Cost savings from a teledentistry model for school dental screening: an Australian health system perspective

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Abstract

Objective. The aim of the present study was to compare the costs of teledentistry and traditional dental screening approaches in Australian school children.

Methods. A cost-minimisation analysis was performed from the perspective of the oral health system, comparing the cost of dental screening in school children using a traditional visual examination approach with the cost of mid-level dental practitioners (MLDPs), such as dental therapists, screening the same cohort of children remotely using teledentistry. A model was developed to simulate the costs (over a 12-month period) of the two models of dental screening for all school children (2.7 million children) aged 5–14 years across all Australian states and territories. The fixed costs and the variable costs, including staff salary, travel and accommodation costs, and cost of supply were calculated. All costs are given in Australian dollars.

Results. The total estimated cost of the teledentistry model was $50 million. The fixed cost of teledentistry was $1 million and that of staff salaries (tele-assistants, charters and their supervisors, as well as information technology support was estimated to be $49 million. The estimated staff salary saved with the teledentistry model was $56 million, and the estimated travel allowance and supply expenses avoided were $16 million and $14 million respectively; an annual reduction of $85 million in total.

Conclusions. The present study shows that the teledentistry model of dental screening can minimise costs. The estimated savings were due primarily to the low salaries of MLDPs and the avoidance of travel and accommodation costs. Such savings could be redistributed to improve infrastructure and oral health services in rural or other underserved areas.

What is known about the topic? Caries is a preventable disease, which, if it remains untreated, can cause significant morbidity requiring costly treatment. Regular dental screening and oral health education have the great potential to improve oral health and save significant resources. The use of role substitution, such as using MLDPs to provide oral care has been well acknowledged worldwide because of their ability to provide safe and effective care. The teledentistry approach for dental screening offers a comparable diagnostic performance to the traditional visual approach.

What does this paper add? The results of the present study suggest that teledentistry is a practical and economically viable approach for mass dental screening not only for isolated communities, but also for underserved urban communities. The costs of the teledentistry model were substantially lower than the costs associated with a conventional, face-to-face approach to dental screening in both remote and urban areas. The primary driver of net savings is the low salary of MLDPs and avoidance of travel and overnight accommodation by MLDPs.

What are the implications for practitioners? The use of lower-cost MLDPs and a teledentistry model for dental screening has the potential to save significant economic and human resources that can be redirected to improve infrastructure and oral care services in underserved regions. In the absence of evidence of the economic usefulness of teledentistry, studies such as the present one can increase the acceptance of this technology among dental care providers and guide future decisions on whether or not to implement teledentistry services.
Introduction

In all Australian states and territories, the provision of free or low-cost dental care for school children is provided by the School Dental Service (SDS). Historically, school dental therapists have been responsible for providing most of the SDS dental services (examination, diagnosis, treatment and preventive care) under the supervision of dentists. The employment of dental therapists was limited to the state-operated SDS, but now many dental therapists are employed in the private sector. In recent years there has been a gradual reduction in workforce participation and scarcity of resources in SDS. A recent report suggested that the SDS rarely provides sustainable dental care, less than a quarter of Australian school children attended a SDS for their last dental visit. The decreased retention and recruitment of school dental therapists is attributed to the preference of school dental therapists to work in the private sector or leave the profession, as well as the establishment of a bachelor degree (3 years at university level) of Oral Health Therapy in several Australian universities. This degree is intended to replace the existing (2-years vocational level) diploma programs in Dental Therapy or Dental Hygiene. The new bachelor programmes allow the oral health therapist (OHT) to incorporate the skills of both the dental hygienist and the therapist. Despite improvements in oral health over past decades, nearly half the school children receiving dental care within the SDS do not enjoy good oral health. In 2010, 55% of children aged 6 years had experienced decay in their deciduous teeth, whereas 48% of children aged 12 years had a history of decay in their permanent teeth. Dental caries is a potentially preventable infectious disease, which, if left untreated, can lead to considerable morbidity requiring expensive treatment. In 2013–14, the total national expenditure on dental care in Australia increased from $6 to $9 billion, with 60% of this estimated to be out-of-pocket spending. Improving oral health in children is achieved through the implementation of a range of systematic preventive strategies, such as oral health promotion, systemic and topical fluorides, fissure sealants and improvements in the diet. However, these measures are often not directed towards children with the greatest needs. Dental screening using a reliable and low-cost screening tool offers a way to identify high-risk groups, and thus provides a useful approach for the effective prevention and control of dental diseases.

