



A scoping review of the roles, training, and impact of community health workers in oral health

Dina T. Garcia,¹ Jaime A. Lawson,¹ Erica R. Brody,² Susan C. McKernan,³ Sarah E. Raskin,⁴ Nixon R. Arauz,¹ Maghboebah Mosavel¹ and Tegwyn H. Brickhouse⁵

¹Department of Health Behavior and Policy, Virginia Commonwealth University, School of Medicine, United States; ²Tompkins-McCaw Library for the Health Sciences, Virginia Commonwealth University, United States; ³Department of Preventive and Community Dentistry, University of Iowa College of Dentistry, United States; ⁴L. Douglas Wilder School of Government and Public Affairs, Virginia Commonwealth University, United States; ⁵Department of Dental Public Health and Policy, Virginia Commonwealth University School of Dentistry, United States

Objective: To synthesize English or Spanish-language literature on community health workers' (CHWs') roles, training, and impact in oral health. **Basic research design:** A scoping review conducted in accordance with the Arksey and O'Malley (2005) methodological framework. **Method:** Electronic literature searches were conducted in Medline (Ovid), Embase (Ovid), DOSS, CINAHL, Web of Science, and Global Health CAB from inception of the databases to April 2020. Three reviewers independently conducted the title and abstract and full-text reviews. This was followed by data charting by three reviewers and data summarizing by two reviewers. **Results:** Out of the 36 articles that met the inclusion criteria, most took place in the United States (n=15) with most published between 2012 and 2019 (12). CHWs were incorporated in programs that focused on access to dental care (n=10), oral health promotion only (9), early childhood caries (8), oral health promotion and services (5), and oral cancer screening (4). Common roles included providing oral health education and behavior change motivation to community members, facilitating utilization of dental services, and the delivery of diagnostic and dental services to community members. Training and outcomes were not consistently described across studies. **Conclusion:** CHWs have been used in oral health programs and interventions across a wide range of locations and contexts. The implementation and scaling-up of oral health CHW programs requires appropriate provision of training as well as community embedded monitoring and evaluation structures based on rigorous methods with clearly defined outcomes.

Keywords: Health promotion, oral health, scoping review, dental care delivery, community health workers

Introduction

Oral diseases are a major global health burden affecting an estimated 3.5 billion people worldwide (Bernabe *et al.*, 2020). From 1990 to 2015, the total disability-adjusted life years (DALYs) lost due to oral diseases increased markedly by 64 percent illustrating their growing worldwide burden (Kassebaum *et al.*, 2017). Untreated oral conditions greatly affect people's general well-being and quality of life (Sheiham, 2005; Petersen and Ogawa, 2018). They also impose a substantial economic burden on society accounting approximately for US \$356.80 billion in direct costs and US \$187.61 billion in indirect costs (Righolt *et al.*, 2018).

Across and within countries there are persistent oral health inequalities that are avoidable, unfair, and unjust. Increasingly the greatest burden of oral diseases disproportionately affect socially disadvantaged individuals and populations across the lifecourse (Pitts *et al.*, 2011). Such oral health inequalities are linked to socioeconomic status and broader social and commercial determinants of health (Peres *et al.*, 2019). There are also stark differences in the distribution of oral conditions across countries. Analyses of data from the 2017 Global Burden of Disease study indicate that higher income countries (HICs) have the lowest burden of untreated caries and severe periodontitis (measured in all-ages years lived

with disability) (Bernabe *et al.*, 2020). HICs also have a higher burden of edentulism further suggesting that as countries grow economically so will the burden of oral diseases (Dye, 2017). Yet, global access to dental care and treatment options remains limited, especially in rural areas. Lower and middle-income countries (LMICs) tend to have lower population coverage for oral health care and higher within-country relative inequality than HICs (Hosseinpoor *et al.*, 2012). Even within HICs, oral health care is financially prohibitive for some individuals and populations (Mejia *et al.*, 2018).

Addressing global oral health inequalities requires a radical system change in which dental services become integrated into broader health systems, specifically primary care. This includes shifting from the dentist-centered model of care towards an integrated interdisciplinary team approach that includes diverse experts such as community health workers (CHWs) (Watt *et al.*, 2019). CHW is an umbrella term that encompasses a wide range of titles all representing "lay individuals with an in-depth understanding of the community culture and language, that have received standardized job-related training of a shorter duration than health professionals, and whose primary goal is to provide culturally appropriate health services to the community" (Olaniran *et al.*, 2017). Throughout the past half-century, large-scale CHW programs have been used worldwide as an effective strategy to address health

workforce shortages and extend the primary healthcare system (Liu *et al.*, 2011). In particular, the Alma Ata Declaration of 1978, which called for Health for All by 2020 through primary care, proliferated CHW programs to the national scale worldwide, although long-term support waned due to broader political and economic forces (Perry *et al.*, 2014). Nonetheless, throughout the years CHWs have continued to serve as a cadre of health workers embedded in either large-scale programs or local efforts facilitated by community-based, faith-based, or nongovernmental organizations (Lehmann and Sanders, 2007).

Global commitment to strengthen community health systems emphasized in the 2018 Astana Declaration on Primary Health Care has further propelled international focus in CHW programs presenting an opportunity to address oral health inequalities worldwide (Lancet, 2018). This emphasis on interprofessional and collaborative practice within the broader context of non-communicable diseases is also critical to mitigating the current gaps in the oral health workforce and its distribution globally (Yamalik *et al.*, 2014). Experts from the Global Oral Health Interest Group of the Consortium of Universities for Global Health (CUGH) have already developed preliminary oral health competencies in education for various health professions and groups including CHWs, further underscoring their role in the prevention, control, and management of oral diseases worldwide (Benzian *et al.*, 2015). However, no review has been undertaken to describe the state of science of how CHWs have been engaged globally within the field of oral health. To address this gap, a scoping review of existing literature on the roles, training and outcomes of CHWs in oral health programs and projects was conducted. This scoping review will enable us to determine the scope of published literature to date on CHWs' involvement in oral health interventions, which is necessary to uncover gaps and determine future directions.

Methods

Scoping reviews are the ideal approach to examine the extent, range and nature of research activity within a specific area of interest (Arksey and O'Malley, 2005). This approach was chosen as it enabled review of a broad range of literature on how CHWs are involved in oral health interventions across a wide range of locations and contexts. The review was conducted in accordance with the methodological framework established by Arksey and O'Malley (2005). As such, a review protocol was not published (Colquhoun *et al.*, 2014) and findings are reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al.*, 2018).

A systematic search for peer-reviewed English and Spanish-language literature describing the roles, training, and outcomes of CHWs in oral health was conducted in Medline (Ovid), Embase (Ovid), DOSS, CINAHL, Web of Science, and Global Health CAB Direct from inception of the databases to April 3, 2020. The search used a combination of keywords and controlled vocabulary for the constructs of CHWs and oral health. All research designs were considered. A sample search strategy for Medline can be seen in Supplementary Table 1 at https://scholarscompass.vcu.edu/hcpr_pubs/22/.

