Title: Public health matters: innovative approaches for engaging medical students

Short title: Innovative approaches for engaging medical students

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Abstract

Background

Public health faces the paradox of being increasingly emphasised by the key health and social care regulators and stakeholders, while remaining a largely under-represented discipline in the context of medical curricula. Enhancing medical student engagement in public health teaching is one way to address this concern.

Methods

We discuss four key solutions to the challenges faced by public health educators in medical schools, and present five cases studies which demonstrate innovative approaches to engaging medical students in our discipline.

Results

Four different approaches have been piloted by members of the Public Health Educators in Medical Schools (PHEMS) network: (i) ensuring social accountability, (ii) demonstrating clinical relevance, (iii) mapping the core curriculum, and (iv) using technology enhanced learning. Preliminary student feedback suggests that these approaches can be used to position public health as an enabler of modern medical practice, and promote a more holistic understanding of medicine by linking patient-centred care to the population level.

Conclusions

The zeitgeist in both academia and the healthcare system supports the teaching of public health within the medical curriculum; there is also consensus at the political and pedagogical level. The challenge of **ensuring engagement** now needs to be met at the student-teacher interface.

Key words

Practice Points

- Despite being increasingly emphasized by stakeholders, public health remains a largely under-represented discipline in medical curricula.

- There are various explanations for the low profile of public health, most of which are modifiable.

- This paper looks at the key challenges to teaching public health teaching in medical schools and presents potential solutions.

- Case studies are used to demonstrate how student engagement in public health can be enhanced in medical schools.

- **Increased appreciation of public health principles in academia and the healthcare system supports its inclusion within the core medical curriculum.**

Introduction

Public health is a multifaceted discipline concerned with understanding and influencing health and wellbeing at the population level; it operates within three core domains of health protection, health improvement and health services, underpinned by health intelligence (Myles et al. 2014). Public health practice exists beyond the medical profession alone, with undergraduate and postgraduate level programmes producing a highly multidisciplinary workforce (Evashwick et al. 2014). However, in the context of medical curricula, public health faces the paradox of being increasingly emphasised by key national stakeholders (RCP 2010; NHS 2014; GMC 2015), while remaining a largely under-represented discipline in terms of the provision of teaching (Lyon et al. 2016).

Current challenges and solutions

There are various explanations for the relatively low profile of public health within medical school curricula (Gillam & Bagade 2006; Albertine 2014; Gillam et al. 2016); Table 1 summarises these challenges and presents some broad solutions. In this paper we focus on four different solutions, in the form of case studies, for enhancing medical student engagement in public health. **These solutions are consistent with recent calls for a new paradigm in medical education. The discipline of public health can help to bring about a rational convergence between medical protectionism ("Era 1") and measurement-led reductionism ("Era 2") (Berwick 2016), while achieving transformative learning which is cognisant of social justice concerns, imparts leadership attributes, and recognises the interdependence at the heart of the medical profession and healthcare systems in the 21st century (Frenk et al. 2010).**

(Insert Table 1 here)

Solution 1: Social Accountability & Community Engagement

Medical schools both shape the healthcare system and are shaped by it. The World Health Organization (WHO) has called for socially accountable medical schools, defined by "the obligation to direct their education, research and service activities towards addressing the priority health concerns of the community, region and/or nation that they have a mandate to serve" (Boelen & Heck 1995). The WHO Global Consensus Statement for Social Accountability of Medical Schools in 2010 called for a reorientation of education, research and service priorities, and the strengthening of partnerships with community stakeholders (Boelen 2002).

The Lancet Commission on medical education for the twenty first century was highly critical of medical schools for not responding to community and societal needs in their curricula, stating that "fragmented, outdated, and static curricula are producing ill-equipped graduates" (Frenk et al. 2010). These documents provide uncomfortable reading for medical schools, recommending a paradigm shift in medical education away from a specialist and hospital-orientated model, toward a generalist and community-orientated one. Public health principles can inform such a shift and provide content for new teaching, and helping to produce graduates capable of responding to today's healthcare challenges (Boelen 2002; Gibbon 2007).

A practical way to achieve social accountability is by providing students direct exposure to disadvantaged populations. This provides added benefits of enhancing student knowledge and satisfaction, and having a positive influence on career choices (Wear & Kuczewski 2008). Different models of "engagement" have been proposed, with increasing degrees of community input:

- Community-orientated medical education addresses topics in community health but takes place in traditional academic settings

- Community-based medical education involves teaching in community settings, but does not directly engage the community in the design, conduct, or evaluation of these activities
- Community-engaged medical education involves directly engaging members of a community in its design, conduct, or evaluation in order to meet the needs of the community, while enhancing the experience or outcomes of the learners (Ellaway et al. 2016).