In 2015, dentists made up 75% (n = 15 500) of the dental workforce in Australia, compared with <10% (n = 2050) dental therapists or OHTs. However, most Australian dentists (85%) work in the private sector. In recent years, many dental therapists or OHTs have opted for private practice careers because of a lack of competitive salaries in the SDS or public sector. In the private sector, dental therapists or OHTs are often working as ‘hygienists’ responsible for performing scaling and root planing for adult patients; thus, they have a minor role in the provision of dental care. OHTs have not been used effectively to increase the capacity of the existing dental workforce (i.e. mostly dentists) and address the inequity in access to dental care. One way to address the inequality in oral health is role substitution in dentistry, where the duties performed by expensive dentists are delegated to mid-level dental practitioners (MLDPs), such as OHTs or dental therapists. The use of MLDPs to provide dental care has received increasing acceptance worldwide because of the inability of dentists alone to address all unmet oral care needs. There is evidence that OHTs have the potential to detect oral diseases in vivo with a standard comparable to that of dentists. It could be reasonable to use OHTs to screen, diagnose and provide simple treatment while reserving dentists for managing complicated cases. Using MLDPs for the dental screening of asymptomatic populations could improve oral health in underserved populations and free up significant resources.

Despite teledentistry still being in its infancy and not having been widely used as a screening tool, recent reports indicate that MLDPs have the potential to screen for dental caries using a smartphone camera, with acceptable diagnostic performance. These findings are consistent with previous research indicating that teledentistry provides a reliable and potential cost saving alternative to traditional screening. Although teledentistry is becoming increasingly popular, the number of economic analyses of teledentistry, particularly those looking at cost minimisation, remains small. A comparison of the costs of teledentistry and its alternatives is of particular importance to those making future decisions about implementing a new screening service. The purpose of the present study was to model and evaluate the costs of a teledentistry approach to screen for dental caries and compare it with the modelled costs of the traditional alternatives from a national care provider’s perspective.

Methods

In order to identify the least costly alternative, a cost-minimisation analysis was performed to compare the costs of two methods of dental screening that provide comparable outcomes. The analysis was conducted from the perspective of the health system and did not take into consideration costs incurred by the patients or their families. A model was developed to simulate the costs of screening all Australian school children (aged 5–14 years) using teledentistry (where therapists or OHTs performed online charting using dental photographs taken with a smartphone camera) and the traditional approach (a dentist performing a traditional visual screening). Because dental caries in children occurs rapidly and progressively, a 1-year time period was used in both dental screening models. All data were collected from web-based open-access sources; therefore, no ethics approval was required.

Screening procedures for teledentistry and traditional models

The teledentistry model was based on a mobile teledentistry system developed by a team at the Australian e-Health Research Centre, CSIRO. This system uses an Android app and a 'Remote-
 Developed to facilitate the local acquisition of dental photographs, as well as the transmission and reviewing of the dental images remotely. Trained tele-assistants (teachers) acquire photographs from children’s mouths at their schools using their own mobile cameras. Dental records (including dental photographs and anonymous patient details) are then directly transmitted from the Android app to the server via the Internet (Fig. 1). The charting of dental records is performed by dental therapists (charters) under the indirect supervision of registered dentists at a distance. Charters are able to access the database using any web browser and from any location. After selecting a record from the database, a list of dental photographs and a predefined assessment chart appears for the charter to insert their findings (Fig. 2). The chart includes an oral health assessment form aligned with the World Health Organization (WHO) protocol for oral health assessment. The system enables charters to independently review dental photographs and submit reports or recommendations to the server. Detailed descriptions of the Remote-i system and screening process have been published previously.