All references were transferred to Rayyan QCRI, an online program developed as a mobile, collaborative application to conduct systematic reviews (Ouzzani *et al.*, 2016), and duplicates were removed. Three reviewers (DTG, JAL, and NRA) conducted the title and abstract and full-text reviews. An article was included if the program or primary intervention incorporated CHWs and focused on oral health. In cases where manuscripts were available only in Spanish, the manuscript was analyzed by two reviewers (DTG and JAL). Studies were excluded if they incorporated CHWs in research (i.e. collecting data) but the research question(s) did not focus on CHWs, focused solely on licensed non-dentist professionals (e.g. Dental Health Aide Therapists), only mentioned CHWs in future directions and discussions sections, or if they did not explicitly mention oral health topics. Except for the Spanish-language articles that were reviewed by two reviewers, all three reviewers independently reviewed the full-text of all articles to reduce bias. Any disagreements between reviewers were resolved by reaching consensus.

Data from each included study were charted by three team members (DTG, JAL, NRA) using a standardized collection tool. Data collected were reviewed by the other team members with any discrepancies resolved through discussions. The data elements collected were study purpose, location, study design, CHW title, CHW training, CHW activities and roles, and study outcomes. The tool was refined through an iterative process consisting of rounds of data charting followed by group discussion of the data elements and the research questions. Data were collected and managed using REDCap electronic data capture tools hosted at Virginia Commonwealth University (Harris *et al.*, 2009; Harris *et al.*, 2019). REDCap (Research Electronic Data Capture) is a secure, web-based platform to support research data capture, providing 1) an intuitive interface; 2) audit trails for tracking data manipulation and export; 3) automated export to common statistical packages; and 4) integration and interoperability with external sources.

Descriptive analysis was conducted by two authors (DTG and JAL) to identify trends in publication year, study location, CHW title and roles, as well as oral health outcomes and impact. A choropleth map depicted the locations and contexts where CHW programs were implemented. Thematic narrative synthesis followed to organize the source studies based on their focus on roles, training, and outcomes of oral health studies that utilize CHWs.

Results

The search results and study selection process are illustrated in Figure 1 and supplemental table 1 and 2 at https://scholarscompass.vcu.edu/hcpr_pubs/22/. A total of 2,696 articles were identified from the initial search of six databases. Thirty-six-articles representing 30 CHW projects were included in the synthesis phase. Figure 2 shows that most studies took place in the United States (n=15). There was wide variation in the titles used to identify the CHWs, of which community health workers (n=6) was the most common (see Supplementary Table 2 at https://scholarscompass.vcu.edu/hcpr_pubs/22/). Studies were published between 1972 and 2019, with most between 2012 and 2019 (n=12). The articles describe different phases of the development of CHW projects including

