

Reducing Indigenous Oral Health Inequalities: A Review from 5 Nations

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Abstract

Indigenous populations around the world experience a disproportionate burden in terms of oral diseases and conditions. These inequalities are likely due to a complex web of social determinants that includes poverty, historical consequences of colonialism, social exclusion, government policies of assimilation, cultural annihilation, and racism in all its forms (societal, institutional). Despite documented oral health disparities, prevention interventions have been scarce in Indigenous communities. This review describes oral health interventions and their outcomes conducted for Indigenous populations of the United States, Canada, Brazil, Australia, and New Zealand. The review includes research published since 2006 that are available in English in electronic databases, including MEDLINE. A total of 13 studies were included from the United States, Canada, Brazil, and Australia. The studies reviewed provide a wide range of initiatives, including interventions for prevention and treatment of dental disease, as well as interventions that improve oral health knowledge, behaviors, and other psychosocial factors. Overall, 6 studies resulted in improved oral health in the study participants, including improvements in periodontal health, caries reduction, and oral health literacy. Preferred intervention methodologies included community-based research approaches, culturally tailored strategies, and use of community workers to deliver the initiative. Although these studies were conducted with discrete Indigenous populations, investigators reported similar challenges in research implementation. Recommendations for future work in reducing oral health disparities include addressing social determinants of health in various Indigenous populations, training future generations of dental providers in cultural competency, and making Indigenous communities true partners in research.

Keywords: Indigenous people, access to care, community dentistry, dental public health, epidemiology community-based research

Introduction

The United Nations Indigenous People's Partnership defines being "Indigenous" as "having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, who consider themselves distinct from other sectors of the societies now prevailing on those territories" (United Nations 2008). However, tribes and Indigenous communities define being "Indigenous" based on self-determination by the individual. This preserves for these communities the sovereign right and power to decide who belongs to them, without external interference (Cobo 1981).

Despite their cultural differences, Indigenous people at an international level share common problems related to the protection of their rights as distinct populations (Armitage 1995). Indigenous peoples have sought recognition of their identities, a way of life, and right to traditional lands for years, yet throughout history, these rights have been consistently and systematically violated. Indigenous peoples today are among the most disadvantaged and disenfranchised in the world (Anderson et al. 2006). In recognition of this, the United Nations Permanent Forum on Indigenous issues was established in 2000, with a mandate to discuss Indigenous issues related to economic and social development, culture, the environment, education, health, and human rights. In 2007, the Declaration on the Rights of Indigenous Peoples was adopted by the United Nations General Assembly (United Nations

2008). This has been the most comprehensive statement on the rights of Indigenous peoples developed thus far.

Indigenous populations experience a disproportionate burden of oral health inequalities (Slade et al. 2007; Health Canada 2010; New Zealand Ministry of Health 2010). This is likely due to a complex web of social determinants that includes poverty, historical consequences of colonialism, social exclusion, government policies of assimilation, cultural annihilation, and racism (Durie 2004). Indigenous persons experience poor oral health in childhood that continues throughout the life course (Jamieson et al. 2010; Batliner 2016). The prevalence of untreated tooth decay in Indigenous adults can be up to 3 times that of non-Indigenous adults, while the prevalence of

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periodontal disease can be twice as high among Indigenous persons (Phipps 2012; COAG Health Council, 2015). Indigenous persons experience complete tooth loss at almost 5 times the rate of non-Indigenous persons (Slade et al. 2007), affecting their ability to eat, speak, and socialize and with serious impacts on quality of life (Walter et al. 2007). The rate of hospital admissions for dental diseases is also profoundly higher among Indigenous persons (Jamieson et al. 2006), usually for care under a general anesthetic, which is both costly and itself not without risk. Inequitable access to dental care is at the heart of the poor oral health experienced by Indigenous persons, who are less likely to receive timely or culturally sensitive treatment to both prevent and treat poor oral health (Jamieson et al. 2013). This typically results in problem-based dental care, which is associated with increased receipt of extractions as opposed to rehabilitative care to preserve the dentition (Thomson et al. 2010). Prevention interventions have been scarce in these communities.

