Community Dental Health (2023) **40,** 233–241
Received 13 March 2023; Accepted 29 June 2023

doi:10.1922/CDH_00045Gallagher09

Modelling a Consultant Workforce for the United Kingdom: needs-based planning for Dental Public Health

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Objective: To develop a needs-based workforce planning model to explore specialist workforce capacity and capability for the effective, efficient, and safe provision of services in the United Kingdom (UK); and test the model using Dental Public Health (DPH). ***Basic Research Design***: Data from a national workforce survey, national audit, and specialty workshops in 2020 and 2021 set the parameters for a safe effective DPH workforce. A working group drawing on external expertise, developed a conceptual workforce model which informed the mathematical modelling, taking a Markovian approach. The latter enabled the consideration of possible scenarios relating to workforce development. It involved exploration of capacity within each career stage in DPH across a time horizon of 15 years. Workforce capacity requirements were calculated, informed by past principles. ***Results***: Currently an estimated 100 whole time equivalent (WTE) specialists are required to provide a realistic basic capacity nationally for DPH across the UK given the range of organisations, population growth, complexity and diversity of specialty roles. In February 2022 the specialty had 53.55 WTE academic/service consultants, thus a significant gap. The modelling evidence suggests a reduction in DPH specialist capacity towards a steady state in line with the current rate of training, recruitment and retention. The scenario involving increasing training numbers and drawing on other sources of public health trained dentists whilst retaining expertise within DPH has the potential to build workforce capacity. ***Conclusions***: Current capacity is below basic requirements and approaching 'steady state'. Retention and innovative capacity building are required to secure and safeguard the provision of specialist DPH services to meet the needs of the UK health and care systems.

Keywords*: Health Services Needs and Demand, Planning, Health Workforce, Public Health Dentistry, Markov Chains, Operational Research*

Introduction

Dental Public Health (DPH) is one of 13 recognised dental specialties in the United Kingdom (UK) (General Dental Council, 2023; Sharpling and Gallagher, 2017). Creation of the specialty involved proactive dentists with a desire to improve community oral health, prevent oral and dental disease, prioritise care for vulnerable groups, and train successive generations, following the example of their medical counterparts (Gallagher, 2013; Gelbier, 2010).

The unique character of DPH comes from the dual benefits of education and training across dentistry and public health; thus, equipping members to provide a strategic population perspective on oral health and disease, health improvement, health systems and health protection, in addition to training and academic activities (Gallagher *et al.*, 2021) (Figure 1). DPH thus advocates for population oral health, together with informing and shaping change at a strategic level. Given health care systems face the challenges of increasing health expenditures, multi-morbidity, pandemics and demographic change with ageing populations and inequity; this will require a stronger role for public health in future (Faculty of Public Health, 2021), and integrated approaches to promoting and maintaining health, including oral health.

Change over time is a consistent feature of all specialties, given the political nature of healthcare (Gallagher, 2013); and, particularly so for DPH which sits firmly within the public sector, working across health and care services, government and academia (Gallagher *et al.*, 2021).

Historical data suggest that since its inception in the 1990s, the specialty has not exceeded 126 registrants. In May 2022, DPH had 88 people with 'listed titles' on the register held by the regulator the UK General Dental Council (GDC) (General Dental Council, 2023).

To become a recognised specialist, one must successfully undertake higher specialty training in the UK or gain mediated entry to the specialist list with evidence of developing the relevant competencies. Specialty training in DPH lasts four years, including a one-year master's degree in DPH or public health (with a dental module). Clinical academic training also includes gaining research credentials in the form of a doctorate (PhD) and educational credentials such as a Fellowship of the Higher Education Academy (FHEA). Successful completion of specialty training provides a range of career opportunities to work in various strategic roles. Most achieve the status of consultant (NHS title) or honorary consultant and it is increasingly likely that some junior consultants will hold portfolio careers.