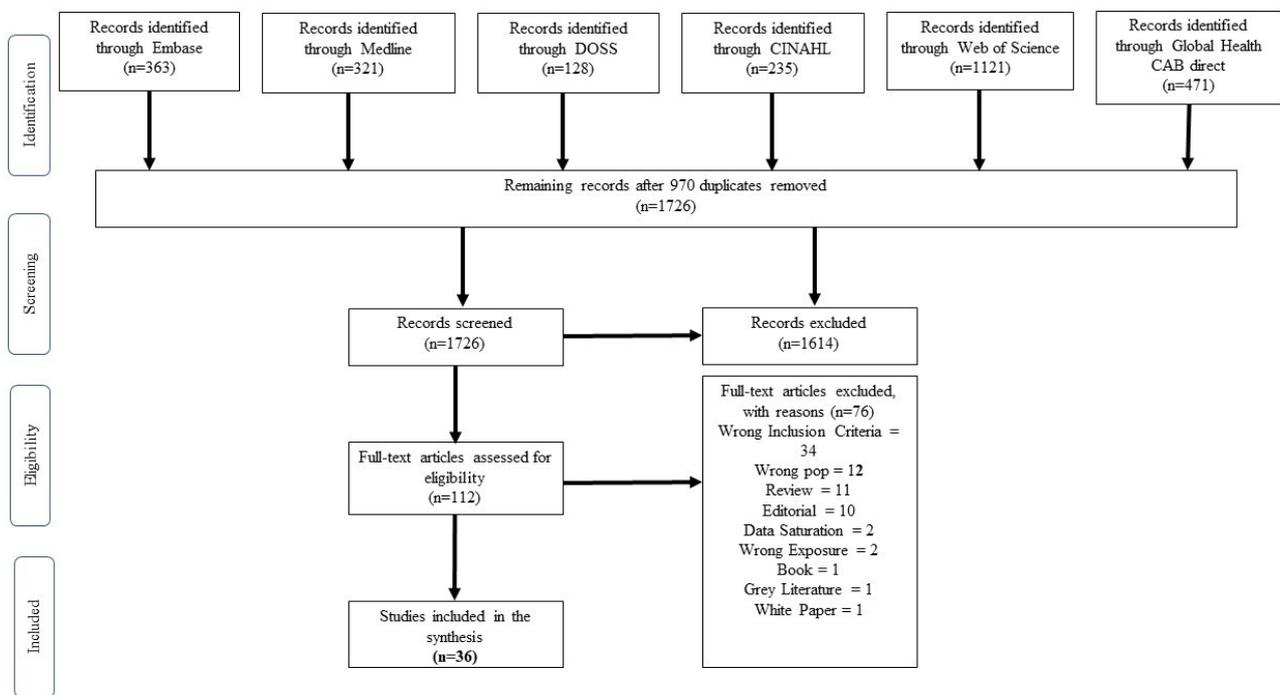


Figure 1. PRISMA flowchart

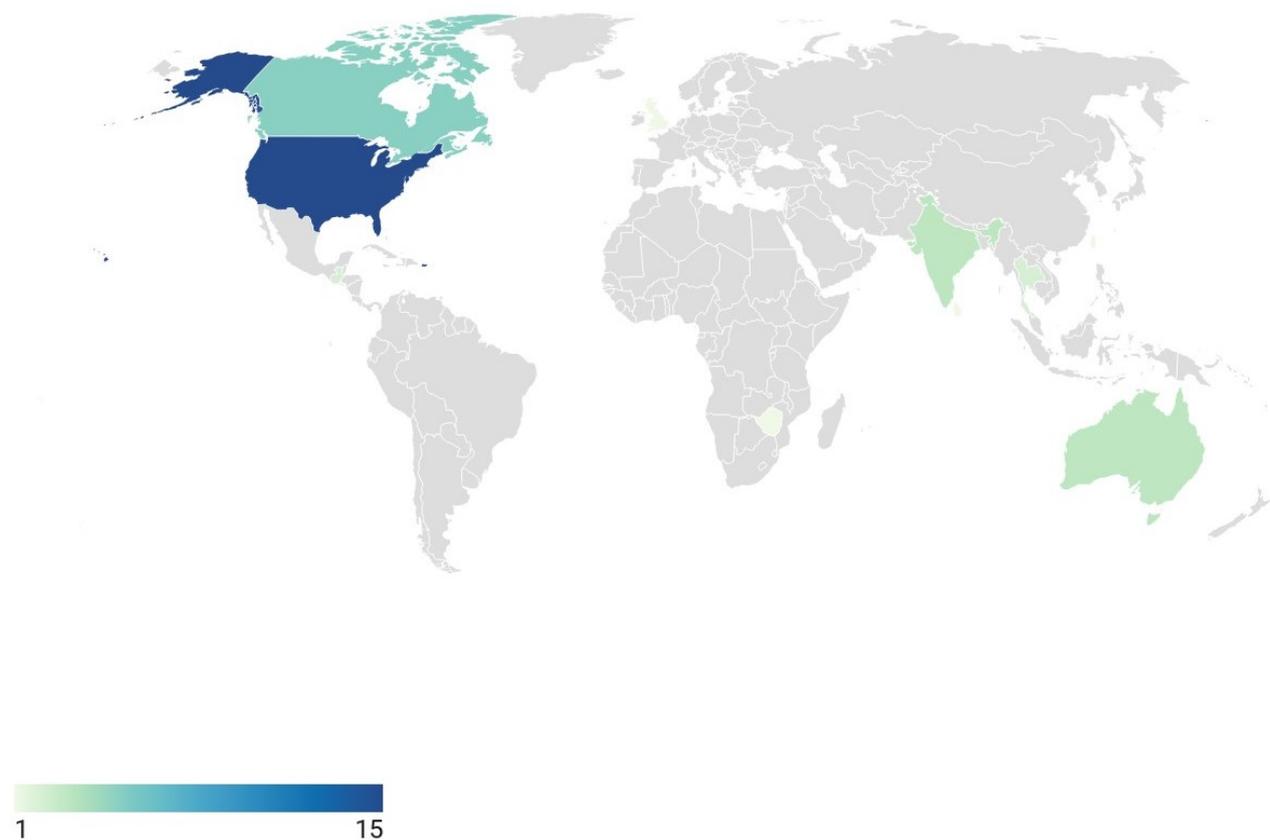


Figure 2. Choropleth map of selected studies

formative research to inform intervention design (n=4), field reports and description of programs (n=14), piloting and pretesting (n=3), and implementation and evaluation (n=15). Across these studies, the most frequently reported study designs to assess CHW programs or interventions in OH include mixed methods, cross sectional, pre-post-test, and quasi-experimental study designs.

CHW projects in the oral health field focused on five topics: access to dental care (n=10), oral health promotion

only (9), early childhood caries (8), oral health promotion and services (5), and oral cancer screening (4). Following is a summary of CHW roles, training and outcomes by oral health topic.

Access to dental care

Ten articles (27.8%), published between 1973 and 2018, described eight programs that provided healthcare navigation or linked individuals to dental care. All programs

that provided patient navigation were conducted in the U.S. whereas broader linkage to dental care programs were implemented in Scotland, Canada, Australia, and the U.S. The most common CHW roles in linkage to dental care programs included assessing insurance eligibility and referrals to dental care as well as promoting access to dental care through community events and/or home visits. In patient navigation programs, the most common CHW roles included care coordination and oral health education. CHWs in the American Dental Association's Community Dental Health Coordinator (CDHC) program had expanded roles that included oral health screenings and provision of limited dental care under the supervision of a dentist.

CHW training varied across access to dental care programs. Articles focused on patient navigation included minimal description of CHW training (Alvarez, 2017; Le *et al.*, 2017), with the exception of the CDHC program which outlined the 18-month program consisting of 670 hours of didactic coursework, 160-hour clinical experience and assessment, and a 1,040-hour internship. Linkage to dental care programs also minimally described training as one manuscript did not specify training (Hodgins *et al.*, 2018) and another study only stated that CHWs were trained over the course of one month (Zandee *et al.*, 2013). Two other studies provided more detail on topics covered in CHW training including procedures to navigate families through funding opportunities (Harrison *et al.*, 2003) and the biology of dental disease and factors of prevention (Olsen *et al.*, 1986).

Study outcomes varied across patient navigation and linkage to care studies. Those focused on patient navigation reported few outcomes, as most were field reports and program descriptions (Alvarez, 2017; Le *et al.*, 2017) or made no mention at all of outcomes (Soble and Chalklin, 1973). The articles on CDHC program pilots were descriptive and credited CHWs' role in scheduling and screening patients with an increase of patient referrals to dental hygienists (Levine *et al.*, 2012; Grover, 2014). Linkage to dental care studies primarily examined whether the CHW intervention improved access to dental care in the target population (Harrison *et al.*, 2003; Zandee *et al.*, 2013; Hodgins *et al.*, 2018), though the primary outcome for one article focused on oral health outcomes for children after the CHW intervention (Olsen *et al.*, 1986). Two of these studies used a quasi-experimental approach and found a suggested increase in access to care through higher and earlier attendance for children (Hodgins *et al.*, 2018) and a decrease in number of people having never visited a dentist in underserved neighborhoods (Zandee *et al.*, 2013). One study implemented in Canada assessed dental benefits coverage for children before and after meeting a CHW and found an increase in children covered by government funding, with 64% of the children completing care returning for preventive care (Harrison *et al.*, 2003). In Australia, Olsen *et al.* (1986) used a cross-sectional and longitudinal design to assess the effect on dental outcomes for children receiving a one-time intervention involving education and linkage to care facilitated by a CHW. The study found minimal impact of the CHW intervention on dental health and utilization of services, which was attributed to limited contact between parents and CHWs and limited access to OH literature in the target population's language (Olsen *et al.*, 1986).

Oral health promotion only

Nine articles (25%) published between 1986 and 2019 described seven oral health promotion programs and projects conducted in Australia, Canada, Thailand, the United States, and Zimbabwe. Oral health promotion efforts were targeted towards specific populations including Spanish-speaking migrant workers in the U.S. (Finlayson *et al.*, 2017; Ponce-Gonzalez *et al.*, 2019), migrants residing in Australia (Gibbs *et al.*, 2015), aboriginal communities in Canada (Mathu-Muju *et al.*, 2016; 2017; 2018), rural communities in Sri Lanka (Saparamadu, 1996), and school-aged children (Horowitz *et al.*, 1975; Björnheden and Sithole, 1994). The most common CHW role was promotion and disease prevention through the provision of oral health information to caregivers and regular fluoride varnish applications on children, which typically took place during home visits. CHWs in three programs delivered an oral health education curriculum specifically designed for the intervention, including the 4-hour program targeting migrant workers in Washington State (Ponce-Gonzalez *et al.*, 2019), the 5-week Boca Sana Cuerpo Sano program (Finlayson *et al.*, 2017), and the Teeth Tales hourly sessions delivered over the course of two to three weeks (Gibbs *et al.*, 2015). Other CHW roles were the effective linkage of children to the oral health care system through referrals and scheduling of dental appointments (Mathu-Muju *et al.*, 2016; 2017; 2018), study recruitment and community presentations (Gibbs *et al.*, 2015; Mathu-Muju *et al.*, 2016; 2017; 2018), and local and state advocacy efforts to improve access to dental care (Finlayson *et al.*, 2017). CHWs in the Children's Oral Health Initiative (COHI) also aligned conventional dental public health messages with traditional models of wellness (Mathu-Muju *et al.*, 2016; 2017; 2018).

