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Campbell, Faith; Goldsmith, Rachel; Rogers, Helen

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## ORIGINAL ARTICLE

# Are we practising what we preach and are we all singing from the same hymn sheet? An exploration of teaching in paediatric caries management across UK dental schools

Faith Campbell<sup>1,2</sup>  | Rachel Goldsmith<sup>3</sup>  | Helen Rogers<sup>4</sup> 

<sup>1</sup>School of Dentistry, University of Dundee, Dundee, UK

<sup>2</sup>Glasgow Dental Hospital and School, Glasgow, UK

<sup>3</sup>Newcastle Dental Hospital, Newcastle upon Tyne, UK

<sup>4</sup>School of Dental Sciences, Faculty of Medical Sciences, Newcastle University, Newcastle upon Tyne, UK

## Correspondence

Faith Campbell, School of Dentistry, University of Dundee, UK.

Email: [fcampbell001@dundee.ac.uk](mailto:fcampbell001@dundee.ac.uk)

## Abstract

**Background:** The evidence underpinning caries management for children has progressed dramatically over the past 20 years. Anecdotally, this is not reflected in the teaching provided to undergraduate dental students, with the ongoing teaching of outdated methods within some dental schools.

**Aim:** To capture the current undergraduate teaching provision and clinical treatment experience requirement relative to caries management in paediatric dentistry in UK dental schools.

**Design:** Cross-sectional analysis of current teaching methods on paediatric caries management was obtained using a piloted online data collection form. Question content included current caries teaching methods, assessment of student exposure and competence. The results were analysed descriptively.

**Results:** Of the 16 UK dental schools, 14 participated. Discrepancy in teaching content was apparent. Many schools ( $n=9$ ) taught biological caries management through therapeutic fissure sealants, yet this was not reflected in assessment and clinical requirements. Some schools ( $n=4$ ) taught amalgam placement in children, and most ( $n=12$ ) operatively taught treatments that would no longer be routinely provided in general dental practice in the UK, including primary tooth pulpotomy.

**Conclusion:** There is substantial variation in the paediatric caries management techniques that are taught across UK dental schools, demonstrating a need for a national consensus to address these disparities.

## KEYWORDS

Dental education, Pulp biology/basic sciences, Restorative dentistry/dental materials

## 1 | INTRODUCTION

Our understanding of the caries disease process has progressed significantly over recent years. Notably, we

recognise that caries is a continuum, which can shift from a state of active demineralisation to one of remineralisation as a result of changes in the oral environment. We acknowledge the ability of caries to slow, arrest and

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remineralise when isolated from the caries biofilm.<sup>1</sup> Therefore, our management approach has evolved accordingly, incorporating non-invasive and micro-invasive therapies to arrest caries and promote remineralisation, rather than traditional treatments that focussed on the removal of carious tooth tissue. This approach offers numerous advantages, predominantly through preserving tooth tissue and delaying the onset of the restorative cycle, which in turn prolongs the retention of teeth and improves oral health-related quality of life.<sup>2</sup> These novel techniques may also be more acceptable for children. Studies have shown preference and positive patient attitudes for biological caries management techniques such as the Hall technique for the placement of preformed metal crowns on primary teeth.<sup>3,4</sup>

Despite the progression of clinical knowledge on caries management, there have been concerns that this may not have been incorporated into the undergraduate curriculum for all 16 dental schools within the UK. Anecdotally, there has been continued provision of teaching of some techniques, with a reluctance to stop teaching them because other dental schools had not done so.

There is no internationally or nationally agreed content for the teaching of paediatric caries management, nor are there clear and current guidelines on education to inform curricula. The General Dental Council (GDC) document 'Preparing for Practice' outlines outcomes that students should be able to demonstrate for registration as a dental professional.<sup>5</sup> This document is not prescriptive, so there remains great flexibility in how individual schools may interpret it and therefore teach their students.<sup>5</sup> Further to determining the specific content that they teach students, schools can also choose the methods of teaching and assessment, and to a degree the amount of clinical experience that students receive before graduating. This may result in students graduating from different dental schools with varying skills in, and views on, caries management, which may translate into children receiving different, and not always optimal, care depending on where their dentist had graduated. As such, it is important to gain clarity on what is actually being taught and assessed across the UK with regard to caries management for paediatric patients. The authors are not aware of any other studies with focus on the teaching of paediatric caries management, leaving a gap in knowledge on this topic within the UK in particular.

The aim of this study was to capture the current UK undergraduate teaching content, methods of teaching and assessment, and clinical experience requirements for managing caries in children. It is anticipated that the findings of this study could prompt the development of a centralised UK paediatric caries curriculum in order to standardise teaching.

