

# Determining the optimal model for role substitution in NHS dental services in the UK: a mixed-methods study

Paul Brocklehurst,<sup>1\*</sup> Stephen Birch,<sup>2</sup> Ruth McDonald,<sup>3</sup>  
Harry Hill,<sup>4</sup> Lucy O'Malley,<sup>4</sup> Richard Macey<sup>4</sup>  
and Martin Tickle<sup>4</sup>

<sup>1</sup>School of Healthcare Sciences, Bangor University, Bangor, UK

<sup>2</sup>Faculty of Health Sciences, McMaster University, Hamilton, ON, Canada

<sup>3</sup>Manchester Business School, University of Manchester, Manchester, UK

<sup>4</sup>School of Dentistry, University of Manchester, Manchester, UK

\*Corresponding author

**Declared competing interests of authors:** none

Published July 2016

DOI: 10.3310/hsdr04220

## Scientific summary

### Role substitution in NHS dental services in the UK

Health Services and Delivery Research 2016; Vol. 4: No. 22

DOI: 10.3310/hsdr04220

NIHR Journals Library [www.journalslibrary.nihr.ac.uk](http://www.journalslibrary.nihr.ac.uk)

# Scientific summary

## Background

Maximising health gain for a given level and mix of resources is an ethical imperative for health-service planners. The independent review of NHS dentistry in 2009 (Department of Health. *NHS Dental Services In England: An Independent Review Led by Professor Jimmy Steele*. London: Department of Health; 2009) concluded that there was an overwhelming need to make the best use of the whole dental workforce. Across England, approximately 55% of patients who attend for a regular dental check-up do not require any further treatment. By contrast, half of the population does not attend a general dental practitioner (GDP) on a regular basis and this group tends to be the most disadvantaged and experiences the majority of dental disease. As a result, patients with the least need are being seen and treated by the most expensive resource, the GDP, whereas patients with high levels of need can have problems accessing NHS dental services.

Role substitution occurs when appropriately qualified non-dentist team members undertake the clinical activity previously provided by GDPs. In primary dental care, role substitution is provided principally by dental hygienists (DHs), dental hygiene therapists (DHTs) and dental therapists (DTs). This contrasts with dental nurses, who augment the activity of the GDP in the form of role supplementation. Unlike role supplementation, role substitution has the potential to improve efficiency and the capacity to care and lower costs. In addition, it has the potential to reduce inequalities in service delivery as resources can be diverted to the population with the greatest need. Technical efficiency is defined as the production of the maximum amount of output from a given amount of input so that a service operates at the production frontier. Academic research into technical efficiency is being used increasingly in health-care evaluation, although no studies have empirically investigated the efficiency of NHS dentistry or role substitution in dental practices. By contrast, NHS dental service provision has developed historically, with levels of future service provision being determined by extrapolating trends from past activity into the future, at a time when disease levels are actually reducing.

## Aims and objectives

This programme of research sought to address three research questions (RQs):

1. What is the technical efficiency of NHS dental teams that make use of role substitution?
2. What are the barriers to, and facilitators of, role substitution in NHS dental practices?
3. How do incentives in the remuneration systems influence the organisation of these inputs and production of outputs in the NHS?

The following were the objectives of the programme:

- to conduct a cross-sectional study to determine the current working patterns of non-dentist team members capable of role substitution in NHS dental practices (DHs, DHTs and DTs)
- to collect input data (NHS hours worked) and output data (clinical activity) from participating practices
- to identify the most technically efficient provider mix among the different provider configurations observed
- to assess the external validity of the methods used for efficiency analysis
- to explore barriers/enablers to increased use of role substitution
- to examine how the technical efficiency of the different provider models varied across different remuneration systems (England, Northern Ireland and Scotland)
- to examine how financial incentives in remuneration systems influence the organisation of inputs and the production of outputs in NHS dentistry.

## Methods

A multimethod approach was adopted, integrating both qualitative and quantitative methodologies. Following NHS ethical approval (12/WA/0403), the membership of the British Society of Dental Hygiene and Therapy (BSDHT) were contacted and asked to complete a screening questionnaire in 2013 to determine the current working patterns of DHs, DHTs and DTs in NHS dental practices. Questionnaires were distributed to all of the 3100 members of the BSDHT (saturation sampling) after being reviewed by the research team's patient and public involvement (PPI) group.

Based on the results of this initial screening questionnaire, NHS practices that utilised role substitution were identified in England, Scotland and Northern Ireland. Once these were identified, a second detailed questionnaire was distributed to capture input data (number of NHS hours worked by the whole dental team and number of surgeries) and important practice demographics. Practices were also asked to consent to its output data being obtained (measures of clinical activity recorded by their relevant NHS payment agency). The input and output data were then linked and anonymised by a third party.