All studies reported on CHW training, though level of detail varied widely. Training duration was specified by four studies, which ranged from a 4 hour session (Ponce-Gonzalez *et al.*, 2019), multi-day workshops (Horowitz *et al.*, 1975; Saparamadu, 1996), and training throughout the span of 6 to 8 weeks with additional refresher courses (Björnheden and Sithole, 1994). Two programs did not specify duration of CHW training but stated that the training incorporated instruction on how to implement the particular curriculum (Gibbs *et al.*, 2015; Finlayson *et al.*, 2017). One program used national OH competencies in order to standardize training delivery for their CHWs, though these specific competencies are not detailed within the manuscripts themselves (Mathu-Muju *et al.*, 2016; 2017; 2018). Studies not guided by a specific curriculum reviewed topics such as oral health statistics, social determinants of health, the relationship between oral health and chronic conditions, and best practices to teach preventive strategies (Horowitz *et al.*, 1975; Björnheden and Sithole, 1994; Saparamadu, 1996; Ponce-Gonzalez *et al.*, 2019). Training modalities were specified in two studies and included didactic and interactive components such as hands-on activities and skits (Horowitz *et al.*, 1975; Ponce-Gonzalez *et al.*, 2019).

Outcomes were reported for four oral health promotion programs (Gibbs *et al.*, 2015; Mathu-Muju *et al.*, 2016; Finlayson *et al.*, 2017; Mathu-Muju *et al.*, 2017; 2018; Ponce-Gonzalez *et al.*, 2019). Finlayson *et al.* (2017) reported on the use of community-based participatory

research approach to conduct formative research activities consisting of key informant surveys/interviews and community focus groups to inform the development of the Boca Sana, Cuerpo Sano (BSCS)/Healthy Mouth, Healthy Body Program. This formative research identified broader program barriers (e.g. cost of dental care, lack of adult insurance) and the need to change the intervention focus to the whole family to better address the target audience needs (Finlayson *et al.*, 2017). Two studies assessed program impact on caregivers' knowledge of oral health practices utilizing either a pre and post-test (Ponce-Gonzalez *et al.*, 2019) or an exploratory trial (Gibbs *et al.*, 2015). Ponce-Gonzalez *et al.* (2019) found that the CHWs intervention significantly increased caregivers' knowledge while Gibbs *et al.* (2015) found the intervention increased caregivers' confidence to take care of their children's teeth with no significant increase in knowledge. Gibbs *et al.* (2015) also found significant differences in debris index and the modified gingival index among study participants (Gibbs *et al.*, 2015).

The most widely evaluated oral health promotion program was the COHI Program implemented across First Nations communities in Canada. Evaluation of this program consisted of qualitative and quantitative methods to examine experiences of program participants, program's impact on preventive dental sealants, and the effect of the use of CHWs on access to preventive dental services access. These studies found that 50 percent of the targeted population enrolled in the program and that CHWs were instrumental in increasing access to preventive dental services (Mathu-Muju *et al.*, 2016; 2017; 2018). Authors largely attributed COHI's success to community ownership and control over decisions influencing the oral health of the community (Mathu-Muju *et al.*, 2016).

Early Childhood Caries (ECC)

Eight studies describe seven early childhood caries (ECC) prevention programs carried out by CHWs during home visits or in clinical settings. Most took place in the United States (Chinn *et al.*, 2013; Hoefl *et al.*, 2015; Hoefl *et al.*, 2016; Martin *et al.*, 2018; Milling *et al.*, 2019) and were published between 1975 and 2019. All programs and projects targeted caregivers of children across a wide range of populations including Latinx in the U.S. (Chinn *et al.*, 2013; Hoefl *et al.*, 2015; Hoefl *et al.*, 2016; Martin *et al.*, 2018; Milling *et al.*, 2019), Aboriginal families in Australia (Smith *et al.*, 2018), rural Thai communities (Vichayanrat *et al.*, 2013), and Vietnamese immigrants living in Canada (Harrison and Wong, 2003). The primary role of CHWs was the provision of oral health education covering topics such as basic rearing practices, oral hygiene practices, caries etiology, and the benefits of fluoride use and access to dental care. CHWs in three studies also assessed the oral health of children to detect early caries lesions either visually (Vichayanrat *et al.*, 2013; Smith *et al.*, 2018) or through risk assessment tools like the My Smile Buddy mobile technology (Chinn *et al.*, 2013). Less commonly reported CHW roles were the provision of emotional support to caregivers (Vichayanrat *et al.*, 2013) and participation in community-wide oral health promotion initiatives (Harrison and Wong, 2003).

CHW training was described in five of the eight studies (Chinn *et al.*, 2013; Vichayanrat *et al.*, 2013; Hoefl *et al.*,

2015; Hoefl *et al.*, 2016; Smith *et al.*, 2018). Duration of training varied from hourly sessions (Chinn *et al.*, 2013), daylong training (Vichayanrat *et al.*, 2013; Smith *et al.*, 2018), to a five-month period (Hoefl *et al.*, 2015; 2016). A wide range of training modalities were utilized such as didactic PowerPoint presentation, group discussions, role-play activities, and hands-on caries identification and risk assessment practice. Training topics focused on ECC included caries screening and oral health behaviors such as tooth brushing (Chinn *et al.*, 2013). The study that utilized the My Smile Buddy mobile technology for caries risk assessment also incorporated instructional guidance on i-Pads and goal setting during the CHW training. Studies that utilized oral health curriculum specifically developed for their programs, such as Contra Caries (Hoefl *et al.*, 2015; Hoefl *et al.*, 2016) and Smiles Not Tears (Smith *et al.*, 2018), used training sessions to familiarize CHWs with program implementation. For example, CHW training for the Contra Caries program also incorporated an overview of group facilitation strategies, study procedures, record keeping, and ethics (Hoefl *et al.*, 2015; Hoefl *et al.*, 2016).

Studies reported outcomes across different stages of for program planning. Two assessed the feasibility and acceptability of pilot studies using questionnaires and qualitative methods (e.g. key informant interviews, focus group, site observations, etc.) (Chinn *et al.*, 2013; Martin *et al.*, 2018). Both Martin *et al.* (2018) and Chinn *et al.* (2013) found that participants felt comfortable talking about oral health with CHWs due to language and social network connections as well as empathy and listening skills, which helped build trust and rapport between participants and CHWs. Chinn *et al.* (2013) also found that the use of mobile technology for caries risk assessment was both easy to use by CHWs and accepted by participants, although operating the application while engaging the clients was an area of challenge (Chinn *et al.*, 2013). Five other studies evaluated already implemented programs and projects using either a community trial design (Smith *et al.*, 2018), process and outcome evaluation (Harrison and Wong, 2003; Vichayanrat *et al.*, 2013), and pre-post testing (Hoefl *et al.*, 2015; Hoefl *et al.*, 2016; Milling *et al.*, 2019). For example, Vichayanrat *et al.* (2013) utilized focus groups to assess barriers to implementation from the perspective of CHWs, which identified lack of training on behavior change counseling and communication with participants as barriers (Vichayanrat *et al.*, 2013). On the other hand, two studies assessed the effectiveness of CHW led oral health promotion programs by assessing dental outcomes of children that participated in the program (Harrison and Wong, 2003; Smith *et al.*, 2018). Both programs found that CHW interventions were efficacious in the reduction of caries and decayed surface rates and in the modifying negative caries-related behaviors, such as feeding practices, suggesting that CHW peer counselling is a cost effective and sustainable dental health promotion approach (Harrison and Wong, 2003; Smith *et al.*, 2018). One program and one project utilized pre-post testing to examine effectiveness of oral health education on the knowledge of caregivers (Hoefl *et al.*, 2015; Hoefl *et al.*, 2016; Milling *et al.*, 2019). Both found that the education intervention effectively improved Spanish-speaking

parents' knowledge of oral hygiene and behaviors, which was sustained 3 months after post-intervention. Although it remains unclear if effectiveness persists longer term, authors report that the use of CHWs increased attendance in classes and overall retention of participants (Hoeft *et al.*, 2015; Hoeft *et al.*, 2016).

