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ORIGINAL ARTICLE

The Kimberley Dental Team: A process evaluation of a volunteer dental programme serving remote Aboriginal communities in Australia

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Abstract

Objectives: This study aims to conduct a process evaluation of the Kimberley Dental Team (KDT), a not-for-profit, volunteer organization providing care to remote Aboriginal communities in Western Australia.

Methods: A logic model was constructed to detail the operational context of the KDT model. Subsequently, the fidelity (the extent to which each of the programme's elements were implemented as planned), dose (types and quantity of services provided) and reach (demographic characteristics and communities serviced) of the KDT model were evaluated using service data, deidentified clinical records and volunteer rosters maintained by KDT from 2009 to 2019. Trends and patterns of service provision were analysed using total counts and proportions over time. A Poisson regression model was used to explore changed in the rates of surgical treatment over time. The associations between volunteer activity and service provision was also investigated using correlation coefficients and linear regression.

Results: A total of 6365 patients (98% identifying as Aboriginal or Torres Strait Islander) were seen over the 10-year period with services being provided across 35 different communities in the Kimberley. Most services were provided to school-aged children, consistent with the programme's objectives. The peak preventive, restorative and surgical rates occurred among school-aged children, young adults and older adults respectively. A trend was observed indicating a reducing rate of surgical procedures from 2010 to 2019 ($p<.001$). The volunteer profile showed significant diversity beyond the conventional dentist–nurse structure and 40% being repeat volunteers.

Conclusions: The KDT programme maintained a strong focus on service provision to school-aged children over the last decade with the educational and preventive components being central to the care being provided. This process evaluation found that the dose and reach of the KDT model grew with an increase in resources and was adaptive to perceived community need. The model was shown to evolve through gradual structural adaptations contributing to its overall fidelity.

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KEYWORDS
Aboriginal, dental, evaluation, Kimberley, treatment, volunteer

1 | INTRODUCTION

Oral diseases affect close to 3.5 billion people globally with Indigenous and at-risk communities shouldering a disproportionately high burden of disease.[1] In response, volunteer-led dental services have been used to 'fill the gaps' and extend the reach of existing services.[2] However, volunteer services have the potential to both help and hinder vulnerable communities.[2] Therefore, it is imperative to measure and evaluate the impact of care to better inform the future direction, quality improvement and sustainability of volunteer services.[2] Similarities in challenges facing Indigenous communities globally means there is value in learning from and adapting existing models of care. To date, there has been limited reporting on the impact of volunteer-led services in remote Aboriginal communities. Traditionally a significant emphasis has been placed on measuring outcomes in health service research, however, a programme's lack of success can be attributed to several process-related factors including programme design, implementation and frequency of services.[3,4] Thus, a process evaluation has also been referred to as looking into the 'black box' of a health service to understand how the delivery and implementation of a programme can affect subsequent outcomes.[5]

The Kimberley Dental Team (KDT) is a non-profit, non-government, volunteer-led team that has provided dental care to remote Aboriginal communities in the Kimberley region of Western Australia since 2009. Located in the northern part of Western Australia, the Kimberley covers over 400 000 km^2 with Aboriginal and Torres Strait Islander people (hereafter, respectfully referred as Aboriginal Australians as preferred by our Kimberley colleagues) making up almost half of the resident demographic profile.[6] The KDT was sparked by an initial visit to Halls Creek in 2009 where opportunistic school screening found approximately 70% of schoolchildren presenting with acute dental infection and severe early childhood caries.[7] Volunteering with KDT is now an annual event where rotating teams of volunteers typically spend a week each in the Kimberley over a period of up to 3 months.

This study aims to conduct a process evaluation of an existing volunteer programme, the KDT, which has serviced remote Aboriginal communities over a 10-year period. It is hypothesized that over time: (i) the rate of surgical treatment would decrease while preventive treatments would increase corresponding to a decreased need for acute emergency dental treatment and an increased emphasis on education and preventive strategies, and (ii) the number of volunteers is associated with clinical productivity.