Data envelopment analysis (DEA) was then used to identify the most technically efficient provider mix in participating practices and stochastic frontier modelling (SFM) followed to assess the external validity of the DEA approach. Prior to DEA, the linked data sets were compared with the national average, using data provided by the relevant NHS payment agency. A production possibility frontier was then created using DEA and the relative distance of each practice from the frontier was measured to determine their technical efficiency. A sensitivity analysis was conducted with alternative specifications for different input and output variables to explore if the findings were sensitive to the choice of these variables. Efficiency scores were then regressed onto a range of practice variables to identify correlates of inefficiency. As DEA provides only a relative measure of efficiency, SFM was used in parallel with estimate the frontier, using regression (Cobb–Douglas function) to test the robustness of the DEA findings.

For the qualitative workstream, practices were recruited using the information generated from the screening questionnaire. Technically efficient and inefficient practices were also identified from the quantitative workstream. This was augmented by invitations to DHs, DHTs and DTs via social networks. Semistructured interviews were then conducted to explore the potential barriers to, and facilitators of, role substitution in NHS practices, using interview schedules that had been developed iteratively with the help of the research team's PPI group.

Data collection and analysis were run concurrently between October 2013 and May 2015, using a framework informed by the literature and the PPI group. This was then developed further as the findings emerged. All interviews were audiorecorded and transcribed verbatim. Thematic analysis was carried out by group, so practice principals (PPs), non-dentist team members and patients were coded separately. Interpretations were then pooled and edited in the presence of all three researchers to produce the final version of the coding frame, with disputes being resolved using a majority voting system. Data analysis was undertaken concomitantly with the interviews, which continued until saturation.

To examine the third RQ, data relating to a natural experiment in NHS service provision in Northern Ireland were collected and analysed. Thirteen practices that were remunerated via capitation were compared with 57 matched controls. The latter were selected according to practice location and were paid on a fee-for-service (FFS) basis within the NHS. The data from claim forms were pooled by the Business Service Organisation over 43 months (April 2011 to October 2014) and underwent ordinary least squares regression, using a long panel form. The Ramsey regression equation specification error test was then used to test for model misspecification.

## Results

Two hundred and eighty-seven of the 1859 screening questionnaires (15.4%) were returned from 432 NHS practices. The most common non-dentist team member capable of role substitution was the DH (64.1%), followed by DHTs (33.8%) and DTs (1.0%). Their mean age was 42.1 years and the mean time since qualification was 16.5 years. Almost all were female and the mean time in post was 8.4 years. More than half worked in one practice, but a substantial majority worked in more than one practice. The mean number of additional non-dentist team members that the respondents worked with was 1.7.

One hundred and twenty-one practices provided input data that could be linked to the Business Services Authority in England. When Units of Dental Activity (UDAs) were used as the output measure in England, NHS dental practices operated at a mean level of efficiency of 64%. This changed very little when the outputs were measured in terms of number of patients seen or the number of treatment plans generated. NHS dental practices that did not use any form of role substitution had a higher mean level of efficiency (68%;  $n = 39$ ). Any use of non-dentist team members was found to be associated with statistically significant lower efficiency scores (14% lower for UDAs, 11% lower for treatment plans or patients seen) than practices that used no role substitution.

No significant interactions with patient population characteristics were found. Correlations between efficiency scores estimated by SFM and DEA were  $> 0.6$ , which supported the robustness of estimated DEA efficiency scores and the internal validity of the approach. Efficiency in NHS dental practices in Northern Ireland and Scotland was consistently higher (94% and 80%, respectively), although it was difficult to make robust comparisons across the two countries because of their smaller sample sizes ( $n = 20$  and  $n = 29$ , respectively).

Sixteen PPs and 17 non-dentist team members were interviewed. The use of role substitution in the NHS across the practices was highly varied. Some practices used DHs, DHTs and DTs to their full scope of practice and were enabling them to undergo further training; whereas in other practices, they were limited in the duties they could carry out and were used primarily to complete routine scale and polishing.

The PPs interviewed felt that the greater use of role substitution did not result in financial gain. Instead, the current NHS dental contract appeared to disincentivise its use. In addition, the attitudes and beliefs of PPs towards non-dentist team members appeared to be highly influential in terms of how the practice was organised and whether or not the practice culture supported role substitution. Practices with low levels of role substitution appeared to be led by PPs who were concerned about the abilities of DHs, DHTs and DTs, in particular how much longer it might take to carry out treatment when compared with a GDP. PPs who used non-dentist team members tended to have confidence in the ability of their own staff, but were less confident in the use of role substitution more generally.