Oral health promotion with services

Five studies (13.8%) described programs and interventions in which CHWs conducted oral health promotion activities and provided dental services within community settings. All studies were descriptive and took place before the 2000s in Central America (Gereda, 1972; Gereda and Fuentes Soria, 1976; Kamliot *et al.*, 1992), Thailand (Anumanrajadhon *et al.*, 1996), and in a refugee camp (Ogunbodede *et al.*, 2000). CHW's main roles in these programs were the community-wide provision of dental services as well as oral health education. Services commonly conducted by CHWs were scaling and extractions, atraumatic restorative treatment (ART) and the removal of calculus and plaque. Oral health education took place at community sites, schools, and child care centers and included teaching community members how to create homemade toothpaste, advise on teeth cleaning, and dietary counselling. Programs that integrated oral health in primary care used oral health education as a vehicle to introduce other topics such as breast-feeding and HIV prevention (Ogunbodede *et al.*, 2000). Two programs further underscored CHW's role as agents of change within communities (Gereda, 1972; Gereda and Fuentes Soria, 1976) and in the provision of culturally responsive care (Ogunbodede *et al.*, 2000).

There was wide variation in CHW training across programs. Duration ranged from 5 months (Kamliot *et al.*, 1992) to 277 hours and 15 min (Gereda, 1972; Gereda and Fuentes Soria, 1976) to 10-weeks (Ogunbodede *et al.*, 2000). Training was conducted by universities (Gereda, 1972; Gereda and Fuentes Soria, 1976), non-profit organizations (Kamliot *et al.*, 1992), governmental initiatives such as the Intercountry Center for Oral Health in Thailand (Anumanrajadhon *et al.*, 1996) or based on existing curricula such as World Health Organization training modules (Ogunbodede *et al.*, 2000). Training typically commenced with a theoretical component followed by practical and clinical instruction in the provision of dental care through simulations and field experiences. One program also described training CHWs to construct their own dental chairs, suction apparatuses, and dental units (Kamliot *et al.*, 1992).

Programme outcomes were either not detailed (Kamliot *et al.*, 1992; Anumanrajadhon *et al.*, 1996) or only descriptive including metrics measuring total number of CHWs trained and retained, number of services provided, and activities performed (Gereda, 1972; Gereda and Fuentes Soria, 1976; Ogunbodede *et al.*, 2000). Both programs conducted in Central America called for the expansion of the CHW model to other rural areas (Gereda, 1972; Gereda and Fuentes Soria, 1976; Kamliot *et al.*, 1992). Two studies encouraged the integration of oral health into a primary health care strategy as a sustainable approach for health promotion and prevention (Anumanrajadhon *et al.*, 1996) including during population displacements (Ogunbodede *et al.*, 2000). These studies, however,

emphasized the need for community participation in the planning and operation of the programs as well as provision of remuneration for CHWs and integration into the public health systems.

Oral cancer screening

Four studies (11.1%) describe oral cancer early detection screening (OCS) by CHWs. All four were published between 2018 and 2019, mostly in India (75%). CHWs mainly conducted OCSs among high-risk populations (e.g., betel quid chewers, smokers, men) or taught individuals how to conduct OC self-exams. Among studies where CHWs conducted OCSs (Bhatt *et al.*, 2018; Basu *et al.*, 2019; Birur *et al.*, 2019), all utilized oral visual examinations and two also incorporated mobile technology for screening (Bhatt *et al.*, 2018; Birur *et al.*, 2019). Another common role among CHWs was providing targeted populations with education on oral cancer and associated risk factors. CHWs involved in programs that integrated OCS with other non-communicable disease screenings had additional roles including measuring blood pressure, blood glucose, and instruction on self-collection for HPV test (Bhatt *et al.*, 2018; Basu *et al.*, 2019).

CHW training varied from 3 days to 5 weeks. Only one study described provision of training updates three months after completion of the initial training (Basu *et al.*, 2019). All training emphasized OCS knowledge and skill acquisition (oral visual exam or mobile health screening). Two programs also trained CHWs in communication and community awareness (Bhatt *et al.*, 2018; Lee *et al.*, 2019). Training modality was described in three studies and ranged from reference to a training manual (Lee *et al.*, 2019) to detailed descriptions of activities including demonstrations, role playing, group activities, and practice exercises (Bhatt *et al.*, 2018; Birur *et al.*, 2019).

The two most frequently measured outcomes for studies where CHWs conducted OCSs were the percentage of identified OC positive cases and referrals to primary care. The percentage of positive cases identified across studies ranged from 5% (Bhatt *et al.*, 2018) and 11.8% (Birur *et al.*, 2019). Basu *et al.* (2019) stratified the percentage of positive cases by gender reporting 0.4% in women and 8% men. Two studies additionally compared accuracy in screening decisions to other medical professionals such as nurses, medical specialists or remote specialists (Bhatt *et al.*, 2018; Birur *et al.*, 2019). Birur *et al.* (2019) found a high level of agreement between CHW and medical specialists ($k=.92$) but lower agreement with remote specialists ($k=.62$) suggesting CHWs can accurately conduct oral visual examinations.

The only study that evaluated effectiveness of CHWs in teaching participants how to conduct the Mouth Self-examination found that CHW intervention significantly reduced barriers toward screening with a higher effect size than if only leaflets were used (Lee *et al.*, 2019). Studies that incorporated mHealth in OCS found that the technology facilitated case management and follow up in real time as well as increased self-confidence, self-esteem, and motivation for CHWs to conduct OCS (Bhatt *et al.*, 2018; Birur *et al.*, 2019). Two studies that reported compliance with referrals to primary care found conflicting results with one showing high compliance for those that screened positive during oral visual examination (Basu

et al., 2019) and the other showing no impact on an mHealth intervention (Bhatt *et al.*, 2018). Only one study reported on CHW's perceived barriers to OCS including social, cultural, and financial barriers (Bhatt *et al.*, 2018).

Discussion

This scoping review aimed to describe current evidence on how CHWs have been used in oral health programs. From 1972 to 2019, 30 unique programs or interventions were implemented across five oral health focus areas demonstrating a wide range of approaches used to incorporate CHWs within this field. The most common roles carried out by CHWs were providing oral health education and behavior change motivation to community members, facilitating the utilization of dental services, and the delivery of diagnostic and dental treatment to community members. These align with roles commonly reported across broader CHW programs (Scott *et al.*, 2018). However, it is important to note that CHW roles varied by context. For example, CHWs delivered diagnostic and dental treatment to community members almost exclusively in rural areas within LMICs. This finding corroborates a systematic review reporting that CHWs in these settings typically provide curative services (Kok *et al.*, 2015). In contrast, most interventions where CHWs mainly assisted with linkage to dental care were conducted in HICs and targeted populations known to face inequitable access (e.g. migrant workers, low-income families, indigenous communities, etc.). Both trends exemplify the mismatch between community needs, accessibility, and type of dental care services provided (Watt *et al.*, 2019).