2 | METHODS

A process evaluation was conducted using the framework proposed by Saunders and colleagues.[8] This involves a description of the KDT programme components and its context, evaluation of fidelity (the extent to which each of the programme's elements were implemented as planned), dose (the types and quantity of services provided) and reach (demographic characteristics and communities serviced). The programme components and context were described by constructing a logic model detailing the objectives, resources, activities, outputs and expected outcomes (Figure 1).

Service data and deidentified clinical records maintained by KDT from 2009 to 2019 were obtained. Volunteer rosters were also

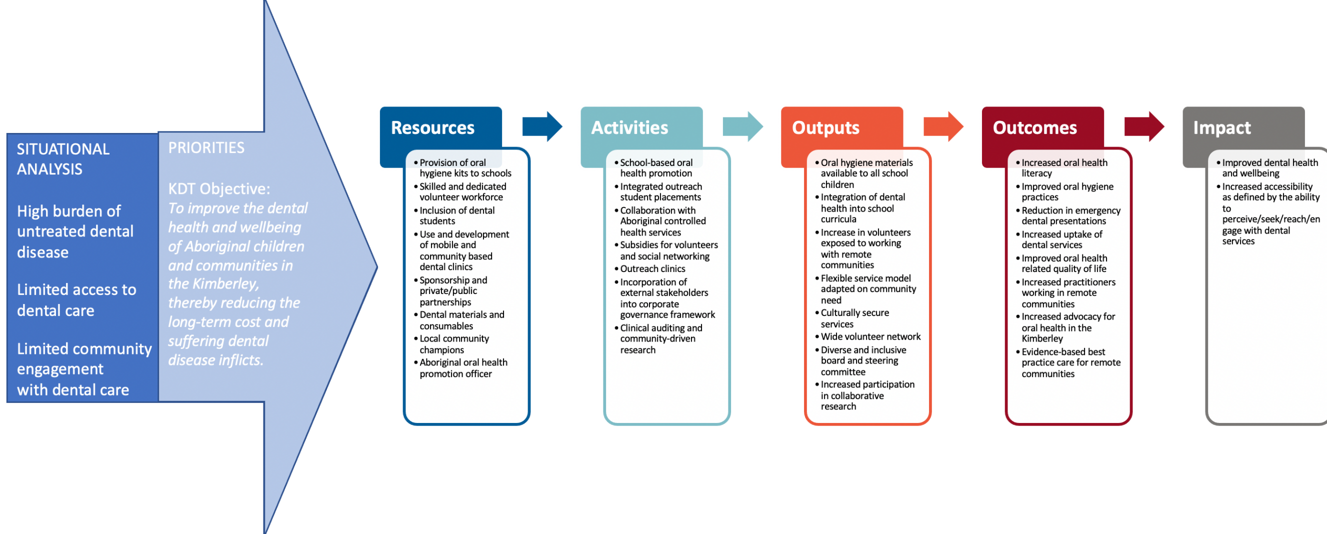

FIGURE 1 Logic model of the Kimberley Dental Team (KDT) programme showing the inputs, outputs, outcomes and anticipated impact.

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collated, from which the number of volunteer weeks and the demographic profile of volunteers were measured. This data was audited to evaluate the dose and reach of the programme by aggregating service and volunteer data over each year of the programme. As the KDT model is flexible and allows for local adaptation, fidelity was descriptively assessed by comparing trends in the type and number of services over time in relation to key variables such as age to see whether these were consistent with the objectives of the KDT programme. Additional elements such as recruitment and dose received (based on community feedback of the programme) have been described elsewhere following a structural evaluation and by using qualitative methodology.[9–11]

2.1 | Statistical analysis

Trends and patterns of service provision are presented graphically with data presented as proportions, raw counts and rates (per 10 patients). One of the key elements of the KDT model is to reduce suffering from untreated dental disease, thus, surgical treatment was used as a proxy measure of acute need and Poisson regression was used to explore the rates of surgical treatment provided over the 10-year period. The first year of the programme (2009) was excluded as only examinations occurred. Since both the number of volunteers and patients presenting to the service could vary each trip, the model was adjusted for the number of volunteer weeks while the number of patients seen was set as an offset (exposure variable), producing adjusted incident rate ratios and their corresponding 95% confidence intervals. A volunteer week was defined as the number of volunteers per week collated for each trip, that is, 6 volunteers in 1 week = 6 volunteer weeks or 1 volunteer over 6 weeks = 6 volunteer weeks. Associations between volunteer weeks, the number of total services provided and number of patients were examined using Pearson's correlation coefficients and linear regression.

