Knowledge of public health informatics among Italian medical residents: design and preliminary validation of a questionnaire

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ABSTRACT

Background: public health requires strong information skills and competencies, as it is information-intensive and information-driven. Public health informatics has been defined as the "systematic application of information, computer science, and technology to public health practice, research, and learning". New information and communication technologies offer unprecedented opportunities, such as linking smart-phones and mobiles devices to web based tools for data collection, enabling and enhancing participatory epidemiology. However, being an emerging discipline, despite its potential and importance, public health informatics is often neglected and overlooked, being rarely offered as course. The present study was designed as a pilot study, with the aim of designing and validating a questionnaire on the knowledge of public health informatics among medical residents in public health in Italy.
Methods and Results: thirty-two Italian residents in public health volunteered to take part into the study. Mean age of the sample was 31.44±2.23 years, most responders were males (68.8%), from northern Italy (53.1%), at the third year of residency (34.4%) and currently doing practical training at the clinical management staff/hospital directorate (34.4%). Other places of training were the Prevention Department (21.9%), the Institute of Hygiene (18.8%), the local health units and the territory (12.5%), the occupational health service (6.3%) and the Regional Health Agency (3.1%). Cronbach's alpha coefficient yielded a value of 0.909, demonstrating excellent psychometric properties of the instrument.
Conclusion: in conclusion, the developed questionnaire seems to be an appropriate and useful tool to detect gaps concerning knowledge, education and practices of public health informatics among residents in public health.

Key words: public health informatics; public health practice; survey; design and validation of questionnaire

INTRODUCTION

Public health requires strong information skills and competencies, as it is information-intensive and information-driven [1-3]. Public health informatics is the "systematic application of information, computer science, and technology to public health practice, research, and learning" [4]. More specifically, according to the American Medical Informatics Association (AMIA), public health informatics can be defined as "the application of informatics in areas of public health, including surveillance, prevention, preparedness, and health promotion" [5].

While, during the Public Health training, there is a strong focus on traditional topics such as health management, health promotion, hygiene, epidemiology, and environmental health, there is a lack of awareness concerning other emerging topics. These include applied medical informatics, computing and technology skills, both theoretical and practical, that are required to become a specialist in Public Health. Therefore, a clear definition of the demanded operative competencies and the relative training in Public Health Informatics is highly needed. Indeed, these skills are necessary to make informed decisions regarding software, technologies and data managing.

Recently, a working group of the Centers for Disease Control and Prevention (CDC) [6] has identified three major categories of informatics competencies: namely, (a) the use of information per se for public health practice; (b) the use of information technology to increase one's individual effectiveness as a public health professional and (c) the management of information technology projects to improve the effectiveness of the public health enterprise.

New information and communication technologies offer unprecedented opportunities, such as linking smart-phones and mobiles devices to web based tools for data collection and enabling and enhancing participatory epidemiology [7,8]. Social media and other smart-phones based applications can be exploited for communicating and interacting with physicians and other healthcare providers, as well as for more effectively counteracting, preventing and managing chronic-degenerative diseases [9].

However, being an emerging discipline, despite its potential, public health informatics is often neglected and overlooked, being rarely offered as course.

The present study was implemented as a pilot study, with the aim of designing and validating a questionnaire on the knowledge and attitudes of public health informatics among Medical residents in Public Health in Italy.

METHODS

Items development and selection

The questionnaire comprised of 58 items, distributed in five sections: namely, section A (general questions related to age, gender, year of residency, current training; 8 items), section B (availability of computational tools and devices at workstation; 9 items), section C (individual propensity to use mobile, social networks and the internet; 2 items), section D (education; 10 items) and section E (self-rated assessment of knowledge, competencies and practices of public health informatics; 29 items).

For four items (namely, "Which software is your workplace equipped with?"; "Which applications or services, listed below, do you use for professional purposes?"; "Which social media, listed below, do you use for professional purposes?"; and "For which software, listed below, do you have received a specific education?"), more than one answer was possible.