Under the traditional model, operators (registered dentists) and their dental assistants are assumed to travel across the nation to perform on-site dental screening among the same cohort of children in their own schools. Using the screening protocol as in previous studies, the unaided visual examination of school children was performed by operators to screen for caries lesions and existing restorations, which were then recorded on an oral assessment form aligned with the WHO protocol. No radiographs were used in the dental screening, but retractors and mirrors were used to permit visualisation of the teeth.

National distribution of the models
Australia is divided by the Australian Bureau of Statistics (ABS) into 54,000 non-overlapping statistical areas level 1 (SA1). The population data of children across each of the 54,000 SA1s are distributed by age, state and remoteness. The degree of remoteness of each SA1 was obtained from the ABS using the Australian Standard Geographical Classification (ASGC). According to the ASGC, Australia is divided into five remoteness zones: major Australian cities (R1), inner regional Australia (R2), outer regional Australia (R3), remote Australia (R4) and very remote Australia (R5). The number of school children aged 5–14 years across all states and territories of Australia, as well as over the five remoteness area groups (Fig. 3), was obtained from the ABS and entered into Microsoft Excel spreadsheet (2003).

Estimation of costs
In the present cost model, the majority of unit costs were derived from real data and real values. However, some assumptions were used when data were not available. The costs for both models of dental screening were further divided into fixed and variable costs. All costs are given in Australian dollars and all salaries used in the calculation are based on the Australian government pay rates.

Fixed costs
No fixed costs were associated with the traditional method of dental screening. For the teledentistry option, we considered establishment costs, which included the annual software licence fee, annual server host fee, marketing and training (online induction and self-practice to take good images), to be fixed costs. However, the costs of communication or the Internet and smartphone devices were not considered in the present economic evaluation because almost all schools in Australia have Internet access and most tele-assistants (local teachers) own suitable mobile devices.

Variable costs
Traditional model. The variable costs associated with the traditional alternative were divided into direct and indirect costs, which included staff salaries and the costs of travel and overnight accommodation at each site for operators and their assistants, as well as the additional costs of travel and accommodation for the dental assistants. All staff salaries were based on the Australian government pay rates.
well as consumable items or materials used to conduct the visual screening. The costs of consumable items (e.g. gloves, mirror, and retractors) were assumed to be $5 per patient. The cost of office space rental was not taken into consideration because the screening process was assumed to be performed in schools.

Based on a recent report, an operator would need ≤15 min for the oral examination and the assistant would spend ≤15 min on chair-side charting. Typically, in Australia, a working year consists of 220 active days per year (after deducting 20 days annual leave and 10 days sick or family leave). After deducting education, administration and travel times from 220 working days, the active days per year remaining in which to perform traditional dental screening range from 90 (screening located in R4 or R5) to 162 (screening located in R1). Considering the movement between screening sites across different geographical zones, the estimated workload (number of children intended to be screened) ranged from 20 children per 5 h per day located in R4 or R5 to 30 children per 7.5 h per day located in R1 (i.e. in 12 months, the number of children who could be screened would range from 4860 (located in R1) to 1860 (located in R4 or R5)). The number of full-time equivalent (FTE) operators or dental assistants was 620. The estimation of FTE for the traditional model is provided in Table 1.

Staff salaries included the salary for operators and their dental assistants. The average annual salary (base salary plus 20% on-costs, superannuation and workers compensation) of the operator (registered junior dentist) and the dental assistant would be $108 000 and $60 000 respectively. Considering the incentive allowance for the operator and assistant performing screening in R4 and R5 regions, the annual salary was augmented with a 20% remote allowance, bringing these to salaries to $126 000 and $70 000 respectively.

Because the majority of the target population and dentists or operators are clustered near cities, most screening sites would be located in R1 and R2, but dentists and their assistants would need to travel to screening sites located in R3, R4 and R5 areas to perform the on-site screening. Travel allowance expenses (transport, accommodation and incidentals) were adjusted for each remoteness zone. Flights and accommodation expenses were only considered for three geographical zones (R3, R4 and R5). Estimated costs for transport (flight, train or car) were allocated to each of the five geographical groups (R1–R5). The average transport costs (car, bus or train) plus incidentals for one operator or assistant performing screening in the R1 or R2 zones were estimated to be $75 per person. The average costs for flights, overnight accommodation and incidentals (i.e. 20% of total travel allowance) for one operator or assistant performing screening in the R3–R5 zones were estimated at $750 per person.