### Why this paper is important to paediatric dentists

- There is inconsistency across the UK regarding the content of teaching on caries management in children to undergraduate dental students.
- There has been a delay in the adoption of evidence-based caries management techniques and a reluctance in removing outdated techniques from the paediatric caries curriculum.
- There is a need for a national UK paediatric caries curriculum to ensure UK undergraduate students can receive standardised, evidence-based content, regardless of where they study.

## 2 | MATERIALS AND METHODS

This study used a cross-sectional design to capture teaching approaches for caries management in children during the academic year 2020/2021 through the use of a data collection form that was sent to all 16 dental schools within the UK. In order to obtain meaningful information relating to the national picture, it was important for this project to include as many dental schools as possible.

### 2.1 | Recruitment

An open invitation was sent to known contacts within the paediatric dental teaching teams at all 16 UK dental schools, through the Child Oral Health National Research Collaborative (CONNECT). These contacts were all members of the network and were speciality registrars, core trainees or staff grades in paediatric dentistry. It was emphasised that participating schools would not be identifiable through the data supplied during dissemination to avoid reporting bias.

The invitations were sent in February 2022 and included the details of the project, a consent form and the data collection form. Participating schools were given until May 2022 to complete and return the form. All schools that did not respond within 2 weeks were sent email reminders regarding completion. Given that numerous dental schools were undergoing changes in their teaching programmes, contacts in participating schools were also given the opportunity to update their responses between November 2022 and March 2023. Invitations reassured potential participants that their responses would be held anonymously and that only the research team would know their individual response. Invitations also clarified that neither the

respondent nor their dental school would be identifiable through the dissemination of findings.

## 2.2 | Consent

All participating schools gave consent for the data supplied to be published anonymously. This consent was provided prior to data collection and confirmed with a further consent form prior to the dissemination of results, with an opportunity to update data supplied or withdraw from the study. No patient consent was required as no patients were involved in this study.

## 2.3 | Data collection

A data collection form was developed to assess three domains: teaching methods and content regarding paediatric caries management, assessment and clinical experience (Data S1). These domains were chosen to evaluate teaching content, methods and therefore the experience that students were graduating with. It was anticipated that this would differ between schools due to 'Preparing for Practice' being so open to interpretation.<sup>5</sup> An introductory paragraph within the form defined all technical terms used (Data S1). The form used closed questions with the opportunity to add free text within each of the three domains.

The teaching method domain included lectures, tutorials/seminars, online modules and preclinical skills teaching. Teaching content explored how students were taught to prevent caries, manage early and established carious lesions not into pulp (defined as less than one-third into dentine), and carious lesions close to or into pulp in the primary and permanent dentition. Some miscellaneous topics were also included. The threshold of less than one-third into dentine is important as non-cavitated carious lesions that have progressed less than one-third into dentine are not likely to be significantly infected with bacteria and hence are capable of healing with biological approaches to caries management with no caries removal.<sup>6</sup>

To explore the assessment of student competence in managing caries in children, the data collection form explored whether the school had prerequisite competencies, the methods employed for these competencies, subject areas covered and how they were graded. The form also sought information on how failure to demonstrate competence on the first attempt was managed. This would provide information on whether and how students had to demonstrate competence in managing caries in children. Clinical experience requirements (sometimes referred to

TABLE 1 Summary of responses received for the data collection form.

Data collection form responses	
Number of responses from UK dental schools	14/16 (88%)
Number of complete responses from UK dental schools for Domain 1, teaching	13/13 (100%)
Number of complete responses from UK dental schools for Domain 2, assessment	13/13 (100%)
Number of complete responses from UK dental schools for Domain 3, clinical experience	2/13 (15%)
Number of partially complete responses from UK dental schools for Domain 3, clinical experience	9/13 (69%)

as 'targets') were sought for students who had graduated in the academic year 2020/2021.

The data collection form was designed to be completed on a computer, and initial piloting in Glasgow and Newcastle suggested that this should take less than 2 h to complete with senior academic support as required. After piloting, adjustments were made prior to releasing the form to the other schools to complete in order to make this as straightforward to complete as possible. These revisions considered balancing adequate comprehensiveness to collect sufficient data to be meaningful whilst not being so long that it discouraged completion. The final form was sent in the Microsoft® Word format (Microsoft®, Washington).

## 2.4 | Analysis

Simple descriptive statistics were undertaken on the combined data from all of the participating schools on a master data collection sheet in Microsoft® Excel® (Microsoft®). The researchers predicted some discrepancies in how each unit would provide the data, which would likely limit the amount of statistical analysis that could be undertaken. Further narrative analysis was therefore likely to be useful. If data were missing from a section of the form, then that school was excluded from analysis for that component only, in order to reduce the extent to which the missing data impacted the analysis.

## 3 | RESULTS

Responses were received from 14 of the 16 UK dental schools invited (Table 1). Of those schools, 13 were able to provide responses through the form. The remaining school was extremely willing to provide information; however, their current teaching practice did not fit in

the response sheet due to the set-up of their curriculum. Therefore, this school was excluded from the analysis of these results. Of those schools that did not participate, one advised that they were in the process of developing their programme and did not wish to complete the data collection form with regard to the previous curriculum. One school did not respond to contact attempts.