The final three questions of section D were on a Likert-type scale of one to four, whereas all the items of section E were on a Likert-type scale of one to five. For all the other questions, responders had to choose only one item among those given (it was not possible to input free text; specifically, the questions were multiple-choice items).

The items were designed systematically searching the existing scholarly literature on the topic, using PubMed/MEDLINE, Scopus and ISI/Web of Science as databases and a proper string of keywords such as "public health informatics", "survey", "questionnaire", "knowledge", "skills" and "competencies". Since no instruments specifically investigating the public health informatics knowledge and skills could be found in Italian language, we started elaborating on the list of competencies in public health informatics originally developed by the CDC in August 2002, then updated in 2009 [6]. The CDC list instituted a new kind of professional: the Public Health Informatician. Another list of core skills and competencies that informed the items of our questionnaire was prepared in 2014 by the Council on Linkages Between Academia and Public Health Practice [10].

Our aim was not to investigate advanced and sophisticated levels of knowledge of public health informatics, but those core and basic skills that are considered to be of crucial and fundamental importance for future healthcare professionals.

The survey received the scientific support from the Italian Society of Hygiene, Preventive Medicine and Public Health (SITI) through the working group of Italian Medical Residents on Public Health Informatics. This working group comprised of 50 residents, all of which were contacted.

Administration of the questionnaire

The questionnaire was administered as an online survey, exploiting EUSurvey (https://ec.europa.eu/eusurvey/home/welcome), which is a freely available online survey management system for creating and publishing forms, launched in 2013. EUSurvey is the European Commission's official survey management tool

[10]. In order to verify the validity and reliability of the questionnaire, we administered the survey to a sample of Italian medical residents in Public Health Postgraduate Schools. The questionnaire was anonymous, self-administered and voluntary-based.

Validation of the questionnaire

The validation process took place in February 2018.

Validity and internal consistency were measured computing the Cronbach's alpha coefficient, using the following formula:

$$\alpha = \frac{K}{K-1} \cdot 1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_X^2}$$

where K is the number of items of the questionnaire σ^2_X, the variance of the observed total score, and σ^2_Y the variance of component *i* for the current sample of participants. The Cronbach's alpha coefficient enables the computation of how a given set of items are closely related to one another as a group.

Magnitude of the coefficient was interpreted using the following criteria: reliability was deemed poor if the coefficient was in the range 0.5-0.6, questionable for values in the range 0.6-0.7, acceptable from 0.7 to 0.8, good from 0.8 to 0.9, and excellent if greater than 0.9.

Statistical analysis

Continuous data was computed as means and standard deviations, whereas categorical data was expressed as percentages, where appropriate.

All statistical analyses (handling, pre-processing of data, and computation of the Cronbach's alpha coefficient) were performed using the commercial software "Statistical Package for the Social Sciences" (SPSS for Windows, version 21.0.0, IBM Corporation, Armonk, NY, USA).

RESULTS

The main findings from this pilot study are pictorially shown in Figure 1. Thirty-two Italian residents in public health volunteered to take part into the study (response rate 64.0%). Mean age of the sample was 31.44±2.23 years; most responders were males (68.8%), from northern Italy (53.1%), at the third year of residency (34.4%) and currently doing practical training at the clinical management staff/hospital directorate (34.4%). Other places of training were the Prevention Department (21.9%), the Institute of Hygiene (18.8%), local health authorities and the territory (that is to say, local health districts, 12.5%), the occupational health service (6.3%) and the Regional Health Agency (3.1%). The period of time spent in the current place of training was greater than 12 months for 40.6% of the responders. At the moment of the survey administration, most participants (90.6%) had spent a period of training in one of the National Health Services. Further details are shown in Table 1.

Computers and printers were available in 65.6% and 87.5% of cases, respectively. Only 3.1% of responders had to exclusively use a personal laptop for working activities. Computers were generally equipped with statistical software (Stata in 31.3% of cases, EpiInfo in 18.8% of cases, SAS and, SPSS in 9.4% of cases, and R only in 3.1% of cases), even though this was not present in every workstation in 40.6% of cases.