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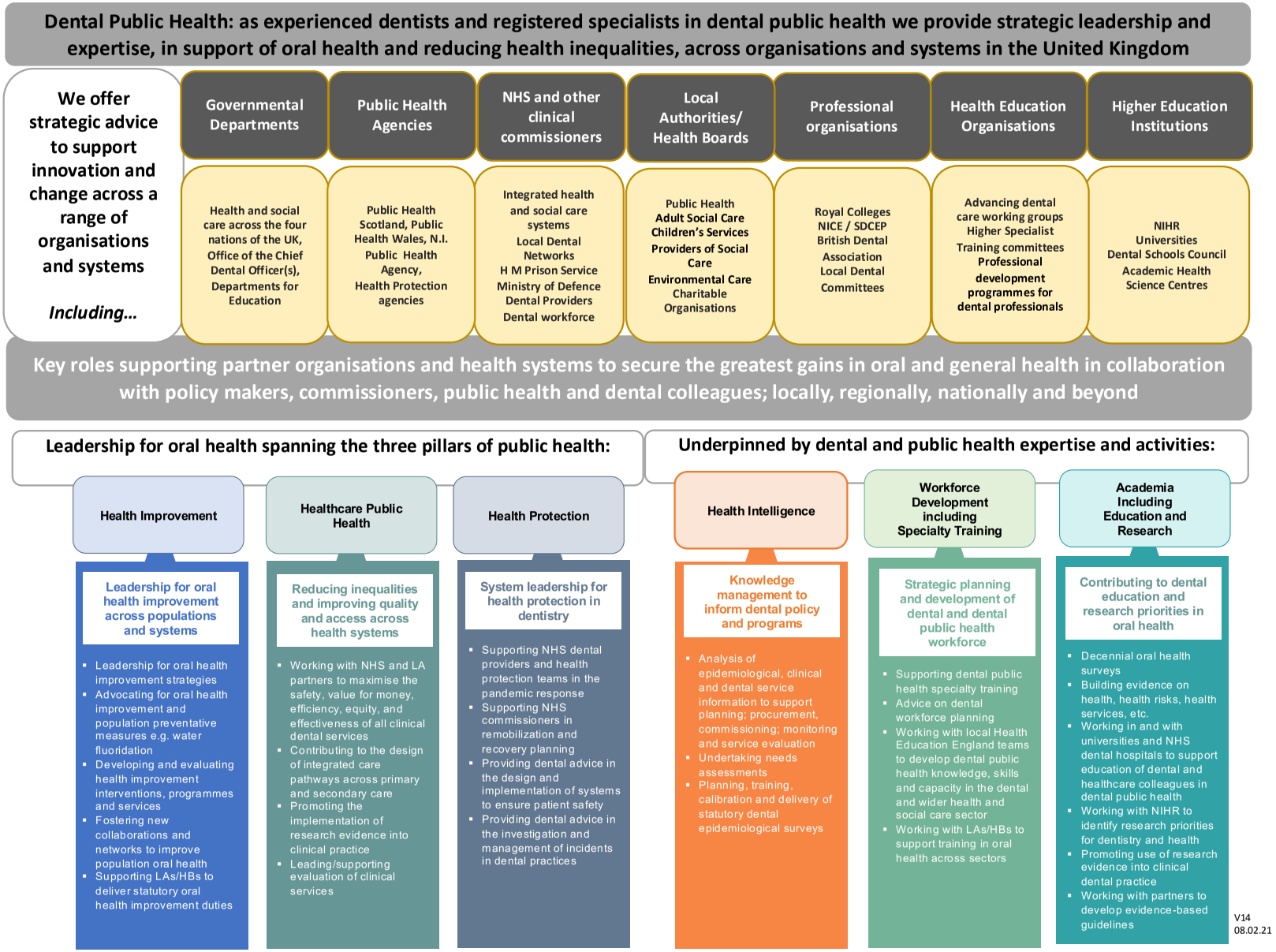


Figure 1. *The Scope of Dental Public Health.*

Academic, health service and government organisations and other organisations and systems require access to sufficient DPH consultant *capability* (competencies, skills, knowledge, and experience) and *capacity* (stock = the right number and level of staff) to deliver specialist advice and leadership for health (Figure 1). As the roles of organisations change, the terms and conditions and the views and expectations of each workforce generation do also change. Furthermore, with a growing trend towards improved work-life balance and more specialists who choose to work part-time, the profile of the workforce is likely to change.

The last review of capacity and capability in DPH, over a decade ago, focused only on England; it recommended a consultant to population ration of 1 to 600,000 population (Department of Health, 2010). This paper presents the development and findings of a needs-based workforce planning model to inform specialist workforce capacity and capability for the effective, efficient, and safe provision of specialist services in the UK and test the model nationally using DPH as a case study.

Methods

A working group of consultants (specialists) with trainee support, was established across the four nations of the UK to agree the scope of a needs-based workforce planning model for the specialist workforce and the data required. International and human resource modelling expertise were sought to contribute to the modelling exercise and provide externality to the project.

A needs-based workforce planning conceptual framework (Ahern *et al*., 2019), in line with contemporary research (Balasubramanian *et al.*, 2021; Birch *et al.*, 2021; O'Malley *et al.*, 2022), was used, adapting it for a specialty which serves populations and organisations.