All data collection forms were completed by clinicians working in paediatric dentistry clinics, with some involvement in teaching undergraduate dental students within their respective dental schools. The level of experience of respondents who completed the forms varied significantly, due to the substantial variation in the size of dental schools and hence the staff available to take part.

Almost all data collection forms had missing data, and one unit completed all domains of the form.

### 3.1 | Domain 1: teaching content and methods of delivery

Domain 1 of the data collection form was completed by 13 schools and explored the teaching of management of early and established carious lesions that did not extend into pulp, and those that extended close to or into pulp within the primary and permanent dentition (Table 2).

### 3.2 | Teaching of caries management in the primary dentition

#### 3.2.1 | Early or established lesions not into pulp

The results for this section are shown in Figure 1. Some schools were teaching biological caries management such as silver diamine fluoride (SDF;  $n = 10$ ), theoretically and practically ( $n = 2$ ). Some were teaching therapeutic fissure sealants through lectures ( $n = 9$ ), with less teaching this practically in the simulated clinical environment (SCE;  $n = 2$ ). A small number of schools reported teaching amalgam restorations for paediatric caries management through lectures ( $n = 4$ ) and in the SCE ( $n = 1$ ; Table 1). Many schools were teaching conventional crown preparation in primary molars in the SCE ( $n = 9$ ).

### 3.3 | Management of carious lesions close to or into pulp

With respect to carious lesions close to or into pulp in the primary dentition, the majority of schools were

TABLE 2 Summary of methods of caries management deemed of greatest interest and showing greatest variance between schools.

Management of caries in the primary dentition for early caries/caries less than one-third into dentine	Number of schools teaching this method (%)
Biological management of caries	
Use of silver diamine fluoride in a simulated clinical environment	2/13 (15)
Prevention-only approach lectures	11/13 (85)
Prevention-only approach in a simulated clinical environment	3/13 (23)
Fissure sealants as treatment through lectures	9/13 (69)
Fissure sealants as treatment simulated clinical environment	6/16 (46)
Hall technique for the placement of preformed metal crowns through lectures	12/13 (92)
Hall technique for the placement of preformed metal crowns in a simulated clinical environment	11/13 (85)
Management of caries in the primary dentition for lesions without pulpal involvement or apical pathology	Number of schools teaching this method (%)
Amalgam restorations in primary teeth through lectures	4/13 (31)
Amalgam restorations in primary teeth in a simulated clinical environment	1/13 (8)
Primary tooth pulpotomy due to carious exposure in a simulated clinical environment	12/13 (92)
Management of caries in the permanent dentition in children for early caries/caries less than one-third into dentine	Number of schools teaching this method (%)
Preventative resin restorations/sealant restorations/enamel biopsies through lectures	12/13 (92)
Preventative resin restorations/sealant restorations/enamel biopsies in the simulated clinical environment	8/13 (62)
Amalgam restorations in the clinical skill environment	3/13 (23)
Prevention-only approach through lectures	9/13 (69)
Prevention-only approach in the clinical skill environment	1/13 (8)
Management of carious lesions close to / into pulp in permanent dentition	Number of schools teaching this method (%)
Non-selective (complete) caries removal through lectures	10/13 (77)

TABLE 2 (Continued)

Management of carious lesions close to / into pulp in permanent dentition	Number of schools teaching this method (%)
Non-selective (complete) caries removal in the simulated clinical environment	4/13 (31)
Use of biodentine / mineral trioxide aggregate (MTA) in deep carious lesions (no frank pulp exposure) through lectures	7/13 (54)
Poor prognosis first permanent molars and planned extraction through lectures	12/13 (92)

teaching all methods of caries removal: non-selective (complete;  $n = 9$ ), stepwise ( $n = 10$ ) and selective ( $n = 11$ ) through lectures. Some schools were teaching selective ( $n = 4$ ) and stepwise management ( $n = 4$ ) of caries in the SCE. As expected, all schools were teaching extraction. Less schools exposed students to extraction in the SCE, in the clinical environment under local anaesthesia only ( $n = 6$ ) or with local anaesthesia and inhalation sedation ( $n = 2$ ). No schools included performing extraction of primary teeth under general anaesthesia within their curriculum, although some did provide clinical exposure to this.

Almost all schools were teaching pulpotomies through lectures ( $n = 12$ ) and in the SCE ( $n = 11$ ). One school also taught pulpectomies in the SCE.