Among non-dentist team members themselves, a number of day-to-day barriers were found to reduce the efficiency of working in the practice environment. These included not being able to prescribe fluoride varnish and the inability to prescribe local analgesia or radiographs. Notably, a substantial proportion of DHs, DHTs and DTs worked across a number of practices (between two and eight).

The majority of patients had a low level of awareness of the roles of different members of the dental team. Most patients interviewed were familiar with GDPs and DHs, but they were not aware that DHTs and DTs could undertake restorations or extractions. Restorations, crowns and bridges were identified as activities undertaken by GDPs, whereas periodontal treatment ('hygiene work') fell within the expertise of DHs. Most patients interviewed were not interested in the debate within the profession about who could treat them. Instead, they reported that they just wanted to know that any treatment being carried out was undertaken by a suitably qualified clinician. They all appeared to place a great deal of trust in the NHS, the regulatory system and in the opinion of their GDP.

The results from the natural experiment in Northern Ireland showed that the mean number of monthly treatment items delivered by FFS practices was higher than the number remunerated by capitation (922 and 811 treatment items, respectively). The mean monthly number of treatment plans delivered to patients was higher in the capitation practices than in the FFS practices (463 and 392, respectively). The mean monetary value of the treatment plans delivered was lower in capitation practices (by £10.83). These differences were statistically significant at a 5% level.

There was no evidence of differences in patient selection between the two types of practices, although practices paid by capitation provided, on average, 9.7 fewer examinations, 17.2 fewer fillings and 11.5 fewer scale and polish services per 100 unique patients per month ( $p < 0.00$ ). They also provided an average of 6.3 more extractions per 100 unique patients per month ( $p < 0.00$ ). The volume of fluoride varnish applications per patient and per 100 child registrations was not significantly different between practice groups.

## Conclusions

The extent of role substitution in NHS dental practices appears to be relatively low and mainly limited to the use of DHs for routine periodontal treatment. NHS dental practices that utilised fewer non-dentist team members were associated with higher levels of technical efficiency, that is as role substitution in NHS practices increased, their relative efficiency dropped. The efficiency of role substitution in NHS dental practices appeared to be heavily influenced by the remuneration system. The inability of non-dentist team members to contract directly with the NHS meant that it was not possible to determine the technical efficiency of individual DHs, DHTs and DTs. They were also subject to the prevailing organisational culture within each practice, restrictions on their ability to prescribe and the views of the individual PPs that employed them.

The scope for addressing the recommendations of the Independent Review of NHS dentistry (Department of Health 2009) to make best use of the whole dental workforce appears limited, as the traditional model of care using GDPs predominates. Aligning financial incentives to encourage the greater use of role substitution would be an important intermediate step, although the development of a NHS contract with DHs, DHTs and DTs would offer greater flexibility for commissioners of services. As oral health continues to improve, this is important if maximising health gain for a given level and mix of resources remains an ethical imperative for the NHS. Failure to do so will increasingly mean that the most expensive resource treats those with the least need.

Further research is needed to:

1. explore new models of NHS dental care that are efficient and make best use of increasingly scarce resources (identifying and assessing different approaches to organising the delivery of dental health care in the NHS)
2. determine the cost-effectiveness of new models of dental care based on role substitution in NHS dentistry
3. examine the quality of the care provided by non-dentist team members and understand how they compare with GDPs
4. develop a needs-based workforce plan for NHS dentistry that makes best use of the whole dental team
5. explore the impact of traditional and new models of care on the health inequalities of NHS dental service provision, including equity, service coverage and access to care.

## Funding

Funding for this study was provided by the Health Services and Delivery Research programme of the National Institute for Health Research.



# Health Services and Delivery Research

ISSN 2050-4349 (Print)

ISSN 2050-4357 (Online)

This journal is a member of and subscribes to the principles of the Committee on Publication Ethics (COPE) ([www.publicationethics.org/](http://www.publicationethics.org/)).

Editorial contact: [nihredit@southampton.ac.uk](mailto:nihredit@southampton.ac.uk)

The full HS&DR archive is freely available to view online at [www.journalslibrary.nihr.ac.uk/hsdr](http://www.journalslibrary.nihr.ac.uk/hsdr). Print-on-demand copies can be purchased from the report pages of the NIHR Journals Library website: [www.journalslibrary.nihr.ac.uk](http://www.journalslibrary.nihr.ac.uk)

## Criteria for inclusion in the *Health Services and Delivery Research* journal

Reports are published in *Health Services and Delivery Research* (HS&DR) if (1) they have resulted from work for the HS&DR programme or programmes which preceded the HS&DR programme, and (2) they are of a sufficiently high scientific quality as assessed by the reviewers and editors.