Perhaps the patterns in CHW roles across settings reflect differences in structure and scope of health systems and their interrelation with political and economic forces (Kandelman *et al.*, 2012). Throughout the early 1970s to the late 1990s, there was little growth in publications with most oral health CHW projects and programs taking place in LMICs. Initiatives implemented during this period were led either by NGOs (Kamliot *et al.*, 1992), broader countrywide efforts led by the Ministry of Health (Björnheden and Sithole, 1994) or through efforts that incorporated oral health into a primary health care model (Anumanrajadhon *et al.*, 1996; Saparamadu, 1996). This mirrored broader trends within the CHW field where programs at scale began to emerge during the mid-1980s after the Alma Ata Declaration of 1978, which emphasized primary health care as the key to achieving "Health For All" (Perry *et al.*, 2014).

From 2000 to 2009, there was a modest increase in publications with only one study conducted in a LIC and three within HICs. This period saw several global efforts to prioritize the oral health, including the WHO Global Oral Health Programme, the Bangkok Charter and subsequent Liverpool Declaration, and discussion of oral health by the WHO's governing bodies including passing of the WHA60.17 resolution (Petersen, 2008; 2014). These political calls emphasized oral health as a basic human right and pushed national and international health authorities to affirm their commitment to strengthen their oral health systems. This momentum translated into a major spike in publications after 2010, with 23

publications during that period. However, most of these publications (83 percent) took place in HICs, accentuating the interplay of oral health workforce shortages, health systems financing and its intersection with prioritization of oral health (Kandelman *et al.*, 2012).

The Astana Declaration of 2018 serves as the impetus to integrate oral health promotion in broader efforts to strengthen primary health care through CHW programs. Achieving the necessary integration of oral health into general primary healthcare requires collaboration, as well as effective and transformational leadership within oral health. One aspect of collaboration entails the expansion of partnerships between primary care and oral health teams through interprofessional practice. A wide range of collaborative care models ranging in level of integration/collaboration have been implemented, most of which are located within the community-based framework of Federally Qualified Health Centers (FQHCs) in the U.S. (Gauger *et al.*, 2018). CHWs play a crucial role within these community-based interprofessional teams. An integrative review found that successful interprofessional collaboration occurs when CHWs are integrated into a primary health team and reflect the population they serve (Franklin *et al.*, 2015). Another aspect of collaboration engages oral health teams with other chronic disease stakeholders to leverage collective influence to reduce common risk factor (Williams *et al.*, 2019).

The literature reveals that CHW projects that focus on oral health lack consistent measurable outcomes and theory. The lack of monitoring and evaluation are known barriers to sustaining comprehensive primary health care (Kraef and Kallestrup, 2019). The implementation and scaling-up of oral health CHW programs that are underpinned by a strong evidence base requires further studies using rigorous methods and clearly defined outcomes. It also requires deliberate investment in building the research infrastructure in LMICs. Only 30 percent of articles in this review took place in LICs, corroborating prior findings that research authorship in the CHW field is heavily skewed towards HIC institutions, scholars, and funding (Schneider and Maleka, 2018). Efforts to scale up and sustain oral health CHW programs should also be context specific and reflect local community priorities and needs (Pallas *et al.*, 2013). Several articles used community engaged research approaches, such as Community Based Participatory Research, to determine program acceptability and feasibility (Finlayson *et al.*, 2017; Martin *et al.*, 2018), to refine program curriculums (Hoeft *et al.*, 2015), and to develop and implement programs (Harrison and Wong, 2003; Gibbs *et al.*, 2015; Mathu-Muju *et al.*, 2016; Mathu-Muju *et al.*, 2017; Mathu-Muju *et al.*, 2018). Some articles also described CHWs' role in local and state oral health advocacy (Finlayson *et al.*, 2017) or as agents of change within communities (Gereda, 1972; Gereda and Fuentes Soria, 1976; Ogunbodede *et al.*, 2000) further underscoring community embeddedness as an enabler of CHW program success (Cometto *et al.*, 2018; Scott *et al.*, 2018). As such, the success of community participation is situational and understanding and measuring it as a process (leadership, trust, building of partnerships) is just as critical as assessing program outcomes (Rifkin, 2009).

Regardless of the context of an oral health project, CHW training was not standardized. Very few articles mentioned continued training or refresher courses. This may influence program sustainability, as it illustrates a potential gap in knowledge, particularly in providing CHWs with the most up to date information to engage the communities they serve. The USAID Health Care Improvement Project suggests that CHWs should receive ongoing training every six months to develop new skills, reinforce pre-service training, and ensure prior skills are being properly practiced (Crigler *et al.*, 2011).

Very few manuscripts described the supervision of CHWs, which may compromise program sustainability if they cannot navigate obstructions to carrying out their roles. The literature demonstrates major gaps in identifying the most successful supervisory structures for CHW programs (such as type of supervisor, frequency of training, or type of training/support provided to supervisors) (Scott *et al.*, 2018). Despite these gaps, supervision involving supportive approaches, including quality assurance and problem solving, may be the most effective supervision method to improve CHW performance (Scott *et al.*, 2018).

Identified components of long term CHW program sustainability and retention involves appropriate pre-service and continuing training, regular and supportive supervision, adequate/appropriate incentives, and options for career mobility (Lehmann *et al.*, 2019). These components suggest a greater need for standardization of oral health training to better support CHW programming. In this regard, the WHO (2018) evidence-based guidelines for health policy and system support to optimize community health workers programs outline best practices related to training, supervision, remuneration, and career mobility. The guidelines are adaptable to the contextual realities of a specific nation's health system (Cometto *et al.*, 2018). Additionally, the integration of oral health care in primary health care through CHW programs should also capitalize on existing global oral health-specific competencies and training for CHWs. For example, the Global Oral Health Interest Group of the Consortium of Universities for Global Health (CUGH) developed preliminary oral health competencies outlining a continuum of skills that CHWs may contribute within interprofessional teams (Benzian *et al.*, 2015). These competencies emphasize CHW training in the WHO "Basic Package of Oral Health" (BPOC), which is an affordable and sustainable community service that can be provided within the framework of the Primary Health Care System (Frenken *et al.*, 2002). Dentists trained in BPOC can train local CHWs to deliver the BPOC components of atraumatic restorative therapy (ART), oral urgent treatment (OUT), and affordable fluoride toothpaste (AFT). Such oral health specific competencies and trainings provide the initial platform for international standardization of CHW roles and training in interprofessional teams.

An emerging area of research is the use of mobile health (mHealth) technologies by CHWs to conduct oral health screening. A scoping review of use of mHealth among CHWs found it has been used within a wide range of settings such as maternal, child, and reproductive health, including to conduct cardiovascular disease

screenings (Early *et al.*, 2019). This study demonstrates that mHealth has been used effectively for caries and oral cancer screening both in LMICs and HICs. Congruent with prior research (Early *et al.*, 2019), the use of mHealth in oral health screenings improves service provision by facilitating case management and follow up in real time. Training CHWs in mHealth could also facilitate the integration of teledentistry, which was used during the COVID-19 pandemic to deliver oral health services, especially to disadvantaged and rural populations with limited access to care (Brian and Weintraub, 2020). As mHealth becomes more prevalent, an important consideration for the use of mobile technology is the need for evidence and evaluation concerning how it can support supervision, mentoring, reflection, and feedback for CHWs (Winters *et al.*, 2018). This is an important consideration because the implementation of a new technology into CHW programs needs to be considered within the broader aspects of CHW program sustainability, such as sustainability, training, supervision, and remuneration.

