiology education at program level is thus warranted. To meet this objective, in this work, the competencies pertinent to the doctoral epidemiology programs of accredited SPPHs are examined.

Methods

Through the CEPH database, institutions conferring doctoral (PhD, ScD, DrPH) degree in epidemiology were identified during Fall 2017 and Spring 2018. The competencies that should be imparted by each doctoral program listed on the corresponding institution's website were examined.

A list of competencies was previously compiled by the author using the ACE/ASPH document [18], and the lists from well-established PhD programs in the United States, along with consultation with other epidemiology faculty within and outside the author's institution. The author-compiled list is termed the main list hereafter. Two graduate assistants (GAs) in MPH programs were trained regarding domains and competencies. Work was carried out by both GAs on website search, information download, and entry into Excel file. Both GAs independently compared the competency list from the same five programs with a main list of competencies. They were asked to note the competencies that are similar to and other competencies that are not in the main list. The author checked both GAs' work and made the final decision if there were any discrepancies.

Via the CEPH website, the search terms (degree: "PhD" and concentration: "Epidemiology") were selected from the drop-down menu on the query page (https://ceph.org/accredited/search/) to identify accredited SPPHs. The same queries were repeated for "ScD" and "DrPH" degrees with "Epidemiology" focus.

If an institution offered multiple degrees (e.g., PhD and DrPH), competencies related to both degrees were examined. The lists of PhD and ScD institutions were combined, as there was only one ScD conferring institution that also offered a PhD.

Eligibility

All institutions conferring a doctoral (PhD, ScD, DrPH) degree in epidemiology in the CEPH query database were eligible for this report. Institutions that posted information in languages other than English were excluded. If an institution offered more than one specialization or track, it was counted only once. For example, if an institution offered four tracks (cancer, environmental, infectious disease, and general epidemiology), it appeared as four programs in CEPH database, but it was counted as one general epidemiology

program in this project. If an institution offered "specific" specialization (e.g., chronic disease and infectious disease epidemiology) and did not offer a general epidemiology degree, general competencies not relating to chronic or infectious diseases were extracted.

Information extracted

The list of competencies for a doctoral degree in general epidemiology was extracted. Each program's competencies were compared with the main list of competencies.

The same competencies were described differently in relation to various programs, thus, similarly worded competencies within a related domain area (domains described in the ACE/ASPH workshop summary [18]) were used to determine the frequency presented in this report.

Results

Sixty-six institutions/universities offered 86 (69 PhD, 16 DrPH, and 1 ScD) doctoral degree programs with focus on epidemiology. However, there were no competencies for 3 of the 16 DrPH programs. For PhD, after exclusion of programs with non-English websites ($n = 3$), multiple programs from a single institution (i.e., 4 institutions collectively offer 16 epidemiology tracks in total, but only 4 relating to general epidemiology track are included and 12 specific epidemiology tracks are not examined), and missing competency information ($n = 6$) and competency results from 48 PhD programs were examined further. If more than 50% of PhD programs list a specific competency, it is considered a common competency across programs in this report.

Although general DrPH competency model was documented by the ASPPH [17], institutions discussed in this report offer DrPH with specialization in epidemiology. Thus, common competencies that students are meant to develop on completion of the epidemiology PhD program (Table 1) were also examined for DrPH in epidemiology program. Some common competencies that are imparted by PhD programs may not be considered relevant for DrPH programs.

The list of 11 common competencies from PhD and DrPH programs is provided in Table 1. Although there were variations in the wording of competency statements, domains captured in each competency were the same. Specific domains captured in these 11 statements were descriptive epidemiology, biology, ethics, study designs, data collection and monitoring, data management and analysis, communication, and substantive area. For over 73% of programs, all three competencies (those listed under No. 8, 9, and 10 in Table 1) relating to the communication domain are included. Only 23% and 38% of DrPH institutions emphasized competencies relating to pathophysiology/descriptive epidemiology (No. 6) and substantive area (No. 11), respectively.

Discussion

This is a preliminary review of the information publicly available from the official websites of CEPH-accredited SPPHs. It presents 11 competencies that are common to all examined doctoral degree conferring institutions. Only 9 of the 11 competencies that PhD programs are envisaged to impart on the graduates are deemed common (>50%) in DrPH programs. However, there are a considerably greater number of competencies beyond those shown in Table 1.