To explore volunteer activity, timesheet data were analysed from two separate years, 2013 (representing the early years of the KDT model) and 2019 (representing the current structure of the model). In both years, volunteers were asked to keep a log of hours each day spent on administration, clinical work, community engagement, oral health education, school screenings, clinical supervision, travelling or other (maintenance, stock take, etc). Descriptive statistics were used to show how volunteers typically spend their time while differences in volunteer activity was compared using Student '*t*' tests. Statistical significance was set at $p < .05$. All statistical analysis was performed using Stata v 14.1 (StataCorp).

3 | RESULTS

3.1 | Context

The provision of dental care to remote Aboriginal communities in the Kimberley is complex and involves careful consideration and adaptation to the unique environmental, cultural, organizational and clinical factors at play. The structural components that respect the cultural context within which KDT operates are illustrated using a logic model, shown in Figure 1 and include:

1. The KDT 'Strong Teeth for Kimberley Kids' school toothbrushing programme which enables access to primary prevention for all school children. This is central to the model as nearly half of Aboriginal population in the Kimberley is under 20 years of age.[6] During each volunteer trip, school-based screening is completed to triage children and facilitate treatment using Aboriginal liaison officers and a dedicated KDT Aboriginal oral health officer.
2. Collaboration with existing community-controlled Aboriginal health services and cooperative use of infrastructure enables holistic culturally secure care for patients.
3. Integration with University curricula and supervised outreach placements supports training of dental students and attracts new graduates to remote practice.
4. Supporting volunteer travel and accommodation and creating a sense of family are central to volunteer recruitment and sustained engagement.
5. Service delivery approaches are adapted to meet community needs; a multi-faceted hub and spoke model with mobile dental units are used to increase the reach of services to remote communities.
6. Strategic leadership through an overarching governance framework that includes the voice of Kimberley leaders, and steered by an external reference committee informs the model of care and its future direction.

3.2 | Fidelity

Fidelity is classically assessed by a programme's adherence to its initial design, however, as shown in Figure 2, the KDT model is adaptive and changes are continuously introduced each year to better service the perceived needs of the community while catering for the growth of volunteer teams.[12] As such a balance between fidelity and adaptation is required for the programme to meet its goals.[12,13] This is supported by Pérez and colleagues who present a modified framework for implementation fidelity that allows flexibility beyond strict adherence to the programme's initial design.[12] In the context of KDT, several adaptations have been made to the model since its inception in 2009. For example, the introduction of the Strong Teeth for Kimberley Kids supervised toothbrushing programme in 2013 primarily drove an increase in the proportion of educational and preventive treatment in subsequent years. Additionally, the use of a multi-faceted hub and spoke model complemented by mobile dental vehicles extended the reach of the programme beyond the original hub of Halls Creek to a total of 35 different remote communities. Increasing the number of communities being serviced also results in a change in the structure of trips, and in the segmentation of volunteer activity. For example, in 2013, clinical treatment