Several limitations to this study should be highlighted. Selection of literature was restricted to Spanish and English publications, which excluded, for example, articles published in Portuguese that took place in Brazil, where there is a long history of incorporating CHW programs at scale (Perry *et al.*, 2014). Second, several publications provided descriptions or field reports of programs without describing their outcomes, which limited assessment of impact. Third, in alignment with standard guidelines on scoping review methodology (Arksey and O'Malley 2005), this review did not assess the quality of included studies. Lastly, the search terms utilized for CHWs were as broad as possible given that there is no standardized definition of them.

Acknowledgements

VCU REDCap is supported by the C. Kenneth and Dianne Wright Center for Clinical and Translational Research grant award UL1TR002649 from the National Center for Advancing Translational Sciences.

References

- Alvarez, M. (2017): A day in the life of a patient navigator. *Journal of the American College of Dentists* **84**, 10-12.
- Anumanrajadhon, T., Rajchagool, S., Nitisiri, P., Phantumvanit, P., Songpaisan, Y., Barmes, D.E., Sardo-Infirri, J., Davies, G.N., Moller, I.J. and Pilot, T. (1996): The community care model of the Intercountry Centre for Oral Health at Chiangmai, Thailand. *International Dental Journal* **46**, 325-333.
- Arksey, H. and O'Malley, L. (2005): Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* **8**, 19-32.
- Basu, P., Mahajan, M., Patira, N., Prasad, S., Mogri, S., Mungwong, R., Lucas, E., Sankaranarayanan, R., Iyer, S., Naik, N. and Jain, K. (2019): A pilot study to evaluate home-based screening for the common non-communicable diseases by a dedicated cadre of community health workers in a rural setting in India. *BMC Public Health* **19**, 14.
- Benzian, H., Greenspan, J.S., Barrow, J., Hutter, J.W., Loomer, P.M., Stauf, N. and Perry, D.A. (2015): A competency matrix for global oral health. *Journal of Dental Education* **79**, 353-361.

- Bernabe, E., Marceles, W., Hernandez, C.R., Bailey, J., Abreu, L.G., Alipour, V., Amini, S., Arabloo, J., Arefi, Z., Arora, A., Ayanore, M.A., Bärnighausen, T.W., Bijani, A., Cho, D.Y., Chu, D.T., Crowe, C.S., Demoz, G.T., Demsie, D.G., Dibaji Foooshani, Z.S., Du, M., El Tantawi, M., Fischer, F., Folyan, M.O., Futran, N.D., Geramo, Y.C.D., Haj-Mirzaian, A., Hariyani, N., Hasanzadeh, A., Hassanipour, S., Hay, S.I., Hole, M.K., Hostiuć, S., Ilic, M.D., James, S.L., Kalhor, R., Kemmer, L., Keramati, M., Khader, Y.S., Kisa, S., Kisa, A., Koyanagi, A., Laloo, R., Le Nguyen, Q., London, S.D., Manohar, N.D., Massenbourg, B.B., Mathur, M.R., Meles, H.G., Mestrovic, T., Mohammadian-Hafshejani, A., Mohammadpourhodki, R., Mokdad, A.H., Morrison, S.D., Nazari, J., Nguyen, T.H., Nguyen, C.T., Nixon, M.R., Olagunju, T.O., Pakshir, K., Pathak, M., Rabiee, N., Rafiei, A., Ramezanzadeh, K., Rios-Blancas, M.J., Roro, E.M., Sabour, S., Samy, A.M., Sawhney, M., Schwendicke, F., Shaahmadi, F., Shaikh, M.A., Stein, C., Tovani-Palone, M.R., Tran, B.X., Unnikrishnan, B., Vu, G.T., Vukovic, A., Warouw, T.S.S., Zaidi, Z., Zhang, Z.J. and Kassebaum, N.J. (2020): Global, regional, and national levels and trends in burden of oral conditions from 1990 to 2017: a systematic analysis for the Global Burden of Disease 2017 Study. *Journal of Dental Research* **99**, 362-373.
- Bhatt, S., Isaac, R., Finkel, M., Evans, J., Grant, L., Paul, B. and Weller, D. (2018): Mobile technology and cancer screening: lessons from rural India. *Journal of Global Health* **8**, 020421-020421.
- Birur, N.P., Gurushanth, K., Patrick, S., Sunny, S.P., Raghavan, S.A., Gurudath, S., Hegde, U., Tiwari, V., Jain, V., Imran, M., Rao, P. and Kuriakose, M.A. (2019): Role of community health worker in a mobile health program for early detection of oral cancer. *Indian Journal of Cancer* **56**, 107-113.
- Björnheden, K.M. and Sithole, W.D. (1994): Good teeth without dentists. *World Health Forum* **15**, 19-23.
- Brian, Z. and Weintraub, J.A. (2020): Oral health and COVID-19: increasing the need for prevention and access. *Preventing Chronic Disease* **17**, E82.
- Chinn, C.H., Levine, J., Matos, S., Findley, S. and Edelstein, B.L. (2013): An interprofessional collaborative approach in the development of a caries risk assessment mobile tablet application: My Smile Buddy. *Journal of Health Care for the Poor and Underserved* **24**, 1010-1020.
- Colquhoun, H.L., Levac, D., O'Brien, K.K., Straus, S., Tricco, A.C., Perrier, L., Kastner, M. and Moher, D. (2014): Scoping reviews: time for clarity in definition, methods, and reporting. *Journal of Clinical Epidemiology* **67**, 1291-1294.
- Cometto, G., Ford, N., Pfaffman-Zambruni, J., Akl, E.A., Lehmann, U., McPake, B., Ballard, M., Kok, M., Najafzadeh, M., Olaniran, A., Ajobor, O., Perry, H.B., Scott, K., Albers, B., Shlonsky, A. and Taylor, D. (2018): Health policy and system support to optimise community health worker programmes: an abridged WHO guideline. *The Lancet Global Health* **6**, e1397-e1404.
- Crigler, L., Hill, K., Furth, R. and Bjerregaard, D. (2011). *Community Health Worker Assessment and Improvement Matrix (CHW AIM): a toolkit for improving CHW programs and services Community Health Worker Assessment and Improvement Matrix (CHW AIM)*. Bethesda, MD, USAID.
- Dye, B.A. (2017): The global burden of oral disease: research and public health significance. *Journal of Dental Research* **96**, 361-363.
- Early, J., Gonzalez, C., Gordon-Dseagu, V. and Robles-Calderon, L. (2019): Use of mobile health (mHealth) technologies and interventions among community health workers globally: a scoping review. *Health Promotion Practice* **20**, 805-817.
- Finlayson, T.L., Asgari, P., Hoffman, L., Palomo-Zerfas, A., Gonzalez, M., Stamm, N., Rocha, M.I. and Nunez-Alvarez, A. (2017): Formative research: using a community-based participatory research approach to develop an oral health intervention for migrant Mexican families. *Health Promotion Practice* **18**, 454-465.
- Franklin, C.M., Bernhardt, J.M., Lopez, R.P., Long-Middleton, E.R., Davis, S. (2015): Interprofessional Teamwork and Collaboration Between Community Health Workers and Healthcare Teams: An Integrative Review. *Health Services Research and Managerial Epidemiology*, **2**.
- Frenken, J.E., Holmgren, C. and Helderma, V.P. (2002): *WHO Basic Package of Oral Health Care* (BPOC). Nijmegen, Netherlands: WHO Collaborating Centre for Oral Health Planning and Future Scenarios, University of Nijmegen.
- Gauger, T.L., Prosser, L.A., Fontana, M. and Polverini, P.J. (2018): Integrative and collaborative care models between pediatric oral health and primary care providers: a scoping review of the literature. *Journal of Public Health Dentistry* **78**, 246-256. doi:10.1111/jphd.12267
- Gereda, R. (1972): Auxiliary rural promoters of oral health. *Revista Guatemalteca de Estomatología* **2**, 15-19.
- Gereda, R. and Fuentes Soria, A. (1976): Rural promoters of oral health: "country dentists". *Asociación Latinoamericana de Facultades de Odontología* **11**, 109-127.
- Gibbs, L., Waters, E., Christian, B., Gold, L., Young, D., de Silva, A., Calache, H., Gussy, M., Watt, R., Riggs, E., Tadic, M., Hall, M., Gondal, I., Pradel, V. and Moore, L. (2015): Teeth Tales: a community-based child oral health promotion trial with migrant families in Australia. *BMJ Open* **5**, e007321.
- Grover, J. (2014): The community dental health coordinator. A valued new member of the dental team. *Today's FDA* **26**, 56-57.
- Harris, P.A., Taylor, R., Minor, B.L., Elliott, V., Fernandez, M., O'Neal, L., McLeod, L., Delacqua, G., Delacqua, F., Kirby, J. and Duda, S.N. (2019): The REDCap consortium: building an international community of software platform partners. *Journal of Biomedical Informatics* **95**, 103208.
- Harris, P.A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N. and Conde, J.G. (2009): Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics* **42**, 377-381.
- Harrison, R.L., Li, J., Pearce, K. and Wyman, T. (2003): The Community Dental Facilitator Project: reducing barriers to dental care. *Journal of Public Health Dentistry* **63**, 126-128.
- Harrison, R.L. and Wong, T. (2003): An oral health promotion program for an urban minority population of preschool children. *Community Dentistry and Oral Epidemiology* **31**, 392-399.
- Hodgins, F., Sherriff, A., Gnich, W., Ross, A.J. and Macpherson, L.M.D. (2018): The effectiveness of Dental Health Support Workers at linking families with primary care dental practices: a population-wide data linkage cohort study. *BMC Oral Health* **18**, 191.
- Hoelt, K.S., Barker, J.C., Shiboski, S., Pantoja-Guzman, E. and Hiatt, R.A. (2016): Effectiveness evaluation of Contra Caries Oral Health Education Program for improving Spanish-speaking parents' preventive oral health knowledge and behaviors for their young children. *Community Dentistry and Oral Epidemiology* **44**, 564-576.
- Hoelt, K.S., Rios, S.M., Pantoja Guzman, E. and Barker, J.C. (2015): Using community participation to assess acceptability of "Contra Caries", a theory-based, promotora-led oral health education program for rural Latino parents: a mixed methods study. *BMC Oral Health* **15**, 103.
- Horowitz, A.M., Bradley, S., Hupp, H. and Morrison, D. (1975): Incorporation of a preventive dentistry program in a Home Start program. *Public Health Reports* **90**, 365-368.
- Hosseinpoor, A.R., Itani, L. and Petersen, P.E. (2012): Socio-economic inequality in oral healthcare coverage: results from the World Health Survey. *Journal of Dental Research* **91**, 275-281.
- Kamliot, N., Mejía, A. and Leiner, S. (1992): Community dental health for Central America: an alternative model for health care delivery in the Third World. *Journal of Public Health Dentistry* **52**, 299-302.