Community-engaged experiences necessarily require students to consider the health needs of the populations with whom they work, as well as of individual patients within that community. **Case Study 1 describes how this patient-family-community mind set was imparted at Plymouth Medical School through an innovative approach which addresses some of the concerns highlighted by the WHO.**

Case Study 1: Learning health promotion in the community by using community "teachers"

Issue addressed and location
Social accountability; Plymouth Medical School.

Intended learning outcomes
To enhance student knowledge and skills in advocacy and promoting behaviour change.

Brief description
Health promotion is a key discipline of public health, drawing on a wide range of theory to prevent disease and promote salutogenesis ("wellness"). We replaced two first year lectures with community teaching in a drug and alcohol rehabilitation centre. Students were provided online material on health promotion before teaching sessions at the rehabilitation centre. At two workshops, groups of eight to ten students engaged with service users' personal experiences at the rehabilitation centre, focusing on "life stories" and health service use. Groups then came together for discussion facilitated by staff and service users.

Evaluation and feedback
These workshops yielded the best feedback for public health teaching at our medical school. Students were moved by the stories they had heard; shocked by the insensitivity of doctors; and encouraged that many service users had made significant changes in their lives. The online materials on the principles of health promotion were seen as useful, but less so than the contact with service users.

What this case demonstrates

It is possible to use innovative pedagogical methods to enhance public health teaching. Clinical relevance can be demonstrated by addressing real needs in local communities and by partnership working. Many other aspects of public health could be taught in experiential ways.

Generalisability to other medical schools
All schools have surrounding communities that can provide practical examples of public health knowledge and practice. Providing students an opportunity for experiential learning is an effective way to meet the challenges facing public health teaching.

Solution 2: Clinical Relevance

The General Medical Council (GMC 2015) "Outcomes for Graduates (Tomorrow's Doctors)" clearly relates the expectations of "the doctor as a scholar and a scientist" to the disciplines of psychology, social sciences, population health, and health improvement. Public health principles have never been more relevant to clinical practice, and demonstrating this to students will improve engagement with this discipline. Graduates need to be skilled in promoting health as well as managing disease; communicating complex information for shared decision making with patients and families; and be skilled advocates for people facing health inequalities (Martinez et al. 2014).

In a world of increasing therapeutic complexity, graduates are expected to practise evidence-based medicine and understand the basic principles of epidemiology (McCartney et al. 2016). Clinicians involved in developing policies for commissioning and delivering healthcare in their local organisations need to be fully conversant with critical appraisal of medical research. **Case Study 2 demonstrates action at Dundee Medical School on practising clinicians' assertion that while they did not recognise the value of statistics, epidemiology and critical appraisal teaching as undergraduate medical students, they found these skills highly relevant to their clinical practice after graduation (Miles et al. 2010).**

In the context of an aging population, rapid medical innovation, and current economic realities, graduates need to learn how to assess and balance the population's health needs with those of the individual (Ivory et al. 2013). **Exploring the domains of public health (such as health intelligence) which inform clinical decision making, and have a subsequent**

impact on patients, is one way to enshrine the clinical relevance of public health teaching.

Case Study 2: Evidence based medicine – getting critical with drug adverts

Issue addressed and location
Clinical relevance; Dundee Medical School.

Intended learning outcome
To perform a structured critical appraisal of research, and demonstrate the ability to interpret statistics presented in published research.

Brief description
Interpreting clinical research and critical appraisal are core skills for all medical graduates (GMC 2015). However, it can be difficult for students to understand why these skills are relevant in the early years of the curriculum. While medical student scepticism of drug companies is on the rise (Carmody & Mansfield 2010), evidence shows their prescribing behaviour being affected by their medical school's policy on drug company advertising (Austad et al. 2011; King et al. 2013).

We sought to enhance students' understanding of drug marketing and critical appraisal through a short project. Second year medical students were tasked with identifying a drug advertisement which cites a research article. Students had to determine: the claim made by the advertisement; whether the claim was justified (by critically appraising the article); what a more accurate claim would be; and what psychological "tricks" were used in the advertisement.

Evaluation and feedback
Student feedback was very positive: "Useful to do that [at] early stage in medical career. More evidence-based medicine practice please!" and "Using real advertisements was a good idea." Students also found the use of a structured critical appraisal tool to be helpful.

What this case study demonstrates
Using a real world scenario of interpreting pharmaceutical advertisements and its supporting literature is an effective way to demonstrate the clinical relevance of public health and evidence based medicine to medical students.