**Teledentistry model.** Variable costs for the teledentistry option include the salaries of the tele-assistants (e.g. teachers), charters and their supervising dentists, and technical experts.

Based on a previous study, a charter or OHT would require an average 10 min for charting and submission of the recommendation online. After deducting education and administration days from 220 working days, the active days per year remaining to

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![Fig. 2.](image-a.png) Assessment of dental photographs by an off-site charter. (a) Snapshot of a record containing a dental chart and dental photographs. (b) Off-site charter logging-in to the database to assess dental records.

![Fig. 3.](image-b.png) Distribution of Australian children aged 5–14 years in Australian states and territories according to the Australian Standard Geographical Classification remoteness category. R1, major Australian cities; R2, inner regional Australia; R3, outer regional Australia; R4, remote Australia; R5, very remote Australia; NT, Northern Territory; ACT, Australian Capital Territory; SA, South Australia; WA, Western Australia; Vic., Victoria; Qld, Queensland; NSW, New South Wales.
perform charting would be 200. The patient load was estimated to be 36 records per 6 h per day or 7200 records per year. The number of FTE charters was 378. In addition, there would be IT support to respond to technical problems and the supervisory senior dentist to monitor the charter (therapists, OHTs) assessment; the FTE for IT support and the supervisory dentists was 1:20 of that for the charter (i.e. 19 FTE each). The tele-assistant (teacher) would need ≤10 min to photograph a child’s mouth and, if working 6 h per day, would need 453 408 h to obtain intraoral photographs from all Australian children over a 1-year time horizon. It is expected that any available smartphone would be used and the data would flow through the existing Internet. The estimation of FTE for the teledentistry model is presented in Table 1.

The average annual salary (base salary plus 20% on-costs) of a charter (OHT) was $72 000. The average annual salaries of IT support and supervisory dentist were $72 000 and $144 000 respectively. The hourly tele-assistant salary was assumed to be $40.

**Statistical analysis**

The cost model was built using a spreadsheet (Microsoft Excel 2003, Redmond WA, USA) to compare the costs and savings associated with dental screening using teledentistry versus visual examination over a 1-year period. The model outputs for traditional screening included variable direct and indirect costs incurred by the operators and their assistants; for the teledentistry model, the outputs consisted of fixed costs and variable direct costs incurred by charters and their supervisory dentists, tele-assistants and IT support. Total costs were also compared for both models. A threshold analysis was performed to determine the number of children at which the total costs (sum of variable and fixed costs) in the two models was similar. A sensitivity analysis was used to determine how the uncertainty in input variables would affect the overall costs of both models under a given set of assumptions.

**Results**

The estimated number of school children (aged 5–14 years) assumed to have dental screening was 2.7 million. Children living in the R1 and R2 geographical zones (1.8 million and 0.5 million respectively) accounted for 87% of the school children population in Australia. The distribution of children across the five geographical zones is shown in Fig. 3.

**Costs of traditional screening**

The total average variable cost of the traditional model of dental screening over 1 year was up to $135 million and the fixed cost of the traditional model was zero (Table 2). In total, the direct costs of the traditional model of screening (including the salaries for the operator and assistant) were $105 million, accounting for 78% of the total costs. The total indirect cost of the traditional model (travel and accommodation costs plus incidental costs) was up to $16 million. The total cost of materials and supply needed to perform dental screening was $14 million.

**Costs of teledentistry screening**

Overall, the total cost of the teledentistry model over a 1-year period was $50 million (Table 3). The total fixed cost of the teledentistry model was $1 million, with the major part of these costs being marketing or advertisement costs. The total average variable cost of the teledentistry model was $49 million. The estimated direct costs (including salaries of the charter, IT support, supervisor dentist and tele-assistant) were up to $49 million, accounting for 98% of the total costs of the teledentistry model. The costs of salaries of the charters and tele-assistants were up to $27 million and $18 million respectively, accounting for 90% of the total cost of the teledentistry model. The estimated staff salary saved was $56 million, and the estimated travel allowance and materials expenses avoided were up to $16 million and $14 million respectively, which represents a net saving of $85 million. The average cost per child for teledentistry was $19.