TABLE 1. Major characteristics of the recruited sample

Socio-demographic parameter	Value
Age	31.44±2.23; 32 [27-35]
Sex	
Male	22 (68.8%)
Female	10 (31.2%)
Year of residency	
1	3 (9.4%)
2	9 (28.1%)
3	11 (34.4%)
4	6 (18.8%)
5	3 (9.4%)
Geographic area of the School of Specialization	
Northern Italy	17 (53.1%)
Central Italy	5 (15.6%)
Southern Italy	10 (31.3%)
Period of training spent in one of the National Health Services	
Yes	29 (90.6%)
No	3 (9.4%)
Current place of training	
Prevention department	7 (21.9%)
Clinical management staff/hospital directorate	11 (34.4%)
Institute of Hygiene	6 (18.8%)
Local health units and territory (local health districts)	4 (12.5%)
Occupational health service	2 (6.3%)
Regional Health Agency	1 (3.1%)
Abroad	1 (3.1%)
Period of time spent in the current place of training	
1-3 months	12 (37.5%)
4-6 months	3 (9.4%)
7-9 months	2 (6.3%)
9-12 months	2 (6.3%)
>12 months	13 (40.6%)

The internet connection was available in majority of cases (78.1%), but was deemed inadequate in 21.9% of cases. Approximately 63% of responders reported to have a personal account to access the workstation. An updated browser was available in 75% of cases. A reference figure for troubleshooting was available in 62.5% of cases.

While 96.9% of responders had a smart-phone and/or a tablet, 62.5% used mobile apps and tablet for professional purposes, whereas 53.1% of the participants did not use social media for professional purposes. More in detail, 59.4% of responders used email and messenger services, 43.8% reference sites (such as guidelines, e-books, up-to-date, MedScape), 46.9% cloud storage services (like Google drive, Dropbox, One Drive or iCloud), 40.6% online encyclopedias (such as Wikipedia), 43.8% search engines for life/biomedical sciences (such as PubMed/MEDLINE or Google Scholar), 40.6% tools for planned commitments and reminders (agenda, notes), 31.3% medical scientific news sites (like News Medscape or Science Daily), and 21.9% tools for collaborative working (for instance, Google docs, Office 365 or Zoho). Noteworthy, only 9.4% and 3.1% of responders utilized applications/tools for statistical analysis (EpiInfo, EpiCalc, OpenEpi) and telemedicine services, respectively.

The most utilized social media were social networks (like Facebook, Twitter, Periscope, Google Plus, Snapchat, or MySpace; 43.8%), professional networking sites (such as LinkedIn, ResearchGate, or Academia.edu; 28.1%), media sharing platforms (like Youtube, Slideshare, Periscope or Snapchat; 15.6%) and content production platforms (such as blogs or Wikis; 3.1%).

Only, 28.1% and 21.9% of responders had attended a course related to computer science and its applications in public health (deemed poor, sufficient, average and good by 3.1%, 9.4%, 6.3%, 9.4% of responders respectively) or a course related to biostatistics (considered average or good by 9.4% and 12.5% of responders), respectively, on their own. The informatics course was attended less than 1 year ago by 12.5% of participants, 1-3 years ago and more than 5 years ago by 9.4% and 6.3% of responders, respectively. The course led to certifications (12.5% of the total sample). In the case of lectures on statistical software, this was R (28.1% of cases), Stata (21.9% of cases), SPSS (18.8% of responses) and EpiInfo (9.4% of responses). The biostatistics lectures were attended less than 1 year ago by 6.3% of participants, 1-3 years by 12.5% of subjects and more than 5 years ago in 3.1% of cases. The biostatistics course with tutorial on statistical software was deemed poor by 3.1% of responders, as well as good (3.1%) and excellent (3.1%). Approximately 6% of participants had attended it less than 1 year ago, with 3.1% of the sample having attended it 1-3 years ago.