### 3.4 | Teaching of caries management in the permanent dentition

#### 3.4.1 | Early or established carious lesions not into pulp in the permanent dentition

All schools were teaching a variety of methods for managing early caries in permanent teeth in children (Figure 2). Most schools were teaching 'preventive resin restorations' (PRRs) through lectures ( $n = 12$ ) and in the SCE ( $n = 8$ ). Many schools were teaching the placement of fissure sealants to manage early caries through lectures ( $n = 10$ ) and in the SCE ( $n = 10$ ). Amalgam was being taught as a restorative material for carious permanent teeth in children through lectures ( $n = 6$ ) and in the SCE ( $n = 3$ ). Additionally, some other schools commented that this was indeed being taught in relation to the management of carious permanent teeth in children, but that this teaching was provided by their restorative colleagues.

### 3.5 | Management of carious lesions close to or into pulp

For the management of carious lesions close to or into pulp in permanent teeth for children, most schools taught the majority of management approaches through lectures (Figure 3). Within the SCE, most schools did not teach any methods of managing carious lesions close to or into pulp. Again, this may be due to shared teaching with restorative colleagues.

### 3.6 | Domain 2: assessment of student competence

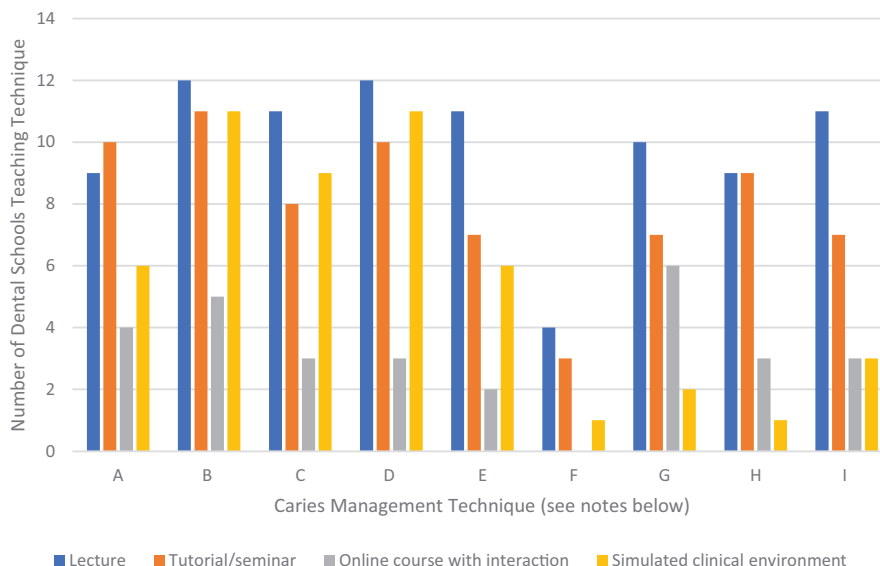
All of the responding schools had prerequisite competencies related to caries prevention and management for paediatric patients, which took varying forms, and were graded and utilised differently between schools (Table 3). All schools also employed observed clinical procedures as a method to assess competence, with three using posters and case-based discussions and four using oral presentations and assignments. Most schools used multiple methods to assess competence.

Of note, no single topic was a competence required by all schools, including fissure sealants and preformed metal crown placement using the Hall technique. All schools allowed repeat attempts at competencies if they were not passed first time, with approximately half having ramifications for repeating.

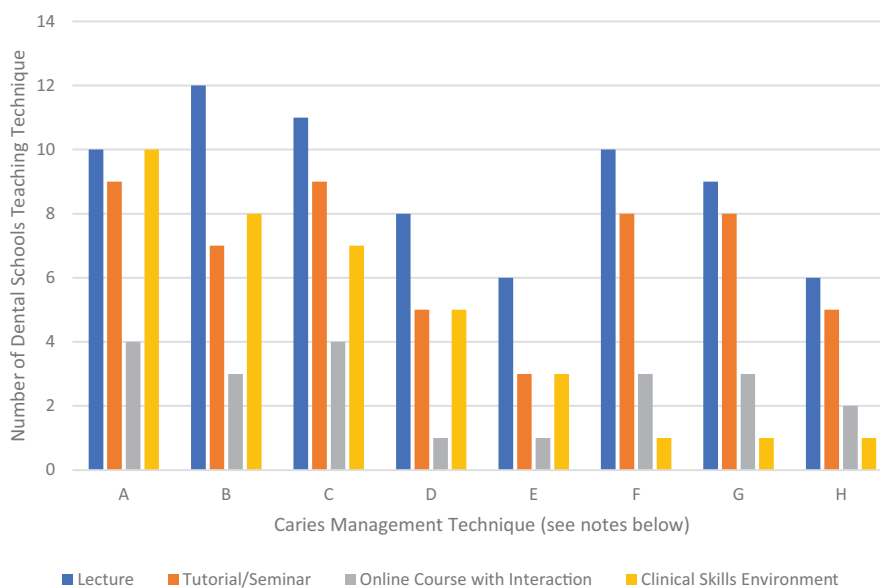
### 3.7 | Domain 3: clinical experience in paediatric dentistry

The completion rate of the 24 questions relating to the clinical experience and requirements was varied. This ranged between 0 and 24 questions answered, and the mean question completion rate was 43% ( $n = 10.5$ ). Of those completed questions, not all sections of the question were always complete, and the frequently missing section was the number of times that a procedure was undertaken.