Generalisability to other medical schools
Developing the materials is a simple but initially time-consuming process, involving the identification of suitable drug advertisements which cite research relevant to the level of study of the students. This concept could easily be replicated in other medical schools, regardless of curriculum style.

Solution 3: Core Content & Assessment

Internationally, there is increasing recognition of public health at various levels of teaching. In the United States, major and minor undergraduate degree components in public health have been developed (Albertine 2014), along with nationally recognised undergraduate learning outcomes (Petersen et al. 2013). The challenge is to orientate this work towards teaching appropriate for undergraduate knowledge and skills, rather than delivering a "mini Master in Public Health" in medical schools (Albertine 2014).

In the United Kingdom (UK), the PHEMS network, together with the Faculty of Public Health, has identified the core public health content knowledge to be achieved by any UK medical graduate, irrespective of curriculum design (Gillam et al. 2016). This consensus statement (Myles et al. 2014) maps learning outcomes in the GMC's "Outcomes for Graduates" (2015) against the Faculty of Public Health domains, and highlights indicative public health topics and pedagogical suggestions for educators.

Further integration of public health teaching within medical curricula can result from two other factors: student selected components and assessment. Although public health content is already a core component of the curriculum, student selected (or non-core) elements remain valuable (RCP 2010; Lyon et al. 2016). Developing these components in public health is a recognised approach towards introducing new content which can later be converted into core curriculum. The same principle can be applied to "internal electives" which, in some schools, are completed after final examinations. Such placements can provide students an understanding of public health in a practical setting, without the burden of summative assessment.

An additional strategy is to include public health in all forms of assessment. There is currently little evidence about effective summative assessment of public health topics (Hothersall et al. 2016); however, the shift from essays and project work towards more standardised methods (multiple choice and short answer questions) must be met with a contribution from public health educators to these forms of assessment (Gillam & Bagade 2006; Lyon et al. 2015). **Case Study 3 shows how formative assessment is used at St George's, University of London to help students apply core public health knowledge gained in earlier years,**

through an enjoyable exercise of "pitching" a public health business case to expert assessors.

Recognition of the pedagogical maxim that "assessment drives learning" should be coupled with the notion of spiral learning already present in medical curricula, to further embed public health teaching across various stages of medical education. **The proposal to develop a medical licencing assessment for all UK graduates should include public health topics within the overall assessment framework, guided by recommendations made in the PHEMS consensus statement (Archer et al. 2016).**

Case Study 3: Developing a business case through a public health "Dragons' Den"

Issue addressed and location
Core public health content; St George's, University of London.

Intended learning outcomes
- To advocate for investment in public health services through a verbal "pitch"
- To demonstrate the utility of key public health skills including: use of health information, health needs assessment, critical appraisal of evidence, advocacy, and communication.

Brief description
As part of public health teaching in the final year, each student is asked to make a short "pitch" (in the style popularised by the television show "Dragons' Den") to obtain financial support for a public health initiative to deal with a problem that they have chosen. Students have to use basic demographic and epidemiological data to describe the general health and social profile of their target area, identify and quantify the problem, suggest an evidence based approach to tackling it, identify practical challenges, and devise an evaluation for the proposed programme. Students' proposals are summatively assessed by a panel of tutors.

Evaluation and feedback
Since the inception of this teaching activity, students have identified over 50 issues in around 70 countries. Popular topics include smoking, obesity, alcohol, maternal mortality, transport accidents, violence, HIV and assorted tropical diseases; more unusual problems have included elephant attacks, snowboard injuries and computer game addiction. Student evaluations of the "Dragons' Den" sessions routinely receive a high score (>4.2/5).

What this case study demonstrates
Medical students can demonstrate core public health knowledge through this exercise; delivering a public health "pitch" in the final year of clinical training augments their patient-level knowledge by contextualising it in terms of population health.

Generalisability to other medical schools

The "pitch" or business case approach is already utilised in various educational and health service delivery contexts. As such, this approach could readily be incorporated in other medical schools.

Solution 4: Technology Enhanced Learning

Technology enhanced learning is the application of online, internet-based technologies to improve the learning experience. These technologies can produce deeper learning by engaging higher order thinking and critical reflection; promote collaborative learning through greater student interaction; and improve the provision of feedback (Kirkwood & Price 2014). Kalantzis & Cope (2012) describe seven affordances or conveniences provided by online learning technologies which promote: ubiquitous learning, multimodal meaning, metacognition, collaborative intelligence, and differentiated learning. Colleagues from the PHEMS network recently described approaches to harnessing online learning for public health (Sheringham et al. 2016). Here we focus on two specific innovations: personal response units (PRUs) and massive open online courses (MOOCs).