A biostatistics course (without and with hands-on lectures with statistical software practice) was offered during the residency in 78.1% of cases (59.4% included training with a statistical software). These courses were judged poor and sufficient by 18.8% (18.8%) and 12.5% (9.4%) of responders, respectively. Average and good were given as replies by 18.8% (6.3%) and 15.6% (12.5%) of participants. Approximately 9% of responders found the courses excellent.

However, a general course on computer science and its applications in Public Health was not offered in 59.4% of cases. Those responders who had attended the course deemed it poor in 12.5% of cases and sufficient in 9.4% of cases. Approximately 3% of participants judged it average, good and excellent, respectively.

When asked to rate public health informatics knowledge and competencies of colleagues, these were deemed poor and sufficient in 3.1% and 34.4% of cases, respectively. Approximately thirty-one percent of the participants judged them average, whereas they were considered good and excellent by 25.0% and 6.3% of responders, respectively. For more details, the reader is referred to Table 2.

DISCUSSION

To the best of our knowledge, this is the first instrument available in Italian language that investigates, among public health practitioners, the perceived acquired skills, the availability of updated informatics tools and devices at the workplace, as well as the personal attitudes to mobile technology and the satisfaction for the received computer science/biostatistics education.

Acquiring solid health informatics skills during medical studies is of crucial importance. For instance, in Denmark, Dørup [12] recruited a sample of 1,159 medical students: 71.7% of them had access to a computer at home, approximately 90% and 80% used e-mail and the Internet regularly, respectively. About 60% reported access to the Internet from home. More males than females had access to a computer at home and had a more positive attitude towards the use of computer. Our preliminary data are perfectly in line with these data, indicating that the adoption of new information and communication technologies by medical residents is relatively widespread and common. However, there are some gaps, such as the low use of social media for professional purposes, of telemedicine services and, noteworthy, of open-source instruments and tools, such as R.

For specialists, having informatics expertise is even more urgent and fundamental. Richards [13] interviewed a representative sample of 40 public health academicians from 40 schools and graduate programs of public health in the Unites States. There was a consensus that informatics was needed and represented an important asset for public health practice.

Walpole and collaborators [14] interviewed 23 United Kingdom medical schools. 17% of respondents felt there was little or no health informatics training with a highly heterogeneous array of pedagogies used to teach health informatics, content and timing across schools. Even though the teaching of health informatics was integrated vertically and horizontally across the curriculum, assessment and updates were limited. Furthermore, a low level of confidence among students to use health informatics as doctors was reported in 32% of cases.

Once again, our data are consistent with these findings from the literature. When asked to rate public health informatics knowledge and competencies of

TABLE 2. List of multiple-choice items.