Less than half of the responding schools had a prerequisite number of clinical contacts for undergraduate students seeing children ( $n = 6$ ). The majority of schools, however, had requirements of minimum numbers for given paediatric clinical procedures ( $n = 10$ ). For all of these schools, students were made aware of the minimum numbers. Consequences of not reaching these minimum numbers varied; some schools prevented students from progressing to the next year of



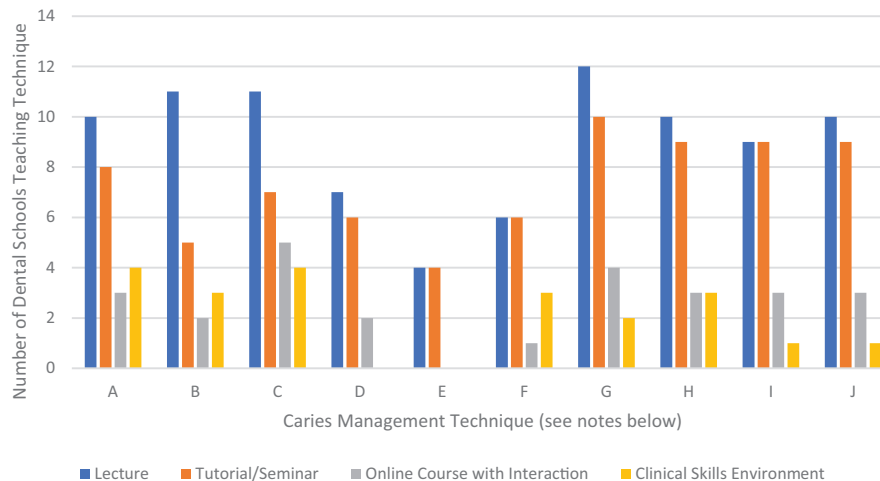
**FIGURE 1** Responses to questions regarding the management of the early/established carious lesion not into pulp (less than a third into dentine) in the primary dentition. A—fissure sealants as treatment for early caries/caries less than one-third into dentine; B—preformed metal crowns (Hall technique—no preparation); C—preformed metal crowns (conventional technique—with crown preparation); D—composite restorations in primary teeth; E—glass ionomer cement/resin-modified glass ionomer cement restorations in primary teeth; F—amalgam restorations in primary teeth; G—silver diamine fluoride in primary teeth; H—making a cavity self-cleansing (discing/slicing contact points); I—prevention-only approach (prevention as above) for the management of non-pulpally involved teeth with no apical pathology.



**FIGURE 2** Responses to questions regarding the management of the early/established carious lesion (not into pulp) in the permanent dentition. A—fissure sealants as treatment for early caries/caries less than one-third into dentine; B—preventative resin restorations/sealant restorations/enamel biopsies; C—composite restorations in permanent teeth; D—glass ionomer cement/resin-modified glass ionomer cement restorations in permanent teeth; E—amalgam restorations in permanent teeth; F—preformed metal crowns on first permanent molars as a short- to medium-term restoration (+/- molar incisor hypomineralisation); G—prevention-only approach (prevention as above) for the management of non-pulpally involved teeth with no apical pathology; H—silver diamine fluoride in permanent teeth.

the programme ( $n=5$ ), sitting their final examinations ( $n=4$ ) or graduating ( $n=8$ ). Five schools had multiple consequences; two prevented both proceeding to the

next year and graduating, whilst three schools prevented proceeding to the next year, sitting final examinations and graduating.



**FIGURE 3** Responses to questions regarding the management of carious lesions close to pulp in the permanent dentition. A—non-selective (complete) caries removal; B—stepwise caries management; C—selective caries management; D—use of biodentine/mineral trioxide aggregate in deep carious lesions (no frank pulp exposure); E—pulpotomies on permanent teeth (carious exposure, not trauma related); F—root canal treatment on permanent teeth in paediatric patients; G—poor prognosis first permanent molars and planned extraction; H—extraction under local anaesthetic; I—extraction with LA + Inhalation Sedation; J—extraction under general anaesthetic.

### 3.8 | Free-text comments

Four schools completed the free-text comments, which were reviewed by all three authors. Since few comments were provided and the topics varied considerably, no attempt was made to qualitatively or quantitatively analyse these comments. In summary, two schools that provided comments outlined plans to align their curricula with guidelines and transition to competency-based assessment. One school discussed plans to include clinical experience in inhalation sedation as part of their curriculum. Finally, comments were provided regarding restrictions placed by the COVID-19 pandemic affecting the clinical experience that the school could provide during the academic year in question.