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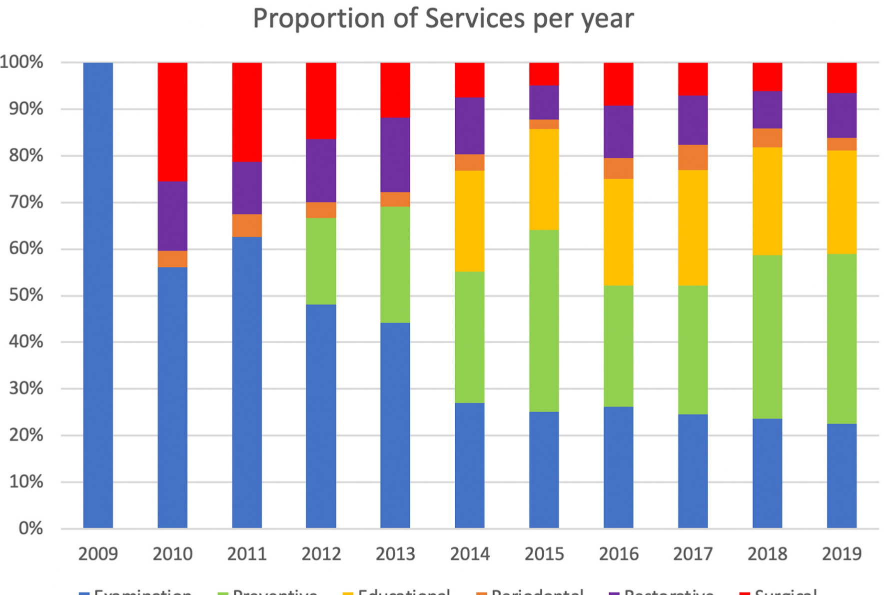

FIGURE 2 Proportion of services provided by year.

was primarily focused on Halls Creek and 13% of volunteer activity was related to travel. In 2019, using mobile dental vehicles, communities were serviced while travelling resulting in 21% of volunteer time being taken up in travel. The number of volunteer weeks also increased, with a resultant increase in clinical productivity. However, aspects such as vehicle maintenance, breakdown and the need for dedicated drivers resulted in an overall reduced efficacy of these adaptations compared to the initial intentions. Lessons learned from these experiences led to changes in the use of mobile dental vehicles, changes to volunteer numbers in both team structure and composition (such as the dentist: nurse ratio, need for administrative support) and community-specific rostering of volunteers. These changes saw a more stable trend in the nature and counts of services being provided from 2016 onwards. This iterative cycle of adaptation and change, reflects Pérez's modified model of assessing fidelity, whereby a continuous cycle of designing, implementing and testing adaptations leads to change while adhering to the goals of the programme.[12] Thus, despite the adaptations to the programme, fidelity was maintained with (i) school children remaining the primary recipients of care every year, (ii) a sustained focus on East Kimberley communities being achieved and (iii) a reduction in the number of surgical services being required, all of which align with the programme's initial intentions.[14]

3.3 | Reach

Over the 10-year period, a total of 6365 patients were seen with services provided across 35 different communities in the Kimberley with the majority (32%) being provided within the Halls Creek district. Most patients (n = 6227, 98%) identified as being of Aboriginal or Torres Strait Islander background and 60% of all services were provided to East Kimberley communities primarily in the Halls Creek district. The mean age of the patients treated was 19 years (SD 17) with a median age of 11 years. Services were skewed towards school-aged children and young adults, with 70% of all services being provided to patients under 25 years of age.

A total of 158 volunteers were directly involved with the KDT programme over the 10-year period. (Table 1). Although dentists (n = 44, 28%) and dental nurses (n = 38, 24%) make up the traditional dental team, the KDT workforce was supplemented by dental students (n = 40, 25%), specialists (n = 12, 8%) and dental therapists,

TABLE 1 Volunteer profile and characteristics.

Volunteers (n = 158)	Demographic categories	N	Percentage (%)
Gender	M	43	27
	F	115	73
Age (years)	18–27	66	42
	28–37	34	22
	38–47	16	10
	48–57	28	18
	58–67	13	8
	68–77	1	1
Employment status	FT	131	83
	PT	25	16
	Retired	2	1
Usual occupation	Dentist	44	28
	Dental student	40	25
	Dental nurse	38	24
	Specialist	12	8
	Other	11	7
	Administrative	5	3
	Dental therapist	5	3
	Liaison officer	2	1
	Coordinator	1	1

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administrative personnel and community liaisons. The gender of volunteer dentists was balanced between males ($n=21$) and females ($n=23$). However, when considering the total volunteer pool, most volunteers were female ($n=115$, 73%). Of the 158 volunteers, 63 (40%) were repeat volunteers having been involved with more than one KDT trip. Furthermore, of the 40 dental students that participated in the KDT programme, 12 (30%) volunteered as dentists following graduation.