Student discussion and interaction promotes active learning, and is a key step in the evolution of undergraduate students from passive consumers of knowledge to active knowledge makers (Ambruster et al. 2009). However, in large group teaching, educators face the challenge of either losing classroom control when engaging in discussion, or facilitating discussion at the expense of delivering content (Knight et al. 2013). PRUs provide a solution to this challenge by: allowing teachers to approximate one-on-one discussion; making participation less threatening for the individual student; providing prompt feedback; and dispelling the "illusion of competence" (whereby students have a false sense of mastery over learning outcomes that cannot be demonstrated during testing) by incorporating questioning into lecture-based teaching (Koriat & Bjork 2005; DeBourgh 2008; Bjork et al. 2013;). **Case Study 4 provides a practical example from Nottingham Medical School on how PRUs can be used in the lecture theatre.**

Case Study 4: Increasing student engagement through audience response systems

Issue addressed and location
Technology enhanced learning; Nottingham Medical School.

Intended learning outcome
To understand basic epidemiological and public health concepts.

Brief description
Socrative is a software that transforms students' mobile devices into personal response units (PRUs). Socrative allows multiple choice, true/false and short answer questions which can be used to test epidemiological concepts and solicit opinions to simulate in-class discussion on contentious public health issues. The short answer question feature can also be set up to enable students to ask teachers questions during class. Teachers can view live student progress as well as download student performance reports for later reference.

Evaluation and feedback
Student feedback (110/241, 46% response rate) on the use of PRUs during lecture-based sessions was positive (4.4/5). One student comment encapsulates the value of PRU technology in enhancing the in-class learning experience: "Socrative during lectures was a really good idea; [it] reinforced what you were learning and I think that really helped me retain the information".

What this case study demonstrates
Interspersing lecture-based teaching with quiz questions can thus dispel "illusions of competence" and enhance retrieval-induced learning (35, 37) as supported by student feedback in our case study.

Generalisability to other medical schools
Teachers can register for a free account on the Socrative website to create quizzes that can be used during lectures to check understanding (recursive feedback or formative assessment) and promote interactive learning in large lecture groups. Students can access quizzes without the need to register by entering a room code generated by the teacher. A core requirement for using Socrative is access to the internet and an internet-enabled device.

MOOCs offer learning for cohort sizes ranging in the thousands, with participation unrestricted by physical space or geographical boundaries. Massive class sizes can be led by emphasising independent learning; collaborative learning via peer discussion forums; and using peer or automated assessment (Margaryan et al. 2015). One UK medical school integrated a MOOC into its anatomy curriculum and reported high usage of MOOC content (videos and quizzes) by students (Swinnerton et al. 2017). Several MOOCs covering content relevant to undergraduate public health medicine are now available (MOOC list 2016); these could be used for capacity building by targeting educators, policy makers and public health practitioners. **Moreover, medical schools could encourage educators to improve their teaching skills by enrolling in relevant MOOCs (Rodrigues & Leinster 2016); Case Study 5 from Norwich Medical School discusses the acceptability and effectiveness of this using approach to faculty development.**

Case Study 5: Utilising MOOCs as a vehicle for faculty development and learning

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Issue addressed and location
Technology enhanced learning; Norwich Medical School.

Intended learning outcome
To assess the suitability of MOOCs as an acceptable and effective pedagogical vehicle for faculty development and learning.

Brief description
MOOCs have made online learning on a vast array of topics accessible to learners worldwide. To date, the potential of MOOCs for faculty development or continuing professional development of healthcare professionals has not been explored in the UK or elsewhere. We conceived, developed and delivered a two-week MOOC "Clinical Supervision with Confidence" on the FutureLearn platform. The content was developed by a team of medical specialists and trainees, and delivered using principles of adult learning and best practice in technology enhanced learning.

Evaluation and feedback
The MOOC was delivered three times in 2015, attracting a total of 7225 registrants from over 80 countries, and a range of health and social care backgrounds. Typical of MOOCs, only 3163 (46.8%) interested learners actually started the course, and 1026 (32.4%) completed it. Feedback comments from individual learners were overwhelmingly positive. Inter-professional and social learning through discussion board interactions, and space for reflection resulted in an enriched learning experience. Learners appreciated the variety of teaching-learning tools used (videos, animations, reading materials, discussion boards and quizzes).

What this case study demonstrates
The online environment created interactions which would not otherwise have been achieved in the classroom setting. Furthermore, it allowed for learning to be integrated into the busy working week; students were learning on their commute, at work, and on the sofa at home using a variety of technological devices.

Generalisability to other medical schools
Existing MOOCs could be used to provide a wider variety of technology enhanced public health learning to students, or as a method of advancing the pedagogical skills of public health educators.