The objective of this review is to present oral health interventions conducted for Indigenous populations of the United States, Canada, Brazil, Australia, and New Zealand. Although there are over 70 countries globally that house Indigenous populations, the authors chose these 5 countries in this review because there are consistent efforts and collaboration among researchers within these countries who are working with the Indigenous populations. In Australia, Indigenous people are referred to as Aboriginal and/or Torres Strait Islanders, who comprise 3% of the total Australian population. In Brazil, the Indigenous population is only 0.5% of the total population. In the 2010 Brazil census, there were 305 Indigenous groups who spoke 274 distinct languages. In Canada, Indigenous people are referred to as First Nations, Inuit, and Métis peoples and comprise 4.3% of the total population. About 15% of the New Zealand population identify as being Māori; it is the country with the largest proportion of Indigenous persons among First World nations. In the United States, Indigenous people are referred as American Indian (AI) and Alaska Native (AN) persons, who comprise about 2% of the US population. The AI/AN population includes 567 culturally diverse groups, with 229 of these in Alaska alone.

Methods

In this review, we examined research published since 2006 on prevention interventions conducted with Indigenous populations in the United States, Canada, Brazil, Australia, and New Zealand. Studies reporting any prevention interventions for oral health were included as available in English, in electronic databases, including MEDLINE via PubMed, Ovid Med, Google Scholar, and Web of Science. The search terms were (*Indigenous populations AND oral health; Indigenous populations AND oral health AND interventions; oral health AND community interventions AND Indigenous populations; American Indian AND oral health interventions; First Nation people AND oral health interventions*).

Inclusion criteria for the search were 1) reports published between 2006 and 2017; 2) studies that reported on any oral

health prevention interventions conducted for any age groups, including children, adults, pregnant women; and mother-child dyads; 3) study design that included community-based interventions, clinical trials, and quasi-experimental studies; and 4) studies that used oral health-based outcomes—either clinical outcomes such as dental caries or oral health knowledge or behavioral outcomes. Exclusion criteria prescribed the exclusion of 1) studies that were descriptive or simply observational and 2) manuscripts that were still in press.

Results

A total of 13 published studies were included in this review. The interventions have been described and details of the studies have been provided in the Table. In addition, we reference several studies in the discussion section that do not strictly meet the review criteria but provide important considerations and information about interventions conducted in Indigenous communities. Eight studies used the clinical trial design, 1 was a case control, 1 was a case study, another was a longitudinal study, and 1 was quasi-experimental and cross-sectional.

Australia

A clinical trial was conducted for an Indigenous adult population in a community-based setting to determine the effect of an oral health literacy intervention on oral health literacy-related outcomes. The intervention comprised 5 sessions, each lasting 1.5 h, across a 1-y period. The themes of the intervention included oral health-related self-efficacy, oral health-related fatalism, oral health knowledge, access to dental care, and rights and entitlements as a patient. The primary outcome was oral health literacy as assessed by the 14-item Health Literacy Dental Scale (HeLD-14) instrument. Oral health literacy moderately improved in the intervention group versus the control group (Ju et al. 2017).

Kapellas et al. (2013) conducted a parallel-group randomized controlled trial to evaluate oral health effects of single-visit, nonsurgical periodontal therapy compared to no treatment. Intervention participants received full-mouth periodontal scaling and root planing during a single visit while the control group received no treatment. This study shows that the nonsurgical approach leads to improvements in periodontal status in an Indigenous Australian population without changing oral hygiene behavior. These findings provide supporting evidence for the provision of periodontal services as part of regular dental care to Indigenous Australians.

Another clinical trial that took a community-based approach in Australian Aboriginal children aged 18 to 47 mo, who are also a high-risk population, significantly lower decayed surface increments in a 3-y period compared with data for children in control communities. The intervention was delivered by Aboriginal health workers, provided fluoride varnish applications, and engaged parents and families during dental screenings and varnish applications at children's playgroups, preschool and community councils, and other community events. Face painting was used alongside fluoride varnish applications to

Table. Summary of Oral Health Interventions from 2006 to 2017 among Indigenous Populations.