Competency statement 2 relates to both study designs and validity of the results; for some programs, a specific statement for designs and validity is provided separately. Examples of some paraphrased statements not shown in Table 1 are the following:

Table 1
Number and percentage of institutions that offer PhD and DrPH in epidemiology programs by competencies

	Competency statements	PhD (n = 48)		DrPH (n = 13)	
		n	%	n	%
1	Recognize potential ethical issues and address/implement the concepts of ethical conduct of research in epidemiologic studies.	40	83.33	10	76.92
2	Design epidemiologic studies applying sound methodology and strategies to assess the threats to validity of results.	37	77.08	12	92.31
3	Develop, validate, and implement data collection methods and tools needed for performing epidemiology investigations.	38	79.17	10	76.92
4	Apply quantitative and reasoning skills and content-area knowledge to analyze data from epidemiological studies systematically.	41	85.42	10	76.92
5	Use the application of statistical methods that are critical to epidemiologic inquiry; manage, manipulate, and analyze data using statistical software packages; interpret data appropriately.	33	68.75	9	69.23
6	Identify major public health problems, their general pathophysiology, descriptive epidemiology, and associated risk factors.	29	60.42	3	23.08
7	Critically evaluate scientific literature and synthesize the outcomes across studies, balancing limitations and contributions of each study.	42	87.50	8	61.54
8	Articulate research questions that advance scientific knowledge; originate, design, and develop new inquiries worthy of research support.	35	72.92	10	76.92
9	Present data at academic and professional meetings and submit scientific articles for publication in high-impact peer-reviewed journals.	35	72.92	13	100.00
10	Convey epidemiologic concepts to students and peers; effectively communicate epidemiologic information to scientists, policy makers, and the public.	45	93.75	13	100.00
11	Conduct an advanced original research project and demonstrate mastery of the topic area.	38	79.17	5	38.46

No competencies were listed for 6 PhD programs and 3 DrPH programs.

1. Be able to select and plan new or traditional study designs based on a research question.
2. Be able to identify threats to study validity (e.g., using causal diagrams) and approaches to minimize such threats.
   In addition, some institutions include competencies relating to macro trends [2] or topics discussed in recent epidemiology organization meetings. Several such examples are given in the following:
3. Understand and apply emerging technologies in other fields (e.g., genomics, information sciences etc.) in the study of diseases.
4. Be able to use evidence from epidemiologic data and apply it in policy, practice, and program developments or recommendations (i.e., translational epidemiology).
   Furthermore, the choice of specific versus general competencies also varied across programs. Some specific competency examples are given in the following:
5. Be able to distinguish effect modification and interaction.
6. Be able to estimate the sample size required for testing a specific research hypothesis.
   Finally, other competencies that are not included in Table 1 but are worthy of mentioning here, and possibly adopting by educational institutions, are given in the following:
7. Provide consultation to nonepidemiologists in conducting epidemiological research.
8. Manage and guide research personnel regarding project management, research, and administrative tasks.

Other competencies this author deems critical and others have found highly relevant [20,21] pertain to primary data collection skills. Although teaching competencies tend to be general, more specific competencies such as syllabus and learning objectives development may be considered if they align with students' career goals.

Some limitations of this preliminary report should be noted. First, unaccredited institutions or those that are under accreditation reviews during the website inquiry phase, and those with non-English websites, were not represented. Furthermore, institutions that offer epidemiology-related degrees under a different title (e.g., PhD in Population Health Sciences, Epidemiology, and Translational Science) may not be captured in the CEPH database, access to which is limited by the drop-down query terms.

Second, this report contains only a limited set of core competencies listed on the institutions' websites, although other valuable competencies may be addressed in the program. In addition, competency alignment was defined crudely (yes or no) for this report. Third, this report does not include other important differences that may affect doctoral education (e.g., linkage of competencies to coursework within the program, faculty size and expertise, course offerings, graduates' success in gaining employment, and so forth). Other program-related information (e.g., number of credit hours relating to epidemiology vs. nonepidemiology courses, content and format of doctoral qualifying examinations, and so forth) is not reported and may be added if further detailed information can be obtained at a later date.

Conclusions

Common competencies, along with a selection of those that are less common, that doctoral programs are expected to impart on the graduates were presented. Some important competencies and topics (e.g., big data) in the evolving field of epidemiology [1,2,22] were absent from the lists offered by the selected institutions. It should, however, be noted that this review is not intended to provide an exhaustive list of competencies nor program-related information.

Implications for teaching

Although competencies in specialized epidemiology (e.g., genetics epidemiology) programs are expected to be more focused, establishing a "unified general core competency list" for doctoral programs in epidemiology may be beneficial not only for the trainees but also for trainers/teachers of epidemiology.

Next step

This report provides a list of competencies that doctoral epidemiology programs are expected to impart at a program level.

Reports relating to epidemiology education have also been summarized at an individual epidemiologist level [1,2,19].

Hence, the aim of this report is to prompt a continuation of a constructive dialog among teachers/program directors of epidemiology doctoral programs and other stakeholders (e.g., employers, ASPPH staff). The next step is to plan a more effective way to capture detailed doctoral program information rather than relying on the information available on the websites.