I. Need for Dental Public Health

The need for DPH as a specialty was determined as outlined in Figure 2 in an iterative series of national and regional meetings. It drew on the principles of a previous English modelling exercise (Department of Health, 2010), adapted to take account of current organisations, population oral health, inequalities and complexities. Due to workforce, NHS financial and recruitment pressures, it was considered prudent to consider the realistic 'minimum' workforce required to run a safe, effective, DPH service, rather than an 'ideal' workforce. Deliberations were therefore tested against past maximum levels of consultant workforce supply locally. These numbers were tested and re-tested amongst consultant colleagues to a point where numbers could be justified and did not exceed past capacity without clear justification. The only area where this 'inflation' was permitted was to ensure that all dental schools have at least one clinical academic in DPH to support education, research and specialist service as previously advised (Department of Health, 2010).

II. Stock (supply) of Dental Public Health

Stock is the current supply of consultants and specialists on the GDC register. The register may include those who may not be actively practising. This may include those in other positions, including being retired or working on a consultancy basis. To account for this, based on a national survey of the specialty (Accessory File 1. Available at https://www.kcl.ac.uk/dentistry/assets/gallagher-documents/accessory-file-1.doc.pdf), and an audit of the profession in 2021 (October), that was updated in 2022 (February), the supply was adjusted using a 'participation rate'. Furthermore, it was recognised that not all DPH specialists are working full-time hours, it is therefore important that a workforce planning model can account for the changing profile and working patterns of those delivering public health services. Our model accounts for part-time workers by adjusting workforce supply using an 'activity rate'. This produces a final provider supply figure reported as a WTE number of practising providers. The stock of practitioners is in flux, affected by both inflow and outflow, under the influence of personal and other circumstances.

Inflow each year includes new specialist registrations, both newly trained consultants and those who gain registration by other means such as mediated entry to the GDC Specialist list, which is less common. The estimated number of newly trained practitioners available for work in DPH was calculated on an annual basis based on the number of practitioners (specialty registrars) completing their Certificate for Completion of Specialty Training in DPH and entering the GDC Specialist Register. The WTE value was informed by the national survey. Data on progression from DPH training to specialist/consultant practice and details about working hours/locations/organisations were obtained via the national survey.

Assumptions regarding inflow in future years were based on trainee numbers. The rate of inflow will largely depend on the number of trainees entering/exiting training (accounting for losses along the way) and the nature (academic/service) and speed of training (whether part-time or full-time).

Outflow of practitioners can be broken down and distinguished further by identifying those retiring, taking a career break, taking up other roles, leaving training or death in service etc. Given the range of leadership options open to consultants in DPH, including senior dental leadership roles which make use of their strategic education and training. Assumptions regarding inflows and outflows in future years were based on career experiences and aspirations. They were also based on the national survey, audit and speciality-intelligence from the past five years. Inflow and outflow from the UK are minimal; however, some specialists may work in other countries whilst remaining on the UK specialist list.

III. Gaps

The gap is simply the difference between the required WTE workforce, minus the WTE stock of currently working specialists. This can be demonstrated as academic or service consultants, or WTEs, as is required.

Modelling

The model simulated total DPH requirements by consultant programmed activities (four hours) and WTE for 2022, and each year thereafter to 2037. From this, the estimated population needs based provider requirements (expert consensus) (WTE equivalent) were produced for all years of the planning period assuming that specialists spend the majority (80%) of their working hours providing such services.

I. NEED for DENTAL PUBLIC HEALTH

A number of key factors influence the effectiveness of an energised consultant job in dental public health, assuming that there is an adequate dental public health team including support staff. In order of impact those factors are as follows:

1. The number of NHS and social care organisations for whom the postholder works which may be mitigated if they are operating for formal collaborative commissioning through a single hub.
2. The population size of the area to be covered by the team, together with oral health needs and population complexity.
3. The number of dental service providers within the area (primary care, specialist and hospital).
4. The geographical size of the area covered by the post.
5. The demographics of the area including socio economic and minority ethnic profile of the population.
6. The number of other key stakeholder organisations such as local authorities, water companies and university dental schools within the area.

For primary care trusts (LOCAL ORGANISATION) the requirement is for

- A minimum of 0.5 WTE per individual organisation irrespective of size to enable the post holder to operate effectively within the organisation and to relate effectively to external stakeholders. Note if the post holder had dental public health duties with another NHS organisation of the same function, that minimum could be 0.4 WTE per organisation
- Plus, an additional 0.1 WTE for each additional 100,000 population above 250, 000
- Plus, an additional 0.2 WTE For organisational responsibilities associated with lead commissioning of clinical services from a dental teaching hospital.

For **regional organisations** the requirement is for:

- A minimum of 0.5 per organisation.
- Jobs planned to cover more than one organisation should be designed to take account of the practical impact of geography and travelling time between organisations and providers.