	Country	Population	Follow-up	Intervention	Primary Outcome	Results
Australia						
1.	Ju et al. 2017	Aboriginal adults in regional location of South Australia	294 adults; 1-y follow-up	Clinical trial: Oral health literacy intervention comprising 5 interactive, contextually relevant oral health tailored workshops over a 1-y period	Oral health literacy	1.3 higher mean HeLD scores (95% CI, 1.1 to 1.6; difference statistically significant)
2.	Kapellas et al. 2013	Aboriginal adults in Northern Territory	273 adults; 1-y follow-up	Clinical trial: Full-mouth periodontal scaling and root planing during a single visit while the control group received no treatment	Periodontal health	PD \geq 4 mm (mean difference, -2.86, [95% CI, 5.01 to 0.71], $P = 0.009$) Gingival bleeding (mean difference, -0.25, [95% CI 0.43 to 0.08], $P = 0.005$)
3.	Slade et al. 2011	Aboriginal children in Northern Territory communities	543 children; 2-y follow-up	Clinical trial: Application of fluoride varnish to children's teeth, advocating water consumption and daily tooth cleaning with toothpaste, promotion of dental health in community settings and primary health care workers trained in preventive dental care	Caries increment	3.0 tooth surfaces per child (95% CI, -4.9 to -1.2; difference statistically significant)
4.	Spencer et al. 2010	Aboriginal communities in Northern Territory	2 Aboriginal communities; 2-y follow-up	Case control: Fluoridation of water supplies (0.6 mg/L)	Caries increment	Project not sustained due to discontinuation of water fluoridation in trial communities
Brazil						
5.	Arantes et al. 2010	Xavante Indians from Central Brazil	Xavante community; 7-y follow-up	Case study: Oral health promotion program including oral hygiene behavior and the use of fluoride	Caries increment	Reduction in caries in children aged 11 to 15 y 2004 dmfs = 4.95 (95% CI, 3.39 to 6.50) 2007 dmfs = 2.93 (95% CI, 1.40 to 3.27) Increase in percentage of caries-free children in this age group (20% in 1999 to 47% in 2007)
Canada						
6.	Mathu-Muju et al. 2018	First Nations communities	25 First Nations communities; 7-y follow up	Longitudinal study: Community-based prevention program over a period of 7 y measuring dental caries in areas of uninterrupted (all 7 y), intermittent (\geq 4 y), or sporadic ($<$ 4 y) service	Service delivery	Children in communities from the uninterrupted service group tended to have the highest rates of enrollment and service delivery
7.	Schroth et al. 2016	First Nation in northern Manitoba	319 children and primary caregivers	Cross-sectional: Oral health promotion campaign in 2 First Nation communities in Manitoba	Caries increment	Significant improvements in caregiver knowledge and attitudes were seen No significant change in ECC prevalence between baseline and follow-up S-ECC in the follow-up study revealed a significant reduction ($P = 0.021$) Both dt and dft were reduced significantly in the follow-up ($P = 0.016$ and $P < 0.0001$)

(continued)

Table. (continued)

	Country	Population	Follow-up	Intervention	Primary Outcome	Results
8.	Harrison et al. 2012	Cree communities in Quebec	241 children; 30-mo follow-up	Clinical trial: Motivational interviewing to mother during pregnancy and up to 6 times postnatally until child age 2 y	Caries increment	No change in ECC in the test and control group; S-ECC lower for children in test group
9.	Lawrence et al. 2008	First Nations communities in Sioux Lookout Zone (Ontario)	952 children; at 2-y follow-up	Clinical trial: Oral health counseling to caregivers and application of fluoride varnish to teeth of children twice per year for 2 y	Increment and caries incidence	18% reduction in "net" dmfs increment in the FV treatment group Caries incidence was 1.96 times higher in the controls than in the FV group (95% CI, 1.08 to 3.56; $P = 0.027$)
United States						
10.	Braun et al. 2016	Navajo Head Start classrooms	897 parent-child dyads; 3-y follow-up	Clinical trial: Highly personalized oral health interventions (5 per child, 4 per caregiver) and 6-monthly application of fluoride varnish to teeth of children	Caries increment	No change in ECC in the intervention and control groups The dmfs increment was smaller among adherent intervention children (+8.9) than among control children (+10.8; $P = 0.02$) Caregiver oral health behavior scores improved rapidly in the intervention group versus the control group ($P = 0.006$)
11.	Robertson et al. 2013	AI mother-child dyads from IHSs in Oregon, Washington, and Arizona	414 AI mother-child dyads; 2-y follow-up	Clinical trial: Mothers received 4 weekly applications of 10% chlorhexidine varnish when child was aged 4.5 to 6 mo, followed by single applications when child was aged 12 and 18 mo	NNCS	CHX varnish did not reduce the mean NNCS Active and placebo groups: 3.82 (SD = 8.18) versus 3.80 (SD = 6.08) ($P = 0.54$)
12.	Riedy 2010	Two southwestern Alaskan communities	50 pregnant women; no follow-up	Clinical trial: Maternal use of chlorhexidine rinse followed by xylitol gum	Caries increment	Study discontinued due to poor participation
13.	Larsson et al. 2015	AI community	89 parents; follow-up immediate	Quasi-experimental: Social marketing risk-framing approach for improving intention to place dental sealants for preschool children	Parental self-efficacy	Stage-of-change score showed significant improvement for all groups after watching the dental sealant message (5.81, $P < 0.0001$; 95% CI, 0.77 to 1.57) Mixed-framed message resulted in the highest scores and gain-framed messaging had the lowest score