Acknowledgment

References

[1] Brownson RC, Samet JM, Bensyl DM. Applied epidemiology and public health: are we training the future generations appropriately? Ann Epidemiol 2017;27(2):77—82.

[2] Brownson RC, Samet JM, Chavez GF, Davies MM, Galea S, Hiatt RA, et al. Charting a future for epidemiologic training. Ann Epidemiol 2015;25(6):458—65.

[3] Public Health Service. The public health workforce: an agenda for the 21st century, a report of the public health functions project. Washington, DC: United States Health and Human Services (USDHHS), National Government Publication; 1997.

[4] Armenian H, Thompson ME, Samet J. Chapter 30: competency-based curriculum in epidemiology. In: Olsen J, Saracci R, Trichopoulos D, editors. Teaching epidemiology: a guide for teachers in epidemiology, public health and clinical medicine. 3rd ed. Oxford, UK: Oxford University Press; 2010.

[5] Parry SB. Just what is a competency (and why should we care?). Training 1996;35(6):58—64.

[6] Kaelin MA, Huebner WW, Cordell RL, Szklarczur B. Professional development for prospective epidemiology teachers in grades 6-12. Public Health Rep 2008;123(Suppl 2):5—11.

[7] Cordell RL, Cordeira KL, Cohen LP, Bensyl DM. Building the pipeline: programs to introduce middle school, high school, medical, and veterinary students to careers in epidemiology and public health. Ann Epidemiol 2017;27(11):752—5.

[8] Centers for Disease Control, Prevention (CDC). Epidemiology and public health science: core competencies for high school students. Atlanta, GA: US Department of Health and Human Services (USDHHS), CDC; 2015. https://www.cdc.gov/careerpaths/k12teacherroadmap/pdfs/ephs-competencies.pdf. [Accessed 5 July 2018].

[9] National Research Council. A framework for K-12 science education: practices, crosscutting concepts, and core ideas. In: Committee on a conceptual framework for new K-12 science education standards. Board on science education, division of behavioral and social sciences and education. Washington, DC: The National Academies Press; 2012. http://www.sciepub.com/reference/255206. [Accessed 5 July 2018].

[10] Goldmann E, Stark JH, Kapadia F, McQueen MB. Teaching epidemiology at the undergraduate level: considerations and approaches. Am J Epidemiol 2018;187(6):1143—8.

[11] Leider JP, Castrucci BC, Plepys CM, Blakely C, Burke E, Sprague JB. Characterizing the growth of the undergraduate public health major: U.S., 1992-2012. Public Health Rep 2015;130(1):104—13.

[12] Resnick B, Selig S, Riegelman R. An examination of the growing US undergraduate public health movement. Public Health Rev 2017;38:4.

[13] Association of Schools, Programs of Public Health (ASPPH). MPH core competency model. http://www.aspph.org/teach-research/models/mph-competency-model. [Accessed 5 July 2018].

[14] Association of Schools of Public Health (ASPH), Centers for Disease Control and Prevention (CDC), Council for State and Territorial Epidemiologists (CSTE). Applied epidemiology competencies curriculum and practicum project. In: Task Force Report. Washington, DC: ASPH, CDC, CSTE; 2008.

[15] Association of Schools, Programs of Public Health (ASPPH). ASPPH councils. https://www.aspph.org/about/. [Accessed 20 June 2018].

[16] Association of Schools of Public Health (ASPH), ASPH Education Committee. Doctor of Public Health (DrPH) core competency model version 1.3. 2009. https://s3.amazonaws.com/aspph-wp-production/app/uploads/2014/04/DrPHVersion1-3.pdf. [Accessed 20 June 2018].

[17] Calhoun JG, McElligott JE, Weist EM, Raczynski JM. Core competencies for doctoral education in public health. Am J Public Health 2012;102(1):22—9.

[18] Samet J, Stoto M, Arcari C, editors. Workshop summary: ACE/ASPH workshop on doctoral education in epidemiology. Baltimore, MD: Association of Schools of Public Health; 2002.

[19] Brunner Huber LR, Fennie K, Patterson H. Competencies for master and doctoral students in epidemiology: what is important, what is unimportant, and where is the room for improvement? Ann Epidemiol 2015;25:466—8.

[20] Buring JE. Primary Data Collection: what should well-trained epidemiology doctoral student be able to do? Epidemiology 2008;19(2):347—9.

[21] Samet JM, Savitz DA. Education in epidemiology. "The times they are a-changin" (Commentary). Epidemiology 2008;19(2):345—6.

[22] Hiatt RA, Sulsky S, Aldrich MA, Krieger N, Rothenberg R. Promoting innovation and creativity in epidemiology for the 21st century. Ann Epidemiol 2013;23:452—4.