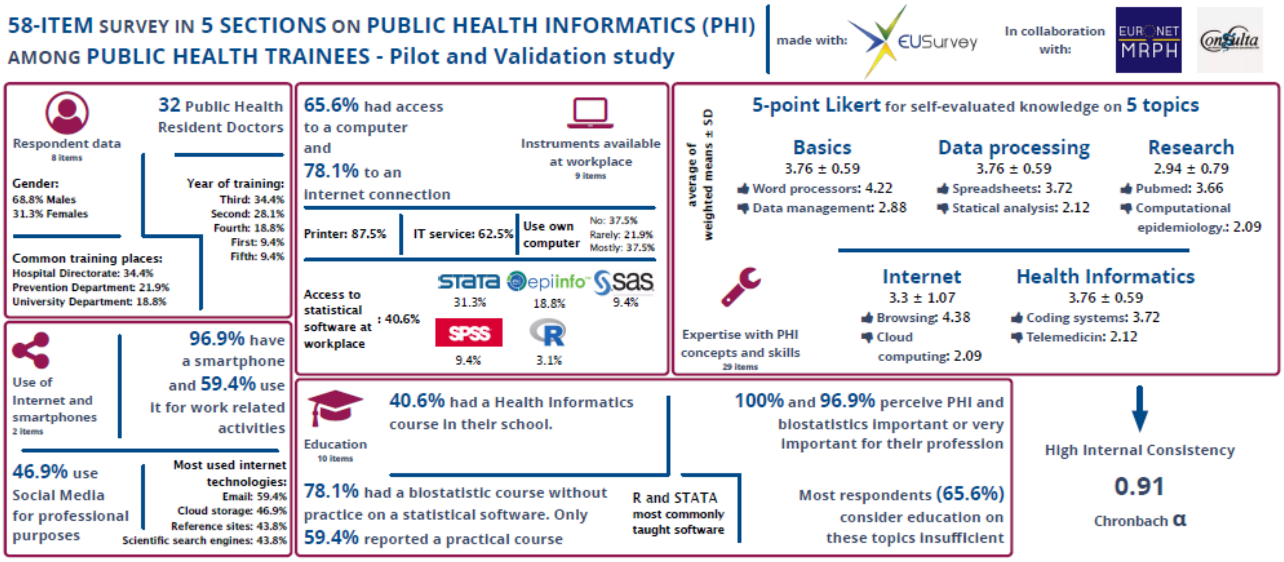
Item		Response
Availability of computer		
	Yes	21 (65.6%)
	Yes but inadequate	11 (34.4%)
Availability of printer		
	Yes	28 (87.5%)
	Yes but inadequate	3 (9.4%)
	No	1 (3.1%)
Personal account to access the workstation		
	Yes	20 (62.5%)
	No	12 (37.5%)
Internet connection		
	Yes	25 (78.1%)
	Yes but inadequate	7 (21.9%)
Updated browser		
	Yes	24 (75.0%)
	Yes but inadequate	6 (18.7%)
	No	2 (6.3%)
Reference figure for troubleshooting		
	Yes	20 (62.5%)
	Yes but inadequate	8 (25.0%)
	No	4 (12.5%)
Use of personal laptop for working activities		
	Yes rarely	7 (21.9%)
	Yes most of time	12 (37.5%)
	Yes only mine	1 (3.1%)
	No	12 (37.5%)
Presence of statistical software in the workplace		
	Yes but not in every workstation	13 (40.6%)
	Not at all	10 (31.3%)
	Don't know	9 (28.1%)
Ownership of smart-phone and/or tablet		
	Yes	31 (96.9%)
	No	1 (3.1%)
Use of mobile apps and tablet for professional purposes		
	Yes	20 (62.5%)
	No	12 (37.5%)
Use of social media for professional purposes		
	Yes	15 (46.9%)
	No	17 (53.1%)
Public health informatics competencies of colleagues		
	Poor	1 (3.1%)
	Sufficient	11 (34.4%)
	Average	10 (31.3%)
	Good	8 (25.0%)
	Excellent	2 (6.3%)
General course of computer science and its applications in Public Health offered during residency		
	Yes	13 (40.6%)
	No	19 (59.4%)
Biostatistics course offered during residency		
	Yes	25 - 19 with statistical software (78.1% - 59.4%)
	No	7 (21.9%)
Course related to computer science and its applications in Public Health attended at one's own expenses		
	Yes	9 (28.1%)
	No	23 (71.9%)
Biostatistics course attended at one's own expenses		
	Yes	7 – 3 with statistical software (21.9% - 9.4%)
	No	25 (78.1%)

The Cronbach's alpha coefficient yielded a value of 0.909, demonstrating excellent psychometric properties of the instrument. Table 3 reports the items and the respective changes in the Cronbach's alpha coefficient for each item deleted: only for 4 items, deleting the item resulted in a higher coefficient, indicating the validity of the theoretical structure of the questionnaire.

TABLE 3. List of items on a Likert-scale and changes in Cronbach's alpha coefficient in case of item deletion.