AI, American Indian; CHX, chlorhexidine; def, decayed, extracted, filled teeth; dmfs, decayed, missing, filled surface; dt, decayed teeth; ECC, early childhood caries; FV, fluoride varnish; HeLD, Health Literacy Dental Scale; IHS, Indian Health Service; NNCS, number of new carious surfaces; PD, pocket depth; S-ECC, severe early childhood caries.

increase acceptability of the varnish in children. This resource-intensive intervention reduced the dental caries increment by 2.3 to 3.5 surfaces, per child, which is 24% to 36% fewer tooth surfaces per child who developed dental caries over 2 y (Slade et al. 2011).

Spencer et al. (2010) conducted a series of projects for the fluoridation of remote Indigenous communities in the Northern Territory in Australia to reduce dental caries in children. Two remote communities were chosen to conduct fluoridation of their drinking water. One plant was operational for 18 mo of the first 25 mo, while the other was operational 22 of the first

28 mo. However, due to technical, operational, funding, and policy issues, the projects were shut down. The cessation of the fluoridation of the 2 communities occurred too early to be able to document any oral health benefits.

Brazil

A case study was conducted with the Xavante people in Brazil. The culturally tailored study comprised an oral health promotion intervention including oral hygiene skills and the use of fluoride (Arantes et al. 2010). The program incorporated 3

components: behavioral education, prevention, and clinical service. Recognizing the traditional means of oral hygiene and associating them with Western techniques, the community recognized and accepted the use of the toothbrush and fluoridated toothpaste for oral health. In the age group of 11 to 15 y, there was a significant reduction in caries experience; the mean DMFS (decayed, missing, filled surfaces) score fell from 4.95 in 2004 to 2.39 in 2007 ($P < 0.01$). In addition, an increase in the percentage of individuals in this age group who were free from caries was also noted from 20% to 47% from 1999 to 2007.

Canada

A longitudinal community-based prevention program measured the outcome of dental caries in First Nation children over a period of 7 y based on uninterrupted (all 7 y), intermittent (≥ 4 y), or sporadic (< 4 y) service from a community health worker (Mathu-Muju et al. 2018). Four outcome variables measured longitudinal changes in access to preventive dental services: the number of enrollments, fluoride varnishes delivered, the sealants placed, and atraumatic restorative techniques done. Children in communities from the uninterrupted service group tended to have the highest rates of enrollment and service delivery, which remained constant over time.

Schroth et al. (2015) conducted a study to determine the effectiveness of a community-wide oral health promotion campaign to prevent early childhood caries (ECC) in 2 First Nation communities in Manitoba. The project aimed to assess improvements in caregiver knowledge, attitudes, and behaviors relating to early childhood oral health and the burden of ECC and severe ECC (S-ECC). Significant improvements in caregiver knowledge and attitudes were observed following the Healthy Smile Happy Child (HSHC) campaign. There was no significant change in ECC prevalence between the follow-up and baseline, but S-ECC in this follow-up study revealed a significant reduction.

A cluster-randomized pragmatic trial was conducted in the Cree community in Quebec, which is the largest First Nations group in Canada to test a motivational interviewing (MI) approach for mothers. In total, 274 Cree mothers who had either recently given birth or were between 12 and 34 wk pregnant were enrolled in the study, and randomization into test and control groups was done based on their community. The two MI-style “scripts” were used: one script for pregnant and new mothers and another for those whose child had experienced the first tooth eruption. After a 2-y follow-up, results supported an effect on extent and severity of dental caries, although the caries increment was not lower for the intervention group. Decay in dentin and pulp was reduced, and fewer children in the intervention group reported to have lost sleep, cried, missed preschool, or seen a dentist because of pain. However, these differences were not significant, suggesting that the intervention may have helped to slow the development of severe caries (Harrison et al. 2012).

Lawrence et al. (2008) conducted a cluster randomized controlled trial of fluoride varnish (FV) application and oral health counseling to caregivers in Ontario First Nations children. Twenty First Nations communities in the Sioux Lookout Zone (SLZ), Northwest Ontario, Canada, were randomized to 2 study groups. All caregivers received oral health counseling,

while children in 1 group received FV twice per year and the controls received no varnish. FV treatment conferred an 18% reduction in the 2-y mean “net” dmfs increment for Aboriginal children. Adjusted odds ratio for caries incidence was 1.96 times higher in the controls than in the FV group.