**Table 1. Patient load assumptions for the teledentistry and traditional models**

| ASGC, Australian Standard Geographical Classification remoteness category; R1, major Australian cities; R2, inner regional Australia; R3, outer regional Australia; R4, remote Australia; R5, very remote Australia; FTE, full-time equivalent |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Patient loads in the traditional screening (for one operator plus one assistant per operator) | R1 | R2 | R3 | R4 | R5 | Total |
| Patients screened per day | 30 | 30 | 25 | 20 | 20 | 106 |
| Working days per year | 220 | 220 | 220 | 220 | 220 | 1100 |
| Education days per year | 5 | 5 | 7 | 7 | 7 | 28 |
| Administration days per year | 48 | 48 | 48 | 48 | 48 | 240 |
| Travel days per year | 5 | 5 | 48 | 72 | 72 | 172 |
| Movement (weeks per year) | 48 | 48 | 24 | 36 | 36 | 144 |
| Active days per year | 162 | 162 | 117 | 93 | 93 | 543 |
| Patients screened per year | 4860 | 4860 | 2925 | 1860 | 1860 | 14050 |
| FTE | 379 | 111 | 91 | 23 | 16 | 620 |

| Patient loads in the teledentistry model (for one charter) |
|-----------------|-----------------|
| Records charted per day | 36 |
| Working days per year | 220 |
| Education days per year | 10 |
| Administration days per year | 10 |
| Active days per year | 200 |
| Records charted per year | 7200 |
| FTE | 378 |
Compared with a cost of $41–187 per child with traditional screening (difference of $22–168), depending on the remoteness of residence (Table 4).

Sensitivity analysis

The cost analysis showed that the threshold at which the teledentistry alternative became cheaper than traditional dental screening occurred at a workload of 22 700 children (Fig. 4). A series of scenarios were created to identify the effects of making different assumptions about the underlying variables on the total costs, as detailed below.

If a registered dentist was used to substitute a therapist or OHT as a charter, this assumption would make teledentistry costs increase from $50 to $61 million. Replacing a registered therapist or OHT with a qualified overseas-trained OHT (the average annual salary for dental therapists in New Zealand is $60 00037) would lead to a reduction in the teledentistry cost by $4 million (8%) from the baseline estimated cost for teledentistry. The latter assumption would make the teledentistry model cheaper.

If a registered dentist ‘operator’ was replaced with OHTs to perform traditional screening, travel allowance expenses plus total salaries for OHT ‘operators’ and their assistants (FTE = 620) and their supervisory dentists (FTE = 1 : 3 operators) would be $132 million. This assumption would result in an increase of 8% from the baseline calculated cost for the traditional model.
Assuming a charter or OHT reviews 24 records per day (rather than the proposed 36 records) and a tele-assistant recruits four children (instead of the proposed six children) per hour over 6-h day (i.e. 24 children per day) results in a teledentistry model cost of $75 million, an increase of 50% from the baseline of estimated costs for teledentistry. Alternatively, if we considered a charter or OHT reviewing 48 records per day (instead of the proposed 36 records) and a tele-assistant recruiting eight children (instead of the proposed six children) per hour over a 6-h day (i.e. 48 children per day), the teledentistry model would cost $38 million, a decrease of 25% from the baseline calculated cost. The latter assumption would make the teledentistry model the cheapest of all the scenarios.

If we considered a charter or OHT charting 48 records per day (rather than the proposed 36 records) and a 15% reduction in the standard salary for charters was assumed in the calculation, the total costs of the teledentistry model would decline by 20% from the baseline estimated cost, resulting in a teledentistry model cost of $40 million. In contrast, if we considered charters or OHTs charting 24 records per day (instead of the proposed 36 records) and a 15% rise in the standard salary for charters in the calculation, the total costs for teledentistry would elevate from $50 to $72 million.