Volunteers were found to spend the most amount of time engaged in clinical work (31%), followed by travelling to communities (17%) and administrative work (14%). Other activities included community engagement, providing oral health education, school screening and clinical supervision of students. Despite changes to the programme, no statistical difference was found between 2019 and 2013 in terms of volunteer activity ($p=.5$).

3.4 | Dose

Figure 2 shows the proportion of services provided each year, including the initial screening visit conducted in 2009. Examination (including school-based screenings), preventive (including fluoride varnish applications and fissure sealants) and/or education (including oral hygiene instruction and dietary advice) accounted for more than half of the total services each year, increasing to more than 75% of all services after 2014. The count data show a consistent pattern peaking in school-aged children across all services (Figure 3). Variation between services was less significant across older age groups (Figure 3A). However, the pattern is vastly different when exploring rates of services by age where the peak preventive, restorative and surgical rates occur among school-aged children, young adults and older adults respectively (Figure 3B).

A Poisson regression model adjusted for the number of volunteer weeks shows a linear reduction in the number of surgical procedures with each increasing year (Figure 4) and an average 3.3% reduction (IRR: 0.967, 95% CI: 0.954–0.979) in the rate of surgical procedures year on year after 2010 ($p<.001$).

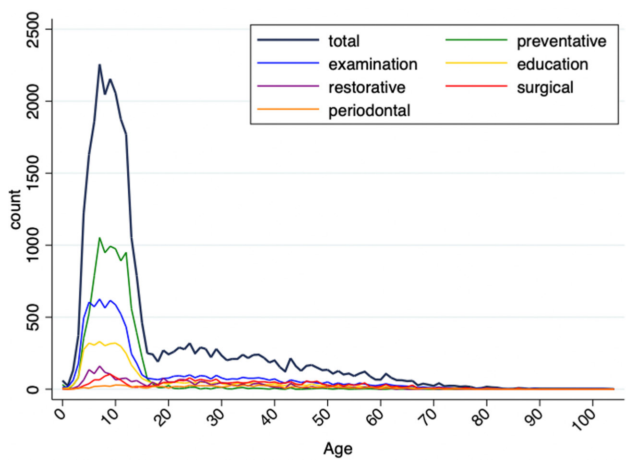
Clinical productivity as assessed by total service items was found to be strongly correlated with the number of volunteer weeks, Figure 5. An increase in volunteer weeks was associated with an increase in the total number of treatments ($r=0.79$) and number of patients seen ($r=0.69$). For each increase in volunteer weeks, the number of patients increased by 12 (95% CI: 6 to 18, $p=.001$) and the number of services on average increased by 55 (95% CI: 22 to 88, $p=.004$).

4 | DISCUSSION

4.1 | Summary of key findings

This process evaluation describes the nature and extent of services provided by the KDT over the last decade and shows a general increase in number and types of services provided as the programme evolved. An increase in prevention and decrease in surgical treatment supports the programme's intended objectives and hypothesis. The volunteer demographics and activity profile show significant diversity and reflects the complex dynamics of a volunteer model that extends beyond simply a dentist and dental nurse providing care.