Limitations and recommendations

The case studies of innovative teaching in this paper provide a limited experience from five UK medical schools, and their generalisability might be limited due to teacher, student, curriculum and content factors. These are outlined as "challenges" in Table 1, and individual

educators must take these factors into account, and be guided by their local context. Our case studies are also limited by the varying amounts of student feedback received.

The introduction of student selected components and electives, with a view to later inclusion in the core curriculum (Solution 3), must be understood as a strategic exercise which provides only an interim and partial solution to exposing a limited number of students to public health content. This approach requires building up alliances with other educators, linking new teaching to learning outcomes, and monitoring student performance and preference for the new teaching activity.

We recommend that educators attempting curricular interventions (such as those outlined in our case studies) should link their efforts to the domains of public health described in the PHEMS consensus statement (Myles et al. 2014). This will help educators to ensure they are adequately covering different aspects of public health practice.

More research is needed to assess the effectiveness of different curricular interventions, and to understand the factors which help or hinder the same intervention in different settings. Whereas we judged our case studies on student satisfaction, more robust data is needed on whether new teaching has actually made a difference to public health knowledge and skills, and changed behaviour in clinical practice. We invite interested educators to contact the PHEMS network in order to take this work forward (PHEMS@jiscmail.ac.uk).

Conclusion

Public health should now be seen as the great enabler of modern medical practice. It promotes a more holistic understanding of what it means to be a doctor by applying the notion of patient-centred care at the population level. The increasing appreciation of public health principles, both in academia and the healthcare system, supports its inclusion within the medical curriculum, alongside a corresponding consensus at the political and pedagogical level. The challenge of establishing relevance now needs to be met at the student-teacher interface.

Viable solutions for enhancing medical student engagement in public health already exist. We now need to show students the relevance of public health to clinical medicine; support them in understanding their communities; and personalise the pedagogical paradigm through technology enhanced learning.

Declaration of Interest

The authors report no declarations of interest.

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Table 1: Challenges and solutions to teaching public health in medical schools (italicised solutions are presented as case studies)

Key factors	Challenges	Solutions
Student factors	Perception of public health as being outside a doctor's scope of practice (Ivory et al, 2013)	*Demonstrate the clinical relevance of public health and epidemiology (Martinez et al, 2014) – Case Study 2*
	Students enter medicine with a sense of social purpose, yet they are not interested in the social sciences (Mise, 2014)	
Teacher factors	Public health educators are sometimes not well trained in pedagogical methods or unable to connect with the current generation of students (Lyon et al, 2016)	*Utilise technology enhanced learning by delivering teaching using methods relevant to the Millennial generation (Kirkwood & Price, 2014) – Case Study 4 & 5*
	Lack of inspirational teaching, with excessive focus on epidemiology and biostatistics rather than social justice issues (RCP, 2010)	Enhance the pedagogical skills of those who choose to teach (for example, through a postgraduate certificate in clinical education)
Curriculum factors	Crowded medical curricula with many learning outcomes to be covered per year (Gillam & Bagade, 2006)	Capitalise on existing curricular structures by: using problem based learning to integrate public health alongside clinical medicine (Gillam & Bagade 2006); developing specific learning outcomes to introduce new content (such as sustainable healthcare) (Thompson et al, 2014); forming alliances with teachers of clinical specialties to integrate public health in their teaching
	Differing interpretations of what comprises core public health content at the undergraduate level	*Establish core public health content and assessment by mapping the public health curriculum against the consensus statement issued jointly by the UK Faculty of Public Health and the UK network (Myles et al, 2014) – Case Study 3*
	"Hidden curriculum" phenomenon resulting from lack of public health assessment in final exams	

	Lack of workplace-based teaching or clinical rotation in public health, with subsequent lack of role-modelling (Gillam et al, 2016)	Develop placements in public health settings; for example, Norwich Medical School offers a six week internal elective with the Public Health England Health Protection Team and the County Council department of public health
Content factors	Disciplinary underpinnings of public health may be dissonant with the perceived objectivity of the biomedical model	Establish a narrative that links public health learning outcomes to clinical scenarios; for example, determinants of health → levels of prevention → health services → disease specific epidemiology
	Impart an understanding of the broader roles of a doctor (Martinez et al, 2014)	*Emphasise social accountability, community engagement, and the need to address health inequalities – Case Study 1*
	Emphasise the utility of public health in different settings	Develop new student selected components (example topics include global health, working with disabled people, violence and health) to increase student interest, and thereby promote the inclusion of new public health topics into the core curriculum (Lyon et al, 2016)