If an operator spent 5 min (rather than the proposed 15 min) completing a visual examination and we assumed a 15% reduction in the standard salary for the operator or assistant, combining both assumptions leads to the traditional model costing an estimated $49 million, a decrease of approximately 64% on the baseline estimated cost. This would make the teledentistry model slightly more expensive than the traditional model of dental screening. Alternatively, if an operator spent 25 min (instead of the proposed 15 min) completing a visual examination and we assumed a 15% increase in the standard salary for operator or assistant in the calculations, the total costs of the traditional model would escalate from $135 to $241 million. This assumption would make the traditional model the most expensive alternative among all scenarios.

When considering the lowest prices for travel and accommodation and a 15% drop in the standard salary for operators or assistants in the analysis, the total costs of the traditional model of screening would decrease from $135 to $114 million, giving a net saving of $64 million. In contrast, when the highest prices for travel and accommodation and a 15% increase in the standard salary for operators or assistants was taken into account, this increased the costs of the traditional model from $135 to $156 million, resulting in a net saving of $106 million with the teledentistry model.

Discussion
A cost-minimisation analysis was undertaken in the present study to identify whether dental screening using teledentistry could reduce total costs compared with the traditional approach. Like previous studies, the present study demonstrated significant savings, particularly in rural or remote areas. The analysis showed that the traditional approach used for dental screening was $85 million a year more expensive than the teledentistry model. The major contributions to the cost savings of the teledentistry model were the low cost of salaries for charters and OHTs and avoidance of travel and accommodation costs, as well as a reduction in the use of equipment or disposable supplies. Australia is the world’s sixth largest country geographically with a total population of only 23 million, with the majority living in capital cities. Conducting traditional dental screening in large geographical areas and among such sparsely distributed populations would require lengthy travelling and huge expenses. The avoidance of travel and overnight accommodation contributed to 19% of the total net savings. The fixed costs of the teledentistry model were relatively low and represented a small proportion of the overall expenses. This could be attributed to improvements in telemedicine technology. As the technology for telemedicine evolves, the cost of equipment will decrease while the quality of teleconsultation improves.

In Australia, as in many other countries, the private sector remains the primary oral health delivery system, with most dental services funded on a private basis, and oral care is delivered on a fee-for-service basis. Given that less than half of all Australians have private dental insurance, these individuals are responsible for meeting the full cost of private oral care. Recent evidence indicates that a substantial number of Australians are unable to access oral care due to financial barriers. In addition, the SDS is unevenly distributed across Australia, largely concentrated in urban areas. In addition, the SDS has been suffering from funding difficulties and chronic recruitment and retention issues that contribute to the inequity in access to dental care among school children. Through the SDS, OHTs rarely provide sustainable dental services to large numbers of school children and are unable to reach those living in underserved or remote areas. The prohibitive costs of dental care (dentistry is not covered by Medicare), the uneven distribution of dental services across Australia and the scarcity of resources make providing dental care to all school children difficult.

Numerous strategies have been proposed to address unmet oral health needs, including the use of role substitution to provide dental care. MLDPs, such as OHTs and dental therapists, are often ideal for playing a role in dental screening. They have the potential to provide safe and good-quality dental care at a lower cost than a dentist. Also, training and developing this type of dental workforce would require significantly less time and fewer resources than training a clinical dentist to perform clinical on-site screening. The use of a teledentistry approach to screen for dental caries could offer a means for the effective use of OHTs to remotely screen large numbers of people at a low cost. Screening could be a first step towards the implementation of preventive services and the effective control of dental caries. Dental screening in asymptomatic populations facilitates the identification of children at risk of developing the disease and allows them to receive specific dental care. Those children considered low risk do not need additional management other than to receive preventive care. This strategy can help direct specific dental care or preventive services towards a population that needs it more and allows for the optimal distribution of scarce resources, thus contributing to reducing inequalities in oral health.