United States

A cluster-randomized clinical trial was conducted in 52 Head Start classrooms on a large Southwestern American Indian reservation to prevent ECC (Braun et al. 2016). The trial was conducted within a community-based participatory framework to train the tribal lay oral health specialists who would carry out the intervention. These community oral health specialists, or COHS, provided intensive instruction and support for improving children’s oral health; they also provided oral hygiene supplies for families, quarterly fluoride varnish applications for children in the Head Start centers, and community outreach and education. No differences were found in dental caries between the intervention and control groups after 3 y. A marginal benefit, primarily in terms of increased parental knowledge, was seen. Although both intervention and control groups experienced large caries increments over the 3-y test period, that increase was significantly lower among children whose parents participated actively in the program.

Larsson et al. (2015) assessed the social marketing risk-framing approach for improving intention to place dental sealants for preschool children. Eight-nine American Indian parents were assigned to view a gain-framed, loss-framed, or mixed-framed dental sealant message using digital signage technology. A postintervention survey assessed knowledge, risk perception, self-efficacy, social norms, intention, inclination, stage of change, and perceptions of the message. Significant improvement was seen in the stage-of-change score for all 3 groups after watching the dental sealant message. However, parents who watched the mixed-framed messages and the loss-framed messages had significantly higher self-efficacy scores than the gain-framed messages. This study provides evidence that viewing any message on dental sealants improved intention and stage-of-change scores without regard to framing approach (Larsson et al. 2015).

A placebo-controlled randomized clinical trial was conducted to test the efficacy of a 10% chlorhexidine (CHX) dental varnish applied to AI mothers’ dentition to prevent caries in AI children. AI communities in Oregon, Washington, and Arizona were enrolled in the study. Mother-child pairs were enrolled when the child was 4.5 to 6.0 mo. Mothers received 4 weekly applications of the study treatment (CHX or placebo) followed by single applications when their children were aged 12 and 18 mo. Children received caries examinations at enrollment and 12, 18, and 24 mo. The trial did not reduce the mean new caries surfaces of their children but did appear to reduce the proportion with more severe caries in the AI children (Robertson et al. 2013).

A community-based, double-blind, randomized placebo control trial was conducted to test if CHX rinses followed by xylitol gum intervention for pregnant Alaska Native women could reduce dental caries in their children. The study trial

discontinued due to difficulties with recruitment and retention and because of lack of support from community (Riedy 2010). The authors acknowledged intervention for Alaska native communities should follow community-based participatory research methodologies, and the interventions should be culturally tailored for a successful intervention.

Discussion

The studies reviewed here provide a wide range of interventions that have been conducted in Indigenous communities. The studies include interventions for the prevention and treatment of dental disease and interventions that improve oral health knowledge, behaviors, and other psychosocial factors. Among the 13 studies reviewed, 2 aimed to improve the oral health of adults; 9 studies aimed to improve the oral health of children and included their caregivers in the studies. Two studies were designed to improve the oral health of the entire community. Overall, 6 studies resulted in improved oral health in the study participants. Three Australian studies (Slade et al. 2011; Kapellas et al. 2013; Ju et al. 2017) resulted in oral health improvements; 2 studies measured clinical outcomes as periodontal health (Kapellas et al. 2013) and caries increment (Slade et al. 2011), and 1 measured oral health literacy in adults (Ju et al. 2017). The Brazilian study measured caries increment and was successful in reducing caries in Indigenous children. Two Canadian studies that were successful were preventive interventions in children; 1 measured effects of service delivery, and the other measured caries increment. In the United States, 1 intervention that was successful measured stages of change and parental self-efficacy.

Three studies that did not report any main effects of the intervention in caries reductions nonetheless found effects on reducing S-ECC (Harrison et al. 2012; Schroth et al. 2015) and caries reduction in participants who adhered to the intervention protocol (Braun et al. 2016). Indigenous children have the highest risk for dental caries, and the disease is extraordinarily resistant to interventions. In addition, Indigenous children face the highest rates of surgery under general anesthesia for ECC in Indigenous communities compared to non-Indigenous communities (Batliner 2016; Schroth et al. 2016). Reduction in S-ECC can improve pediatric quality of life by reducing the level of pain children experience, improving sleep, and reducing missed school days (Harrison et al. 2012; Braun et al. 2015). Also, it can reduce stress within families and the number treatment procedures done under general anesthesia (Schroth et al. 2016). Thus, reducing S-ECC can be an appropriate population marker of successful interventions within these communities.