This study found that young adults, from 15 to 25 years of age, required the highest rates of restorative treatment. Early introduction into the restorative 'death spiral'[15] (where placing a restoration commits the patient to a lifelong restorative burden with more complex procedures being needed over time to maintain the integrity of the tooth) along with untreated caries or worsening periodontal disease is likely to then lead to the high surgical rates observed in older adults. It is anticipated that the impact of prevention and education aimed at school children will result in a reduction in future restorative and surgical rates. However, a realistic perspective acknowledges the overwhelming impact that upstream determinants



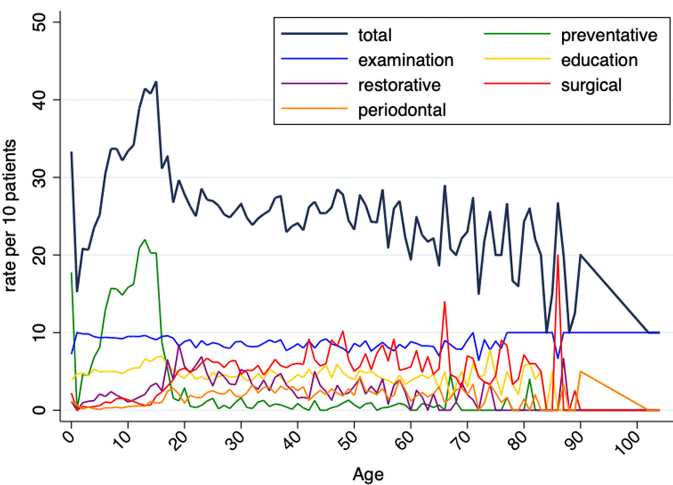


FIGURE 3 (A) Service counts by age, (B) rates of services provided by age.

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and structural inequalities such as a food security and poverty have on oral health outcomes particularly among Aboriginal people in remote communities.[16]

4.2 | Application and importance of the findings to the wider international community

4.2.1 | Indigenous dental care and the role of evaluation

Aboriginal communities globally have been affected by longstanding intergenerational trauma and structural inequalities that stem from colonization and are compounded by neoliberal policies, which together contribute to persisting disparities in oral health.[17] Historically, efforts to address oral health disparities have often been rooted in a 'white knight' mentality, characterized by external agencies imposing their solutions on Aboriginal communities without adequate consultation. Despite being well intended, many oral health interventions implemented for Aboriginal communities have consistently failed to achieve sustainable results.[18] This is echoed by a remark by a Western Desert woman about the transient nature of 'whitefellas' working in Indigenous communities 'Kartiya are like Toyotas. When they break down we get another one'.[19] The findings of this study extend beyond the Kimberley context and highlight the significance of sustained community engagement, education and prevention as a means of achieving long-term change.[20] This level of continuous community engagement is particularly critical in communities that are otherwise subject to constantly changing services, high turnover of staff and unpredictability of services.[21,22] More recently, there has also been a shift towards encouraging health services to adopt a community-driven, collaborative and culturally sensitive approach that prioritizes the community voice in decision-making and ensures the ongoing involvement of Aboriginal people in all levels of governance.[23]

The World Health Organization, suggests that access to urgent dental treatment, affordable fluoride toothpaste and atraumatic restorative treatment are fundamental components of a basic package of oral care.[24] However, 'voluntourism' focused on curative approaches poses a significant threat to the sustainability of local health infrastructure and can reinforce the dependency of host communities on external aid, thereby hindering their efforts towards achieving self-sufficiency.[2] Volunteer organizations frequently encounter time and resource constraints, leading them to prioritize productivity over data-driven evaluation. In areas of unmet need, emergency dental care will always be a priority. As such a global reorientation of volunteer organizations has been recommended where the goal of volunteer organizations should not be to treat as many patients as possible but rather focus on upskilling existing staff and providing advocacy to create sustainable locally driven results.[25] Process evaluations such as this inform continuous quality improvement strategies and support organizations make changes in

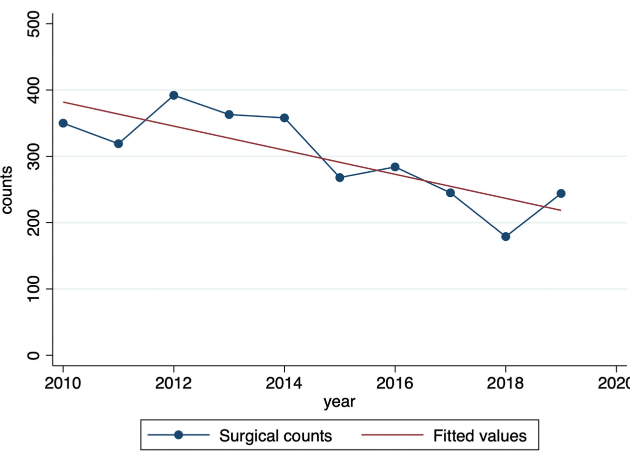

FIGURE 4 Actual and predicted counts of surgical services with the number of patients set as the exposure variable and adjusted for number of volunteer hours.