In calculating the overall workforce requirement for consultant level posts, there is a need to factor in requirement for academic posts reflecting the size of the dental school with an absolute minimum of one consultant level academic post per school.

II. SUPPLY or STOCK of Dental Public Health capacity

- Number and Whole Time Equivalents (WTE) based on registration, participating and activity
- Career information:
    - Pre-specialty training experience: mean (+/-SD), mode for PT/FT/Flexible
    - Specialty training: mean (+/-SD), mode for PT/FT/Flexible
    - Consultant career: mean (+/-SD), mode for PT/FT/Flexible (anticipated in the case of the trainee)

III. GAPS to be filled to achieve a minimum service (across different scenarios)

- WTE

NOTE: Recommended minimum staffing guidance for consultant posts

- One consultant per 600,000 population
- Each dental school, to have an absolute minimum of one consultant-level academic post.

BASED ON Dental Public health workforce planning guidance (Department of Health, 2010) Appendix 2: Pages 66-67 and adapted for current context

***Figure 2**. Need, supply and gaps. Estimating demand for Dental Public Health.*

Using the stock of qualified dentists emerging into the profession each year, numbers were adjusted for all inflows and outflows, to produce an estimate of the supply of trainees at the end of each year, adjusting for out of programme activities and withdrawal.

To model the flow of individuals through specialty training, and a career in DPH, a Markov model was built within MS Excel. A Markov model is a stochastic model describing a sequence of possible events in which the probability of each event depends only on the state attained in the previous event (Guerry and De Feyter, 2009; Jain, 1986). Different roles within DPH were considered as 'states' within the model. The probability of transitions between these states were determined by the working group based on discussion of past evidence (last five years) and input to the model, recognising that individuals may move to different roles within DPH, rather than taking a linear trajectory to a consultant role and staying in such a position.

Markov models are mutually exclusive, such that each individual person can only be represented in one state at any given time. Our model uses the Markovian assumption, i.e., the probability of a state is independent of its history, but only depends upon its immediately previous state (Abbott, 1983). Adopting the Markov model enabled exploration of the numbers within each career stage in DPH, including those entering retirement and leaving the profession across a medium-term time horizon (15 years) and run various scenarios.