The findings of the present study demonstrate that considering OHTs for the operator’s role in the traditional model is more costly than using dentists. Additional expenses incurred are related to the costs of supervising OHTs at screening locations. Under the SDS, OHTs have a limited scope of practice and
therefore need to practice under the indirect supervision of a dentist. This means that before OHTs can start providing treatment, supervisory dentists need to re-examine children in order to verify treatment plans, particularly for those with a moderate or severe disease. With just less than half of Australian children expected to be free of decay, sending dentists to review OHTs’ assessments at screening sites is costly. In contrast, in the teledentistry model, supervisory dentists can monitor OHTs indirectly through teleconsultations and have access to the database, which allows them to verify OHTs’ treatment plans easily and quickly. In the near future, with an extended scope of practice and increasing numbers of OHTs (the Bachelor of Oral Health Therapy is now offered in eight universities), it could be possible to delegate the operator’s role to OHTs under the traditional model.

In the sensitivity analysis, the charter’s role was modified, with qualified overseas-trained MLDPs considered, to enable costs comparison with other nations. The findings suggest that the teledentistry approach supports or facilitates the use of overseas-trained OHTs with accredited qualifications, such as those from New Zealand, the UK, Ireland or Canada, to screen for dental diseases at a distance. When considering ethical and legal aspects, this approach is not intended to remove overseas OHTs from their existing jobs or activities. The teledentistry approach enables oral health professionals anywhere in the world to view and assess dental photographs at their desktops and at their convenience, without the need to be physically present at the screening locations. Using a limited number of off-site overseas OHTs with good mentorships could reduce the dependence on overseas-trained dentists from developing countries who are primarily brought in to mitigate extreme shortages in rural areas.

To our knowledge, no attempt has been made to visually screen all school children in Australia. Undertaking traditional dental screening of all Australian children by dentists or any oral health professionals is challenging due to the high costs associated with such a screening program and maldistribution of the dental workforce. Apart from the economic evaluation, the teledentistry model would provide valuable data about the extent and severity of dental diseases among all Australian children. The data collected from the teledentistry model can be easily linked to existing oral health databases across the states and territories (there are no universal oral health databases in Australia). In addition to its great potential to save substantial costs and improve oral health, teledentistry also has the potential to enhance career or employment opportunities, particularly for those practitioners suffering from physical disabilities and occupational injuries (e.g. chronic shoulder or back disorders) or those nearing retirement age who would prefer to practice without interacting with patients.

The present study has some limitations. Dental services (e.g. restoration, preventive care or oral health promotion) that are often provided by school dental therapists through the SDS were not considered in the analysis. This is due to the scope of the study, which was focused on evaluating the use of teledentistry in dental screening and the difficulty of assigning a monetary value to these services. Despite the large sample size (all school children in Australia) considered in our model, the findings may not be generalisable to models of other dental services or age groups other than children. In a previous study, we showed that in some situations there was a loss of diagnostic details due to the poor quality of dental photographs obtained using smartphone cameras. This may require repeating dental photography and result in a delay in the screening process. In addition, in the teledentistry model, the ability of charters and their supervisors to enquire about certain cases is limited compared with the traditional model, because they need to rely on local tele-assistants to obtain information. Because the supervisory dentists, charters and tele-assistants and IT team are working at different locations, they have to rely on telecommunication for liaison. The absence of collaboration or coordination between remote and hub sites may represent a barrier to the success of teledentistry.

Conclusion
To our knowledge, this study presents the first national-level cost model that has been developed to estimate the potential cost savings from using teledentistry for school dental screening. The results of the present study suggest that teledentistry is an applicable and economically viable approach for mass dental screening. The cost of the teledentistry model was substantially lower than that associated with conventional face-to-face dental screening, not only in remote and very remote regions, but also in urban areas. The primary driver of net savings is related to the lower salaries of MLDPs and the avoidance of travel and overnight accommodation costs. The economic evaluation of teledentistry services is essential to ensure efficient allocation of resources and redirection of net savings to improve oral care services in underserved regions. Such studies can be helpful in guiding future decisions on implementing teledentistry services. Further research on the cost-effectiveness of teledentistry considering other dental services (not only dental screening) is warranted to improve the current model.

Competing interests
None declared.

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