While this review included New Zealand in the search, no studies were reported because none have yet been published. While a number of oral health initiatives have been funded with a strong lens on Māori persons in the past 10 y, only 1 has included an intervention (Broughton et al. 2013), with the primary findings yet to be published. Important cross-sectional studies highlighting oral health inequalities between Māori and non-Māori New Zealanders include those by Børsting et al. (2015) and Broughton et al. (2012).

Although all these studies were conducted with different Indigenous populations in different countries, several

similarities were seen across the studies (Fig. 1). Most were community-based and used community-based participatory research (CBPR) methodologies, including, culturally tailored interventions and community workers to deliver the interventions. The ones that were not culturally sensitive failed or had to be discontinued (Riedy 2010). With the long history of research misuse and mistreatment, it is not a surprise that Indigenous communities have concerns in trusting researchers from outside their communities. Therefore, as Indigenous communities assert their sovereignty in areas of health research, they strongly support CBPR methods and express less enthusiasm for research processes that are not based on participatory practices (Tiwari et al. 2015).

Also common among some studies were the challenges faced by researchers in implementing studies with Indigenous communities (Fig. 1); often these communities were spread over vast areas, and communities studied were remotely located. For example, Braun et al. (2016) conducted the study in Navajo Nation, which is larger than Massachusetts, New Hampshire, and Vermont combined, yet many participants lived in areas without electricity or running water. Lawrence et al. (2008) conducted the study with First Nations communities in the Sioux Lookout Zone, which is 1.5 times the size of the United Kingdom. Several studies included the entire communities as study participants (Arantes et al. 2010; Spencer et al. 2010; Mathu-Muju et al. 2018). Several of these Indigenous communities living in Australia, Canada, and Alaska are only accessible by air. Thus, working with these remote communities makes the interventions both time and recourse intensive and therefore difficult to sustain especially, after the research funding is exhausted.

Three studies that were recently completed in the Indigenous communities in Australia, Canada, and the United States used MI with parents of preschool children as a behavioral intervention to prevent ECC. MI appears consistent with the cultural values of Indigenous people, and MI techniques respect the sovereignty and self-determination of the individual and of the tribe (Tomlin et al. 2014). Lawrence et al. (2017) completed an MI intervention with First Nations children in 2 provinces in Canada. Preliminary findings indicate statistically significant caries reduction at age 2 y in First Nations children residing on a reserve within the intervention group. A similar MI trial was completed in Aboriginal community in South Australia, and it demonstrated moderate success in reducing ECC. A controlled trial using MI with 600 mother-child dyads has just been completed on a Northern Plains reservation in the United States. Despite use of a culturally tailored, highly personalized MI intervention, the initial results have shown no treatment effects when dmfs scores are compared for children in the treatment and usual care groups (Albino et al. 2017).

The studies presented in this review have provided mixed effects of interventions, showing that a technique that proves effective in one community may not be effective in another. Recognizing some of the unsuccessful prevention efforts and barriers to dental care experienced by many Indigenous persons, we are suggesting some recommendations (Fig. 2) that, if implemented at systems levels, could provide some solutions for reducing oral health inequalities.