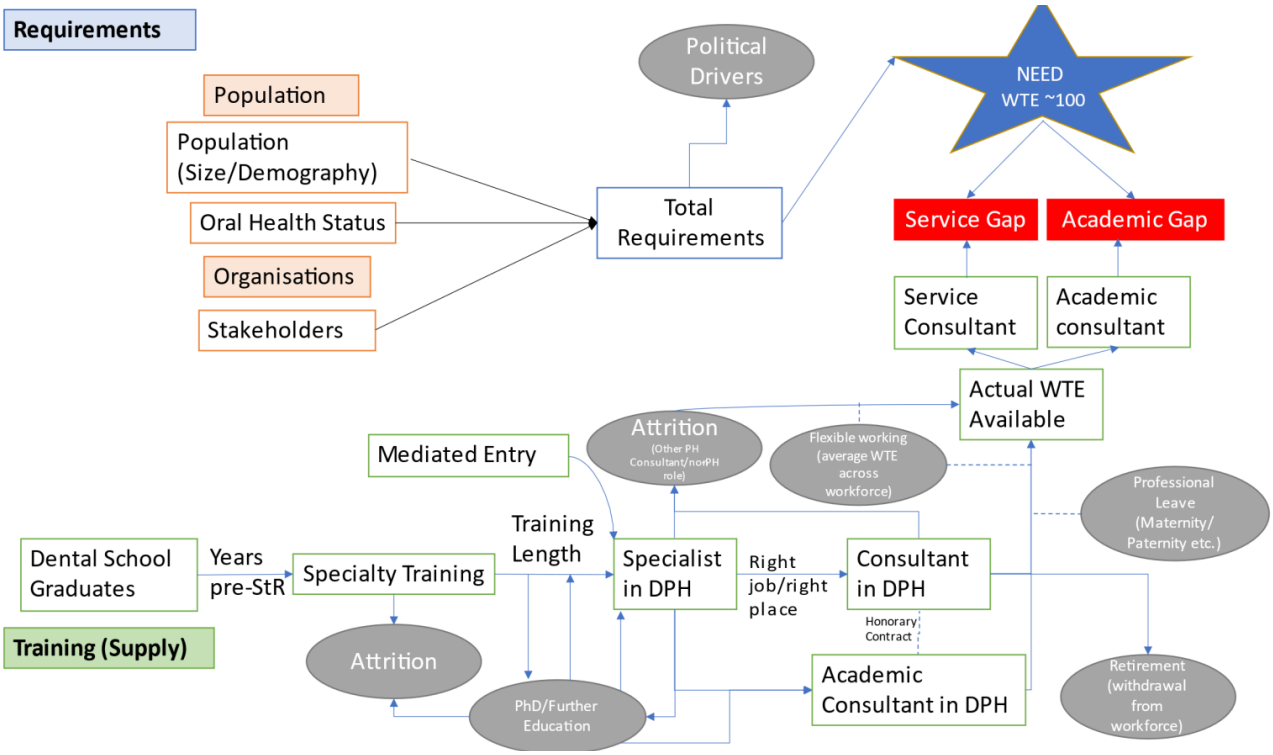


***Figure 3**. Model: supply, process and gap: Dental Public Health specialist workforce.*

Having populated the model with all required data and run the simulation, it was possible to compare both present and future DPH specialist supply and requirements and undertake gap analysis.

Thereafter, the following scenarios were considered:

- no new trainees recruited
- five specialty trainees a year
- 10 specialty trainees a year
- 10 specialty trainees a year, plus if one dentally qualified specialist in public health were to join the DPH specialist workforce
- 12 specialty trainees a year, plus one dentally qualified public health specialist joining the specialty, all working at 0.9 WTE.

Although academic and service consultants undertake different bodies of work, it is anticipated that all consultants will make meaningful contribution towards the specialist workforce.

Results

At a national specialty workshop in January 2020, we determined the realistic consultant whole time equivalent (WTE) for each geographic region, and for all academic institutions. Initially, a target of 104 WTE was proposed but following revision through regional quality improvement groups, overseen by the national working group, and tested in national meetings (2021/2022), a figure of 100 WTE was agreed for the modelling exercise.

Academic and service consultants were combined in our data to meet an aspirational 100 WTE. Furthermore, based on our national survey findings, a working career of 36.5 years, with 25.9 years as a specialist was assumed (Figure 4).

The model was built using the above evidence relating to DPH, recognising career patterns, using existing data from an audit of capacity in January 2022. Currently, there is a gap of some 46.45 WTE. Every region in the UK is operating with a lower number of consultants than required to deliver service and activity requirements (Figure 1), with some regions trying to offer a comprehensive DPH service with only 33% of the required workforce. Within the DPH workforce, it was possible to make some assumptions based on metrics of those contributing to the workforce as shown by the time periods in Figure 4.

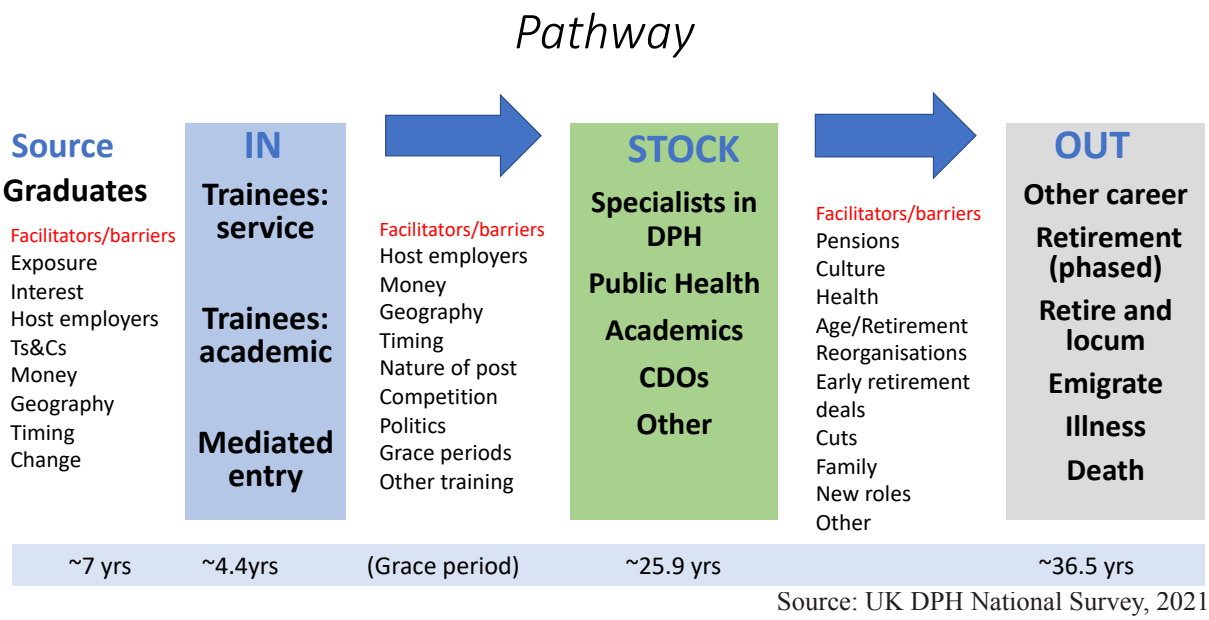
Not all GDC registered specialists take up positions as specialists in DPH outside of traditional NHS or academic consultant roles. For simplicity, this cohort has not been included visually, but is present in numerical analyses (Accessory File 2. Available at https://www.kcl.ac.uk/dentistry/assets/gallagher-documents/accessory-file-2.doc.pdf). In all models, this is less than four WTE at any one time.