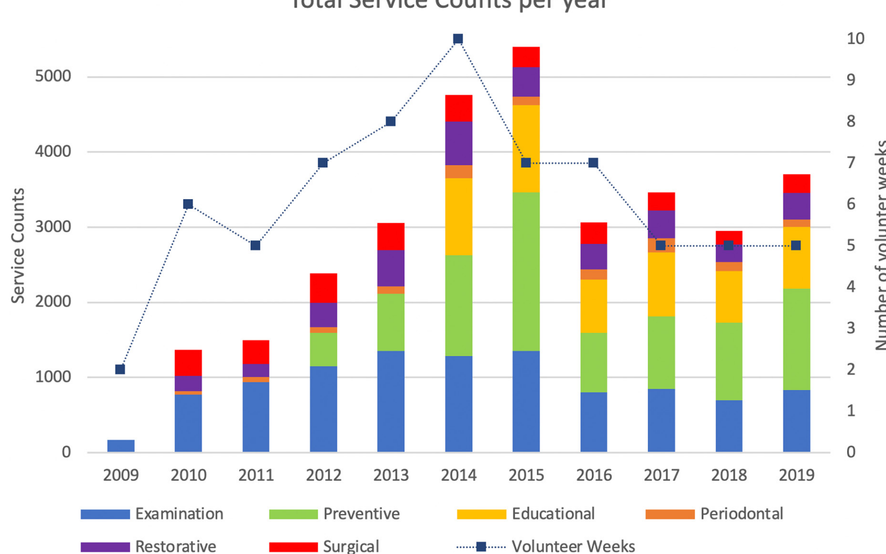

FIGURE 5 Total service counts per year and number of volunteer weeks. Key milestones: 2012: KAMSC Mobile Dental Truck launched. 2013: Implementation of the Strong Teeth for Kimberley Kids School Toothbrushing programme and launch of the McCusker Charitable Foundation/Kimberley Dental Team Dental Mobile Dental Unit. 2014: Establishment of Broome hub.

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response to community-perceived needs thus helps align volunteer efforts to their intended outcomes.[26]

The scarcity of literature on the evaluation of volunteer dental care, especially in relation to Aboriginal oral health, highlights the need for more research in this area. Pulver and colleagues conducted a valuable evaluation that combined service data with stakeholder perceptions, using both quantitative and qualitative methods.[27] While the data covered only a 2-year period, the study emphasized the importance of mixed methods in dental research, showing how service data and interviews with stakeholders can complement each other to generate a more comprehensive understanding of the impact of volunteer programmes and the lived experience of stakeholders.[9,28] In addition, the significance of university involvement from both workforce and research perspectives cannot be overstated. Partnering with Aboriginal communities enables universities to co-create programmes that address oral health disparities while also building research capacity and providing students with hands-on experience and cultural competence training, thereby resulting in mutually beneficial outcomes.[29,30]

4.2.2 | The volunteer workforce

The impact that the composition of the volunteer workforce has on service provision is key to optimizing clinical outcomes as highlighted by the correlation between volunteer weeks and clinical productivity. This study indicated that when larger volunteer teams were involved, the composition changed to include more non-dental personnel. This is a concept that can often be overlooked by volunteer organizations on the assumption that clinical productivity is correlated solely to the number of clinicians. The impact of non-dental personnel such as Aboriginal health workers, community liaisons and administrative personnel may easily go unrecognized, given the difficulty in measuring their contributions despite their roles being critical towards providing effective culturally secure care.