## HS&DR programme

The Health Services and Delivery Research (HS&DR) programme, part of the National Institute for Health Research (NIHR), was established to fund a broad range of research. It combines the strengths and contributions of two previous NIHR research programmes: the Health Services Research (HSR) programme and the Service Delivery and Organisation (SDO) programme, which were merged in January 2012.

The HS&DR programme aims to produce rigorous and relevant evidence on the quality, access and organisation of health services including costs and outcomes, as well as research on implementation. The programme will enhance the strategic focus on research that matters to the NHS and is keen to support ambitious evaluative research to improve health services.

For more information about the HS&DR programme please visit the website: <http://www.nets.nihr.ac.uk/programmes/hsdr>

## This report

The research reported in this issue of the journal was funded by the HS&DR programme or one of its preceding programmes as project number 11/1025/04. The contractual start date was in February 2013. The final report began editorial review in August 2015 and was accepted for publication in January 2016. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HS&DR editors and production house have tried to ensure the accuracy of the authors' report and would like to thank the reviewers for their constructive comments on the final report document. However, they do not accept liability for damages or losses arising from material published in this report.

This report presents independent research funded by the National Institute for Health Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, NETSCC, the HS&DR programme or the Department of Health. If there are verbatim quotations included in this publication the views and opinions expressed by the interviewees are those of the interviewees and do not necessarily reflect those of the authors, those of the NHS, the NIHR, NETSCC, the HS&DR programme or the Department of Health.

**© Queen's Printer and Controller of HMSO 2016. This work was produced by Brocklehurst et al. under the terms of a commissioning contract issued by the Secretary of State for Health. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.**

Published by the NIHR Journals Library ([www.journalslibrary.nihr.ac.uk](http://www.journalslibrary.nihr.ac.uk)), produced by Prepress Projects Ltd, Perth, Scotland ([www.prepress-projects.co.uk](http://www.prepress-projects.co.uk)).

## **Health Services and Delivery Research Editor-in-Chief**

**Professor Jo Rycroft-Malone** Professor of Health Services and Implementation Research, Bangor University, UK

## **NIHR Journals Library Editor-in-Chief**

**Professor Tom Walley** Director, NIHR Evaluation, Trials and Studies and Director of the EME Programme, UK

## **NIHR Journals Library Editors**

**Professor Ken Stein** Chair of HTA Editorial Board and Professor of Public Health, University of Exeter Medical School, UK

**Professor Andree Le May** Chair of NIHR Journals Library Editorial Group (EME, HS&DR, PGfAR, PHR journals)

**Dr Martin Ashton-Key** Consultant in Public Health Medicine/Consultant Advisor, NETSCC, UK

**Professor Matthias Beck** Chair in Public Sector Management and Subject Leader (Management Group), Queen's University Management School, Queen's University Belfast, UK

**Professor Aileen Clarke** Professor of Public Health and Health Services Research, Warwick Medical School, University of Warwick, UK

**Dr Tessa Crilly** Director, Crystal Blue Consulting Ltd, UK

**Dr Eugenia Cronin** Senior Scientific Advisor, Wessex Institute, UK

**Ms Tara Lamont** Scientific Advisor, NETSCC, UK

**Professor Elaine McColl** Director, Newcastle Clinical Trials Unit, Institute of Health and Society, Newcastle University, UK

**Professor William McGuire** Professor of Child Health, Hull York Medical School, University of York, UK

**Professor Geoffrey Meads** Professor of Health Sciences Research, Health and Wellbeing Research and Development Group, University of Winchester, UK

**Professor John Norrie** Health Services Research Unit, University of Aberdeen, UK

**Professor John Powell** Consultant Clinical Adviser, National Institute for Health and Care Excellence (NICE), UK

**Professor James Raftery** Professor of Health Technology Assessment, Wessex Institute, Faculty of Medicine, University of Southampton, UK

**Dr Rob Riemsma** Reviews Manager, Kleijnen Systematic Reviews Ltd, UK

**Professor Helen Roberts** Professor of Child Health Research, UCL Institute of Child Health, UK

**Professor Jonathan Ross** Professor of Sexual Health and HIV, University Hospital Birmingham, UK

**Professor Helen Snooks** Professor of Health Services Research, Institute of Life Science, College of Medicine, Swansea University, UK

**Professor Jim Thornton** Professor of Obstetrics and Gynaecology, Faculty of Medicine and Health Sciences, University of Nottingham, UK

**Professor Martin Underwood** Director, Warwick Clinical Trials Unit, Warwick Medical School, University of Warwick, UK

Please visit the website for a list of members of the NIHR Journals Library Board:  
[www.journalslibrary.nihr.ac.uk/about/editors](http://www.journalslibrary.nihr.ac.uk/about/editors)

**Editorial contact:** [nihredit@southampton.ac.uk](mailto:nihredit@southampton.ac.uk)