Five scenarios for workforce optimisation are displayed visually, which demonstrate workforce size over the next 15-year period (Figures 5a-e). Data include a combined academic and service workforce.

Figure 5a demonstrates a model where no new trainees are recruited. Although in this scenario there would still be a specialist workforce in 30 years' time, this would be limited to only eight working consultants. The final trainee from the existing trainee group would become a specialist in eight years' time.

Figure 5b represents the training status quo with on average, five DPH specialty trainees a year, based on recent training intakes. In this scenario, the specialist workforce will continue its current decline in number for the next 15 years, where it will reach a stasis of 44 – 48 registered specialists.

Figure 5c gives a visual representation of the scenario of increasing the number of DPH specialty trainees to 10 per year. The specialty training workforce plateaus at



Source: UK DPH National Survey, 2021

Figure 4. *Dental Public Health specialist workforce: current career trajectory.*

roughly 28 trainees, and the specialist workforce begins to increase in size year on year. However, the workforce does not reach the realistic functional level of 100 WTE in the next 30 years.

Figure 5d indicates what would happen if 10 trainees were taken a year, plus if one dentally qualified specialist in public health were to join the DPH specialist workforce (possibly with additional training). This is the first model where we may end up with >100 WTE in the next 30 years. The DPH specialty training workforce remains around 28, with 100 WTE reached by year 28.

Figure 5e displays a final scenario of 12 new DPH trainees a year, plus one dentally qualified public health specialist joining the specialty, all working at 0.9 WTE. In this scenario, 100 WTE is reached within 15 years. There would need to be sufficient consultant capacity to train some 30 DPH trainees a year. The specialty would continue to grow, reaching a plateau at around 135 WTE contributing to the specialty at any one time.

Discussion

This modelling exercise demonstrates the ability to consider a realistic functional workforce for DPH in the UK at a national level identifying a major service gap. It highlights the need for planned action to secure a sufficient capacity, considering both service and academic needs. It is important to recognise that the rapid initial growth of the specialty was facilitated through 'grandparenting' onto GDC specialist lists (Sharpling and Gallagher, 2017). Since then, many consultants have naturally retired at the end of their career, whilst successive health sector reorganisations may have accelerated retirements, disrupting the continuity of training programmes and recruitment to substantive posts. Training initiatives, and recruitment of newly trained specialists to consultant posts in the specialty, have therefore not facilitated maintenance of capacity from its height in 2006, over a period when the UK population has risen from around 60 to 67.5 million people (United Nations, 2023). All dental specialties, and indeed the wider workforce, are facing similar issues (Anderson *et al*., 2021); and, thus could benefit from in-depth innovative analysis and needs-based modelling to inform planning (Balasubramanian *et al*., 2021; Birch *et al*., 2021). If a similar approach were used across specialties, this would facilitate more transparent priority setting for the entire health system and better anticipation of training needs.

Size

The current DPH specialist workforce is highly stretched and needs almost to double its capacity (WTEs). Whilst at first sight this could be considered excessive; it would, however, bring workforce levels closer to past capacity when full time working was more the professional norm. Furthermore, the estimate of 100 WTE to provide a basic effective, efficient, and safe provision of service is actually less than the published recommendations of one consultant to 600,000 population (Department of Health, 2010), which would suggest a similar but slightly higher service requirement of 112.5 WTE. Hence, 100 WTE would appear a realistic basic minimum to deliver an effective, efficient, and safe service in the UK.