Recruitment is an important component of a process evaluation and in the context of KDT and other volunteer organizations globally, this is twofold: recruiting and retaining the volunteer workforce and maintaining an adequate patient base that addresses the project's objectives. One of the key strategies of KDT is to create rewarding volunteer experiences to ensure programme sustainability as reflected by the high rate of both repeat volunteers and new graduates. The social psychology behind volunteering is complex and has been attributed to affiliation, beliefs, career development and egoistic factors.[31] Previous work has shown that it is likely that dental volunteers are motivated by each one of these factors to varying degrees.[11]

The structure and focus of volunteer trips considerably impact both productivity and service types provided. For example, in 2014 and 2015, a strong focus was placed on school visits and school-based prevention and treatment. Schools in remote communities are often seen as a community hub and thus present a unique opportunity for health promotion.[10] Working within the schools enables a large volume of children to be screened, more oral health education sessions to be delivered and a greater number of children to be treated. Thus, volunteer programmes must be dynamic and innovative to meet the needs of communities in a culturally informed manner. Approaches such as the use of mobile clinics and school-based care challenge the conventional fixed dental clinic model in which services are dependent on patient attendance, flow and structured appointments that tend to lack wider community engagement.

4.2.3 | Strengths and limitations

Obtaining accurate demographic data in remote Aboriginal communities is a challenge. Patients, particularly elderly community members, may not accurately know their date of birth and names may change over time being affected by cultural traditions such as sorry business.[32] Many elderly members of the community recount being provided with an arbitrary date of birth. Further, children may only be identified by name and school year group rather than date of birth. In addition, the nomadic lifestyle of Kimberley residents means that a patient may be seen in (or identify as a resident of several communities) depending on their social circumstances. Therefore, maintaining a clean data set is near impossible and during the data cleaning process for this study, approximately 800 incomplete records had to be excluded from analysis. The introduction of a digital database in 2014, however, has supported improved record keeping and more accurate auditing of services. Future outcome-based evaluation would benefit from measures such as caries experience and patient satisfaction being recorded as these are not routinely recorded. In the context of service trends, the types and quantity of dental services delivered are dependent on circumstance and the planning of each volunteer trip. For example, if teams are scheduled to attend schools, it is anticipated that a higher number of preventive and educational activities will be performed. Cultural and community events such as a local sports day or a death in the community can also impact on clinical productivity.[32] Therefore, the results of this study do not directly reflect the treatment needs or burden of disease in Kimberley communities. However, as KDT visits have been largely consistent in terms of service locations, timing each year and implementation strategy within each community, trends in surgical services may be a convenient proxy to approximate the level of acute need. Despite these limitations, the data collected represent the largest prospectively collected dental service data to remote Aboriginal communities in the Kimberley, and to the authors' knowledge, no other studies have evaluated the nature and extent of dental services provided by dental volunteers over this length of time. The data therefore provide a valuable insight into how a volunteer-led model may evolve over time and the impact of process adaptations on fidelity, dose and reach to a service.

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5 | CONCLUSION

This study demonstrated the extent and nature of dental services provided by the KDT, a not-for-profit volunteer-led organization, to remote Aboriginal communities over the course of a decade. A linear reduction in surgical treatments was observed over the 10-year period and clinical productivity was associated with the number of volunteer weeks. The programme maintained a strong focus on service provision to school-aged children with the educational and preventive components being central to the care being provided. This process evaluation found that the dose and reach of the KDT model grew with an increase in resources and was adaptive to perceived community need, thus, gradual changes over the years led to a higher fidelity of the programme.

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CONFLICT OF INTEREST STATEMENT

Jilen Patel is a member of the Kimberley Dental Team Board. This is an unpaid and voluntary position. Any reporting bias has been mitigated using external authors and investigators who do not have any involvement with KDT. Furthermore, a variety of data sources have been used to present the material in this study which has been the subject of external review.

DATA AVAILABILITY STATEMENT

Research data are not shared.

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