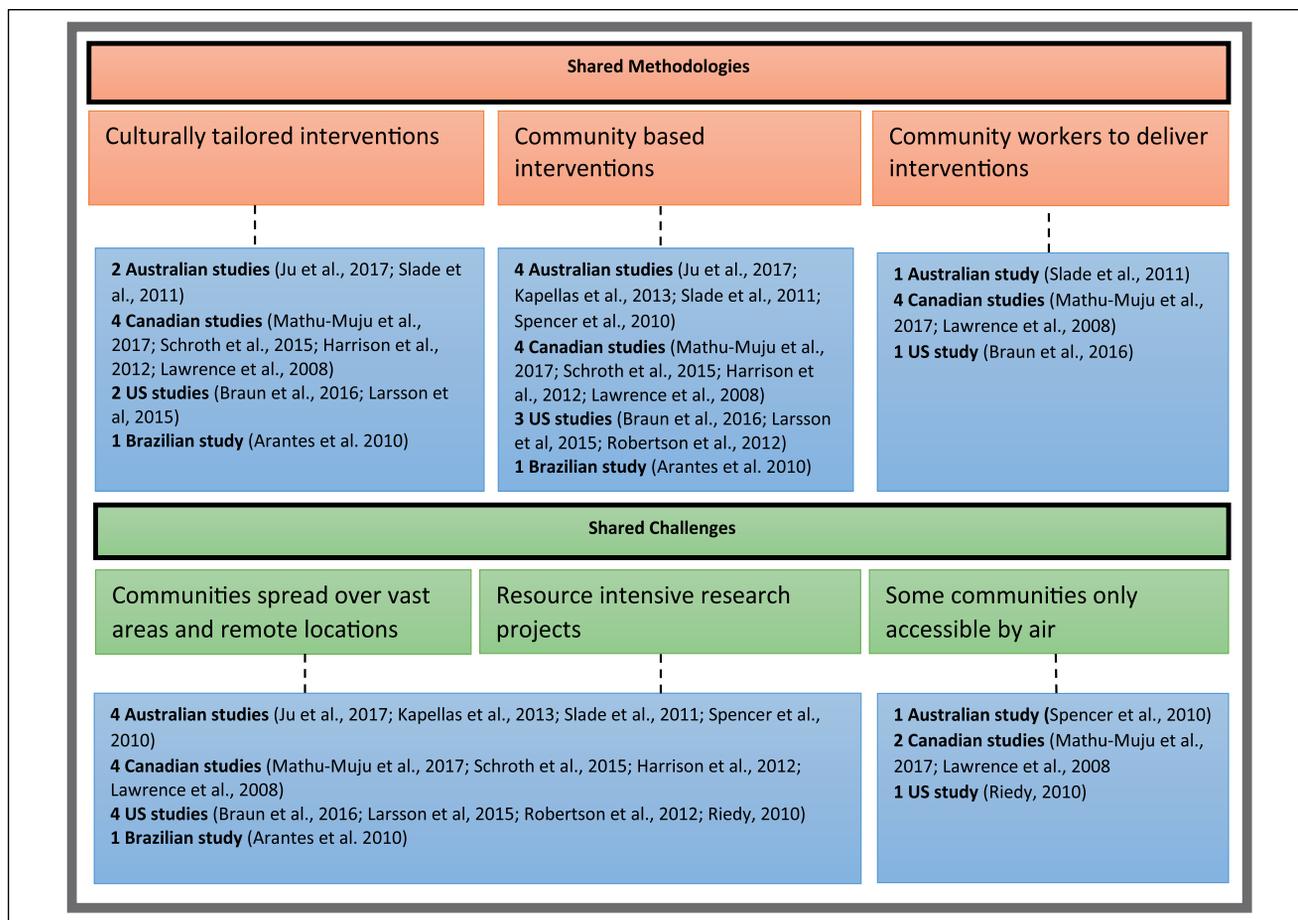


Figure 1. Shared methodologies and challenges of prevention research in Indigenous communities.

Addressing Social Determinants

Irrespective of country, social determinants of health are at the center of inequalities in dental disease experienced by Indigenous populations. Indigenous populations, almost without exception, have been exposed to sustained government policies of assimilation, deprivation, racial discrimination, and loss of land rights (King et al. 2009). The very fabric holding many Indigenous societies together has been rent, damage that cannot be remedied by quick fixes or even by thoroughly thought-out interventions that provide isolated and proximal level activities rather than upstream solutions.

Cultural Competency

There is growing concern across universities in these 5 countries involved to demonstrate they have a robust and comprehensive platform for cultural safety training in each of their health workforce curricula. This has been provided to some degree, but there remain large deficits. This is likely due to multiple factors, including the fact that dental schools are infamously expensive to run, meaning there are many financial barriers to adding additional curricula. In order for dental schools to maintain their accreditation standards, however, they must demonstrate that cultural competency training is in

place. Recognizing that improving the oral health of Indigenous persons and improving access to dental care will be limited under the current funding models for dental service provision (in Australia, mostly through the private sector), having a culturally competent dental workforce is crucial to reducing Indigenous oral health inequalities. In the United States, the Commission on Dental Accreditation mandates that dental schools provide cultural competency training to students, and research is showing how this training can help to reduce oral health disparities (Behar-Horenstein et al. 2017).

Access to Dental Services

Access to culturally appropriate, affordable, and acceptable dental care is a fundamental human right. In the Indigenous context, this provision of care is recognized as being best delivered through specific Indigenous health centers (Makowharemahihi et al. 2016; Cladoosby 2017; Leck and Randall 2017). This is for a number of reasons: 1) the care is framed within a wider, holistic model of health service provision, which is led, governed, and managed through the respective Indigenous community; 2) the providers of oral health care, including auxiliary staff, are often themselves Indigenous; and 3) there generally is a looser structure not rigidly adhering to appointment times, with children and other family members being made welcome to attend