Training

Adequate training must be offered to prevent workforce attrition when the needs of a discipline are clear; it should be considered a key objective of any specialty to establish and maintain training the next generation, in line with wider NHS and academic workforce considerations (Buchan *et al.*, 2019). The health care system must take a longer-term perspective for DPH rather than 'hold-back' during times of change, ensuring that trainees are equipped to negotiate change successfully. Expansion of training places over the forthcoming years is, therefore, required to build up the workforce, together with other innovative actions to extend capacity. The latter may helpfully include attracting dentists who have undergone parallel public health specialist training into the DPH discipline. Our analysis demonstrates that a combination of these

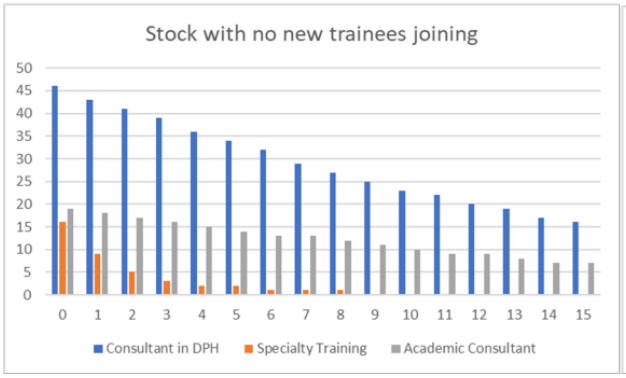


Figure 5a

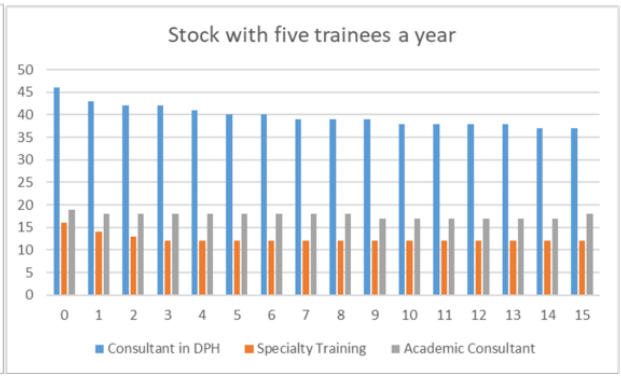


Figure 5b

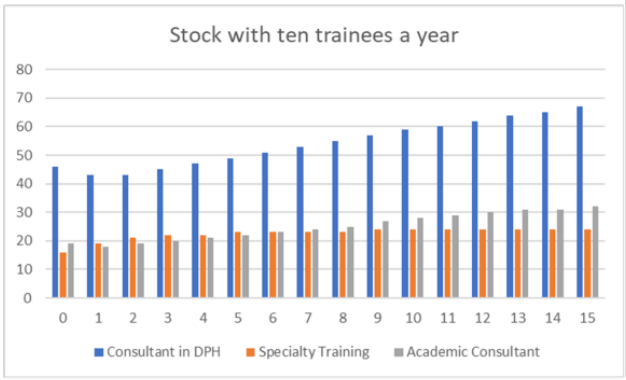


Figure 5c

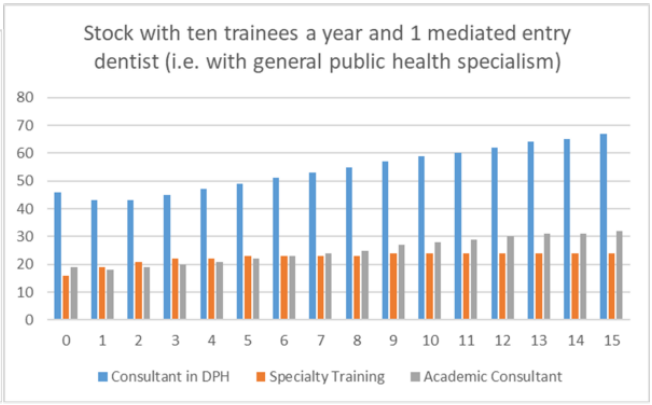


Figure 5d

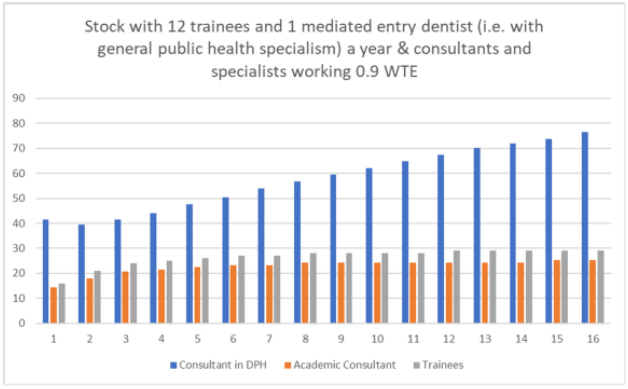


Figure 5e

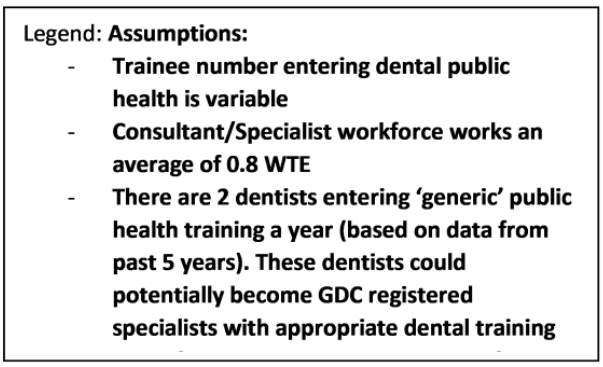


***Figure 5**. Future scenarios: Dental Public Health workforce.*

factors will enable capacity to grow, reducing the gap in services and deliver sufficient workforce capacity. Dentists who have undergone generic public health training may undertake a DPH module to supplement their master's in public health and their subsequent registration as a GDC specialist should be explored. Qualitative research among this cohort of public health professionals may provide insight into their career aspirations and the barriers (real or perceived) of becoming a GDC registered specialist.

It will be important to work with education providers such as NHS Education for Scotland, Health Education England/NHS England and NHS Improvement, Health Education and Improvement Wales, and Northern Ireland Medical and Dental Training Agency to expand the volume of training programmes. This has cost implications and sometimes trainers are not always available in areas where consultants/specialists are most needed. The latter may be overcome by drawing on public health expertise and delivery of remote DPH training supported by technological developments during the global COVID-19 pandemic. Furthermore, when trained, it will be important to ensure that there are sufficient positions to engage this expertise. This will be the active responsibility of all members of the specialty.

Workforce innovation and collaboration

As already outlined, workforce capacity is now more stretched than when Langford conducted a review (Department of Health, 2010), which considered the utility of a 'DPH practitioner' workforce of Dental Care Professionals and dentists working under a consultant/specialist in DPH, but this option was never realised. Such a wider-team approach may be beneficial, with Scenario E demonstrating the need for creative thinking

to rapidly increase workforce numbers. Skill mix utilisation is promoted across all aspects of dentistry (Health Education England, 2021), and also relevant for DPH. A multi-disciplinary team of the future may include data analysts, managers, dental team members with extended skills, or public health trained members of the wider dental team holding voluntary public health registration to ameliorate some stresses on the DPH workforce. There could be development of a curriculum which upskills oral healthcare professionals to become practitioners, as previously recommended who can then support, and supplement work undertaken by specialists. Such approaches may be tested and modelled to inform capacity building.