## 4 | DISCUSSION

This novel study describes the first UK-wide analysis of undergraduate paediatric caries management teaching. Whilst not all UK dental schools took part, the response rate was good, and a wide variation in teaching content and methods, assessment and clinical experience requirements for this key aspect of paediatric dentistry was demonstrated.

These findings are consistent with the existing literature in this field from other countries. Variation in content, method of instruction and amount of clinical experience has been demonstrated between 31 dental schools across 10 Middle Eastern countries through a recent questionnaire-based study.<sup>7</sup> A similar study in Iran

evaluated 40 undergraduate dental programmes and also found variation in the content and experience in paediatric caries management between schools.<sup>8</sup> They also found that minimally invasive approaches to caries management including the use of SDF and the Hall technique for placing preformed metal crowns were not commonly taught 'despite the evidence base for these techniques'.<sup>8</sup> A recent international survey of National Member Societies of the International Association of Paediatric Dentistry (IAPD) to explore the teaching of paediatric dentistry evaluated whether paediatric dentistry was being taught at undergraduate and postgraduate levels but did not however explore the exact content.<sup>9</sup> Furthermore, the results of the present study align with a previous UK-based study that evaluated the teaching of paediatric dentistry in general and found variance between the content and method of undergraduate paediatric dentistry teaching, highlighting heterogeneity across the UK, though this did not focus on caries teaching specifically.<sup>10</sup>

Whilst this study revealed a substantial amount of new information regarding teaching in this field across the UK, the authors are keen to focus in on some key aspects.

### 4.1 | Contemporary caries management

This study found that most schools were teaching some techniques of biological caries management, but despite being taught theoretically in lectures, this did not always translate to practical teaching in the CSE. Non-operative biological management, such as therapeutic fissure sealing of caries and preformed metal crown placement



TABLE 3 Data provided regarding the use of competencies in paediatric dentistry across the 13 participating schools.

<b>Prerequisite competencies related to paediatric dentistry (13 schools)</b>															
Yes	13 (100%)				No	0 (0%)									
<b>Methods employed to assess competencies (13 schools)</b>															
Oral presentation	4 (31%)	Poster presentation	3 (23%)	Clinical skills lab observations	8 (62%)	Observed clinical procedure	7 (54%)	PFMC placement (Hall technique)	9 (69%)	Intra-coronal restoration (primary tooth)	9 (69%)	Case-based discussions	3 (23%)	Assignment	4 (31%)
<b>Subject areas covered by competencies (13 schools)</b>															
Delivery of diet advice	9 (69%)	Delivery of oral hygiene instruction	10 (77%)	Fluoride varnish application	7 (54%)	Extraction of a permanent tooth under local anaesthetic	5 (38%)	Fissure sealant placement	11 (85%)	Alternate scoring system	3 (23%)				
Intra-coronal restoration (permanent tooth)	7 (54%)	Extraction of a primary tooth under local anaesthetic	5 (38%)	Extraction of a permanent tooth under local anaesthetic	5 (38%)	Extraction of a permanent tooth under local anaesthetic	5 (38%)	Fissure sealant placement	11 (85%)	Alternate scoring system	3 (23%)				
<b>How are these competencies graded? (13 schools)</b>															
Pass/fail	10 (77%)					Alternate scoring system	3 (23%)								
<b>Repeat attempts allowed if not passed on first attempt (13 schools)</b>															
Yes	13 (100%)					No	0								
<b>How many times can they be repeated? (13 schools)</b>															
Once only	0	2–4 times	1 (7%)	5+ times	0	No upper limit	11 (85%)	Case-by-case basis	1 (7%)						
<b>Ramifications for repeating (13 schools)</b>															
Yes	7 (54%)					No	6 (46%)								
<b>Timing that competencies carried out (several options allowed).</b>															
At the students' request	4 (31%)	At a predetermined point in the curriculum (e.g., 3rd year/5th year)	7 (54%)	When the clinical supervisor deems appropriate	6 (46%)										

without tooth preparation (Hall technique) for primary teeth, was being taught through lectures, but there was inconsistency in whether students were taught these methods clinically. Failure to fully embed biological caries management techniques in the curriculum may devalue these methods, particularly if students are not clinically practising them. Students may be therefore unprepared to apply them to their independent practice upon graduation. Furthermore, teaching of biological approaches was generally combined with many outdated techniques of managing caries, such as non-selective caries removal, routine use of dental amalgam in children and PRRs to manage early caries.

Non-selective caries removal was defined in this study as 'all demineralised dentine is removed in order to reach hard dentine, where no part of the visible carious tissue is left' prior to the placement of a restoration. This approach is not recommended for either primary or permanent teeth by the Scottish Dental Clinical Effectiveness Programme (SDCEP), European Society for Endodontology (ESE) and Joint European Organisation for Caries Research (ORCA) and European Federation of Conservative Dentistry (EFCD) Expert Delphi Consensus Statements having been demonstrated as being no superior to prevention and biological management for caries in primary teeth.<sup>11-14</sup> Non-selective caries removal in children is being taught in most schools through lectures, and by some in the CSE. It appears that in some schools, teaching needs to align itself with current evidence.