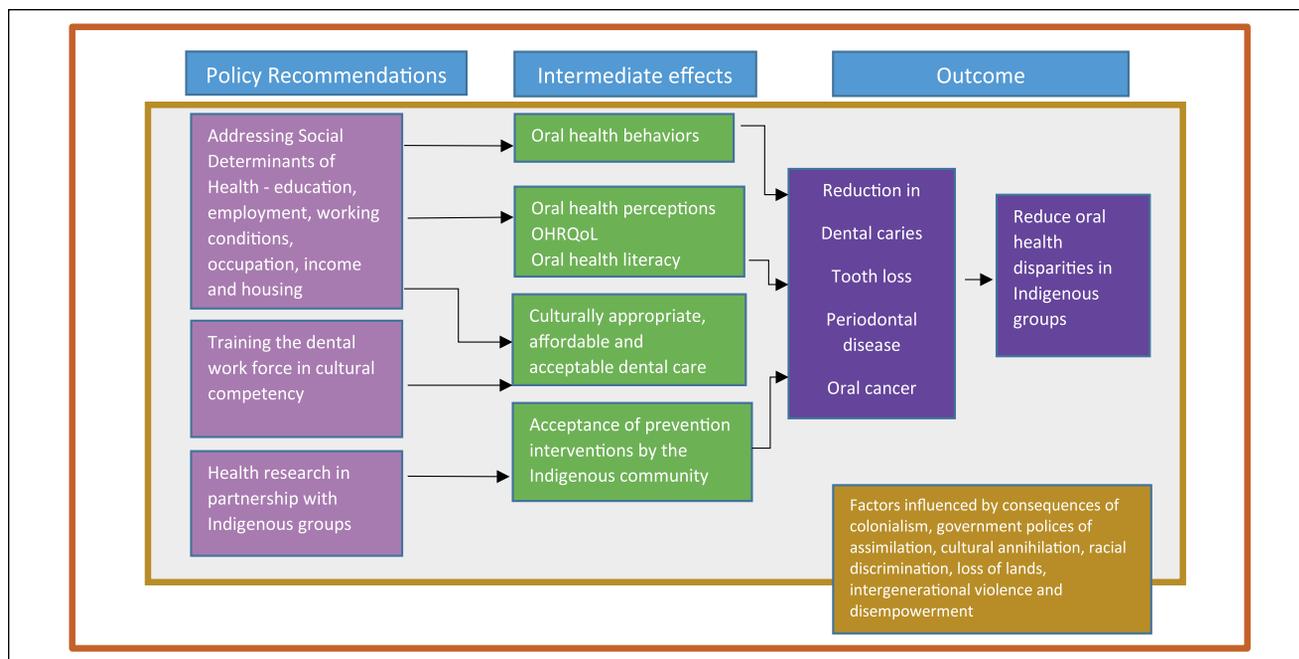


Figure 2. Recommendations for reducing oral health disparities within Indigenous communities. OHRQoL, oral health–related quality of life.

in a support capacity (Gomersall et al. 2017). Addition of a new provider type—dental health aide therapists, who provide high-need prevention and restorative services—is also proving to be an effective model in some of the AI/AN communities. Evaluations of their work have demonstrated improved access to care in remote locations and high patient satisfaction in the AN communities served (Chi 2013).

Health Research in Partnership

No group is more aware of the health inequalities between Indigenous and non-Indigenous populations than Indigenous groups themselves. Researchers in oral health research thus need to work in close partnership with the Indigenous groups with whom they are partnering so that their own objectives and ideas do not mask the community’s own priority areas (Nguyen et al. 2016). This requires both parties to learn how to work together to manage potentially conflicting agendas, including differences in priority perceptions, community politics, and interpretation of findings. The communities and participants need to be engaged as equal partners in all phases of the research process, with a flexible agenda responsive to broader environmental demands (Rowan et al. 2015).

Conclusion

Indigenous oral health is a fundamental human right. The initiatives outlined in this article have ranged from being modestly successful to not successful at all. It is encouraging that Indigenous-led initiatives, including research into Indigenous oral health inequalities, are now supported through many targeted calls for health research in countries where Indigenous populations reside. However, gaps still remain. Vigilance, dedication,

awareness, and humility are required from all dental professionals and dental health researchers to ensure that inequalities and inequities in Indigenous oral health can be reduced in the future.

Author Contributions

T. Tiwari, contributed to design, data acquisition, analysis, and interpretation, drafted and critically revised the manuscript; L. Jamieson, contributed to conception, design, data acquisition, analysis, and interpretation, drafted and critically revised the manuscript; J. Broughton, H.P. Lawrence, T.S. Batliner, R. Arantes, contributed to data interpretation, critically revised the manuscript; J. Albino, contributed to data interpretation, drafted and critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of the work.

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