The Faculty of Public Health (2021) has set an aspirational capacity of 2000 specialists (30 specialists per million population) advocating the need for expansion. Due to the expertise and skills held by DPH specialists, increasing the DPH workforce will provide benefit through supporting public health, educational and research functions.

Limitations and strengths

This research has certain limitations which need to be acknowledged. First, it was led within the specialty, which could introduce bias in calculation of the ideal numbers. However, it could be argued that this is a strength given the strategic perspective and workforce intelligence of the discipline. Second, it is relatively simplistic as a modelling tool. However, simplicity in models assists with transparency and understanding (Sampson *et al*., 2019). Third, DPH activities 'needed' were not broken down by 'type of service', as it is expected that each specialist may have responsibility for all aspects of the role (Figure 1), but that with teamworking and prioritisation there will be some variation over time. Fourth, not all academic consultants may contribute to the specialist workforce equally; however, for the purpose of this model it assumed that they all do. Considering the comparatively large number of academics as a proportion of the overall workforce, consideration should be given to what constitutes an 'appropriate minimum' service component and how this may be delivered in future.

Finally, recognising one-off modelling exercises cannot truly predict the future, we suggest an iterative system of workforce modelling. This is not anticipated to be used as a 'one off model' but an established on-going modelling process, using updated information on a continual basis, thus providing insight to inform future decision making from stakeholders. Indeed, further modelling could embrace changes to workforce at 'place' level (regional/organisational). Updating transition probabilities informed by actual changes in workforce size, and repeating the exercise on a regular basis, would help to monitor and inform action.

Conclusion

In conclusion, needs-based workforce modelling suggests that the current rate of specialist training is not sufficient to reach a realistic functional capacity and thus ensure effective and efficient delivery of DPH functions across six domains for current needs. Careful retention and additional capacity building are required, with innovation, for DPH to ensure the effective, efficient, and safe provision of services for both the short and long term. Oral health needs-based planning of human resources for oral health, if applied iteratively, is essential to inform future priority setting for better oral health.

Acknowledgements

The authors wish to acknowledge the contributions of consultants and trainees of the British Association for the Study of Community Dentistry (BASCD) Consultants and Specialists in Dental Public Health Group across the UK through surveys, workshops and feedback on presentations of this work.

The BASCD as the "professional association for the science, philosophy and practice of promoting oral health in society" (BASCD, 2023), is the UK professional association of the specialty of DPH.

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