Item	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
How much do you think that the computer science competencies are important for a Public Health Professional	97.25	299.41	0.387	0.908
How much do you think that the statistical/biostatistical competencies are important for a Public Health Professional	97.42	306.51	-0.022	0.911
How much do you think that the education and the training have contributed to your current competencies in Public Health Informatics	98.33	298.58	0.293	0.908
Basic skills				
Components, structure and operation of the computer (CPU, memory, peripherals)	97.46	289.91	0.471	0.906
Operating systems and software	97.25	282.72	0.694	0.903
Format and structure of the data	97.88	279.07	0.607	0.904
Internet browsing	96.54	286.52	0.659	0.904
Word processing	96.58	283.82	0.682	0.903
Presentation (PowerPoint)	96.54	290.52	0.554	0.905
Data processing				
Data organization and management (spreadsheet)	97.00	280.44	0.679	0.903
Data representation and creation of graphics	97.17	280.06	0.719	0.902
Data collection (form)	97.21	286.78	0.518	0.905
Creation and management of databases	98.00	268.35	0.804	0.899
Use of statistical software	98.54	281.48	0.548	0.905
Scientific research				
Literature searches	97.00	275.74	0.848	0.900
Software or online services for references	97.58	277.91	0.641	0.903
Computational epidemiology (informatics and statistics combined with mathematics and geographical sciences to perform epidemiological studies)	98.58	282.43	0.513	0.905
Internet use				
Internet browsing	96.42	285.56	0.719	0.903
Shared folders and data storage	96.71	287.78	0.621	0.904
Cloud computing (using remote servers and dedicated platforms accessed through the internet for storing and analyzing data)	97.63	277.20	0.644	0.903
Security (malware, firewall)	97.96	286.30	0.599	0.904
Public health informatics applications on health services				
Software adopted in Health Care Services (software and/or web platforms used for management of health services at the local/hospital level)	97.96	284.65	0.474	0.906
Coding systems adopted (International Classification of Diseases - ICD, Diagnosis Related Groups - DRG, Systematized Nomenclature of Medicine - SNOMED)	97 .67	293.10	0.299	0.909
Surveillance systems for communicable and non communicable diseases	98 .50	296.44	0.245	0.909
Telemedicine	98 .96	292.65	0.448	0.906
Information sciences	98 .33	285.54	0.602	0.904
Laws	98 .50	287.22	0.435	0.907
Ethical implications	98 .38	282.42	0.640	0.903
In your opinion, in what proportion each "education-provider" helped you to reach your current skills?				
Courses or training of your Medical School	98.54	311.13	-0.144	0.917
Courses or masters of your Public Health residency (where applicable)	98.21	310.35	-0.131	0.916
Training places attended during Public Health residency	98.04	309.96	-0.114	0.917
Self-education, private courses, masters or certifications	97.71	288.30	0.373	0.908

FIGURE 1. Design and preliminary validation of a questionnaire to assess knowledge of public health informatics among Italian medical residents.



colleagues, one third of our responders judged them poor or sufficient.

Potential future revisions of the questionnaire could expand on the section dedicated to "Public health informatics applications on health services" to include questions on Artificial Intelligence (AI) architectures for health information systems. Indeed, today's residents will be stakeholders in the development of AI structure of tomorrow's health service, which means they will be highly involved in maintaining an effective health service.

Our study has some strengths, including the methodological rigor, but, on the other hand, it suffers from some shortcomings, which should be properly recognized, such as the small sample size and its pilot study design. As such, further research in the field is urgently needed.

CONCLUSIONS

The developed questionnaire seems to be an appropriate and useful tool to detect gaps concerning knowledge, education and practices of public health informatics among residents in public health. This study was intended as a pilot study. Due to its limitations, future analysis should explore the factorial structure of the questionnaire as well as knowledge and practices concerning public health informatics among Italian and European workers in the field of public health. Future investigations should be performed with a larger sample-size in such a way to obtain a more robust and refined results.

Statistical analysis

The study protocol of this pilot study (PHI_KAP-2018-01) was reviewed and approved by the ethical committee of the University of Genoa, Genoa, Italy.

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