The results of this study show that some UK dental schools are continuing to teach students how to provide amalgam restorations for carious primary and/or permanent teeth in children, though none reported setting clinical experience or assessment requirements for this. The value of teaching the use of dental amalgam in children can be questioned since the 2018 European Directive, which was adopted by the National Health Service (NHS), which states that dental amalgam shall not be used for dental treatment of children under 15 years or in primary teeth.<sup>15</sup> Whilst there may be rare exceptions, it is clear that there is no need for amalgam to form part of a paediatric dental curriculum, particularly since students will likely still learn to use amalgam as part of their adult restorative dentistry teaching. This is further reinforced by the European Academy of Paediatric Dentistry guidance that does not recommend the use of amalgam in primary teeth.<sup>16</sup>

Preventive resin restorations, whereby stained enamel is removed and the tooth 'explored' for the presence of caries, have not been recommended as being an appropriate dental treatment for over 10 years.<sup>6,13</sup> Furthermore, guidance from Europe, the UK, the United States of America and the IAPD does not recommend

this approach for managing early (non-cavitated occlusal) caries; instead, they recommend the sealing in of non-cavitated caries less than a third into dentine with resin sealants.<sup>11,17-19</sup> Likewise, the Joint ORCA and EFCD Expert Delphi Consensus statement advocates for non-invasive approaches and fissure sealing for the management of non-cavitated occlusal lesions, with defect-orientated restoration of cavitated lesions only.<sup>13</sup> Despite this, our study showed that PRRs are still being taught in six schools theoretically, and in three schools practically in the CSE.

This partial adoption of contemporary caries management approaches, and a concurrent reluctance to let go of conventional methods, suggests that further work is needed to truly embed evidence-based dentistry within the curricula.

It is acknowledged that implementing such changes in dental curricula is challenging, requiring strong leadership and management, careful planning and a stepwise approach.<sup>20</sup> There have also been calls for international collaboration in curricular change to optimise the likelihood of successful implementation.<sup>20</sup> This highlights the challenge faced in educational reform and the need for a faculty-driven, coordinated approach to aligning the current undergraduate paediatric dental curriculum.

## 4.2 | Scope of practice

All included dental schools were teaching students to undertake a pulpotomy to manage caries in a primary tooth in a simulated setting, and one school had this as a mandatory competency in the clinical setting. In four schools, primary molar pulp therapy for the management of caries was an assessed clinical competency, which requires further exploration. In some countries, guidelines advise that a pulpotomy may be considered a procedure to be undertaken by general dental practitioners in primary care.<sup>21</sup> In contrast, in the UK, the British Society for Paediatric Dentistry Position statement on pulp therapy has not been updated since 2006, which demonstrates that this is no longer considered a routine procedure even for specialists in paediatric dentistry.<sup>22</sup> According to NHS England commissioning guidance, pulpotomy is classed as Level 2 treatment 'requiring a clinician with enhanced skills and experience who may or may not be on a specialist register'.<sup>23</sup> The UK regulatory body, the GDC, requires newly qualified dentists and therapists to be at the level of a 'safe beginner' defined as 'a rounded professional who (...) will have the range of professional skills required to begin working as part of a dental team'.<sup>5</sup> The value of requiring undergraduate dental students, who are being prepared for general practice, to be able

to demonstrate skills in undertaking such a complex procedure is therefore doubtful and may leave students unaware that this is beyond the remit of a newly graduated, non-specialist dentist. Indeed, even many specialist paediatric dentists would rarely undertake these procedures given the increased success and acceptability of biological approaches such as the Hall technique.<sup>3,4,24,25</sup> By teaching undergraduate students to perform techniques that are either outdated, specialist-level or not routinely provided, this may be taking valuable training time away from learning skills that would be routinely employed as a safe beginner.

### 4.3 | Assessment and clinical experience of caries management

All schools required students to demonstrate competence in paediatric caries management, which is positive, as it demonstrates that this is considered to be a key component of training towards becoming a safe beginner. Nonetheless, there was variation in the specific techniques of caries management that students were required to demonstrate competence in.

A number of schools required students to demonstrate competence in placing intra-coronal restorations in primary teeth. The value of this requirement could be questioned, given that evidence demonstrates that preformed metal crowns are more effective than conventional restorations in managing caries in primary molars and are less likely to cause abscess and pain.<sup>26</sup> The placement of a preformed metal crown using the Hall technique is considered the gold standard for the management of multi-surface caries in primary teeth in guidelines internationally.<sup>11,27</sup> This technique is also more acceptable to general dental practitioners, children and carers than conventional restorations.<sup>3</sup> Conversely, only six of the 13 schools required students to demonstrate competency in placing a preformed metal crown using the Hall technique within their curriculum. Likewise, only two schools required students to place and demonstrate competence in SDF placement. Prior to the COVID-19 pandemic, caries management using SDF was not commonplace in the UK.<sup>28</sup> Since then, it has become much more widely used given the large evidence base to support its use.<sup>29</sup> Furthermore, the use of SDF is now advocated by numerous guidelines nationally and internationally.<sup>16,30,27,31</sup> Therefore, it is essential that students are adequately prepared to provide this treatment. If students are not required to provide or demonstrate competence in biological caries management, it is unlikely that they will be empowered to do so when performing as an independent practitioner.

### 4.4 | International relevance

This is a study based in the UK, which highlights an inconsistency in aligning undergraduate teaching with national and international guidelines. The UK is responsible for training dentists and therapists who work internationally; therefore, the impact of this disparity on teaching may impact globally. The paediatric dentistry curriculum seems to be of international importance, with a team in Australia recently finding that final-year dental students are not confident in pulp therapies and trauma management, recommending the redesign of the curriculum to address this.<sup>32</sup> A consortium in Chile also highlighted a lack of standardisation in the teaching of paediatric dentistry to undergraduate dental students and a need for alignment within the global context.<sup>33</sup> Similarly, a recent survey of teaching of minimally invasive dentistry in Iranian Dental Schools found variation in the teaching of this, with some minimally invasive approaches not being routinely taught at all, in contrast to the current best evidence.<sup>8</sup> Their findings were similar to this current study. Another group in Malaysia has developed expert consensus on relevant topics for the undergraduate dental curriculum in an effort to align teaching.<sup>34</sup> Evidently, paediatric dentistry colleagues are working on this internationally, and this work contributes to a growing base of evidence for collaboration and consistency in developing undergraduate curricular globally.

### 4.5 | Strengths and limitations

Strengths of this novel study include the high participation rate and the involvement of a senior academic in the return of all data. This suggests that tackling curricula variation in paediatric caries management is a priority for dental schools across the UK.

Nonetheless, there are a number of limitations. Missing data were a particular problem within this study, which reduced the sample for analysis in each domain. It was particularly difficult to draw conclusions from the data received on the clinical experience in paediatric caries management due to the very limited amount of data available. The length of the data collection form gave potential for survey fatigue although was only required to be completed once for each dental school, and all respondents were made aware of the survey length prior to agreeing to take part. The form length could certainly have contributed towards missing data, and there were also reported challenges in respondents accessing the data.

Respondents were advised that the data collection form was anonymous and that no unit would be identifiable in the dissemination of results. Nonetheless, there are

a relatively small number of dental schools within the UK, and not all schools participated; hence, some concerns regarding anonymity may have persisted. This may also have led to response bias.

#### 4.6 | Further research

This work has led to the commencement of a scoping review of current international guidelines regarding the management of caries in children, which will inform the development of a consensus statement from UK dental schools regarding the teaching of caries management in children to undergraduate dental students (Open Science Framework Registration, <https://doi.org/10.17605/OSF.IO/SBHC3>). It is anticipated that this will assist in providing aligned, evidence-based curricula for UK dental schools.

This work may also inform other similar studies internationally in order to gain an insight into the content and consistency of teaching of paediatric caries management. This can then inform further research and alignment of curricula globally.

#### 4.7 | Conclusion

There is variation in the teaching of caries management in children to undergraduate dental students. This includes the clinical teaching and assessment of complex, specialist-level procedures in some schools and a delay in fully integrating the evidence base on biological management of caries into all aspects of the undergraduate curriculum. This research demonstrates a need for a UK national paediatric caries curriculum. Further research is in progress to reach consensus on what should be included in the undergraduate dental curriculum for paediatric dentistry nationally. This will achieve equity and consistency for all graduating dental students and the population that they care for.

#### AUTHOR CONTRIBUTIONS

H.R. conceived the idea; F.C. and R.G. collected and analysed the data; F.C. led the writing; all authors reviewed and approved the final manuscript.

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#### CONFLICT OF INTEREST STATEMENT

Helen Rogers is the past Chair of the Teachers' Branch of the British Society of Paediatric Dentistry.

The other authors have no conflicts of interest to declare.

#### DATA AVAILABILITY STATEMENT

Research data are not shared.

#### ETHICS STATEMENT

Ethics approval was sought from Newcastle University (27073/2022).

#### PATIENT CONSENT STATEMENT

Not applicable as this paper does not involve any patients.

#### ORCID

Faith Campbell  <https://orcid.org/0000-0002-7630-2983>

Rachel Goldsmith  <https://orcid.org/0009-0008-3879-9694>

Helen Rogers  <https://orcid.org/0000-0001-5031-5009>

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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