- Kandelman, D., Arpin, S., Baez, R.J., Baehni, P.C. and Petersen, P.E. (2012): Oral health care systems in developing and developed countries. *Periodontology* **2000** **60**, 98-109.
- Kassebaum, N.J., Smith, A.G.C., Bernabe, E., Fleming, T.D., Reynolds, A.E., Vos, T., Murray, C.J.L., Marcenes, W. and Collaborators, G.B.D.O.H. (2017): Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *Journal of Dental Research* **96**, 380-387.
- Kok, M.C., Dieleman, M., Taegtmeier, M., Broerse, J.E., Kane, S.S., Ormel, H., Tijm, M.M. and de Koning, K.A. (2015): Which intervention design factors influence performance of community health workers in low- and middle-income countries? A systematic review. *Health Policy Plan* **30**, 1207-1227.
- Kraef, C. and Kallestrup, P. (2019): After the Astana declaration: is comprehensive primary health care set for success this time? *BMJ Glob Health* **4**, e001871.
- Le, H., Akabike, A. and Le, C. (2017): Navigating the Cultural Dimension of Oral Health Care. *Journal of the American College of Dentists* **84**, 18-21.
- Lee, H., Ho, P.S., Wang, W.C., Hu, C.Y., Lee, C.H. and Huang, H.L. (2019): Effectiveness of a health belief model intervention using a lay health advisor strategy on mouth self-examination and cancer screening in remote aboriginal communities: A randomized controlled trial. *Patient Education and Counseling* **102**, 2263-2269.
- Lehmann, U. and Sanders, D. (2007). Community Health Workers: What Do We Know about them? The State of the Evidence on Programmes, Activities, Costs, and Impacts of Health Outcomes of Using Community Health Workers. Geneva, World Health Organization.
- Lehmann, U., Twum-Danso, N.A.Y. and Nyoni, J. (2019): Towards universal health coverage: what are the system requirements for effective large-scale community health worker programmes? *BMJ Global Health* **4**, e001046.
- Levine, B., Clarke, A., Ganem, I., Deinhardt, A. and Ismail, D.A. (2012): Pennsylvania's community dental health coordinators. *Pennsylvania Dental Journal* **79**, 26-30.
- Liu, A., Sullivan, S., Khan, M., Sachs, S. and Singh, P. (2011): Community health workers in global health: scale and scalability. *Mount Sinai Journal of Medicine* **78**, 419-435.
- Martin, M.A., Lee, H.H., Landa, J., Minier, M., Avenetti, D. and Sandoval, A. (2018): Formative research implications on design of a randomized controlled trial for oral health promotion in children. *Pilot and Feasibility Studies* **4**, 155.
- Mathu-Muju, K.R., Kong, X., Brancato, C., McLeod, J. and Bush, H.M. (2018): Utilization of community health workers in Canada's Children's Oral Health Initiative for indigenous communities. *Community Dentistry and Oral Epidemiology* **46**, 185-193.
- Mathu-Muju, K.R., McLeod, J., Donnelly, L., Harrison, R. and MacEntee, M.I. (2017): The perceptions of first nation participants in a community oral health initiative. *International Journal of Circumpolar Health* **76**, 1364960.
- Mathu-Muju, K.R., McLeod, J., Walker, M.L., Chartier, M. and Harrison, R.L. (2016): The Children's Oral Health Initiative: An intervention to address the challenges of dental caries in early childhood in Canada's First Nation and Inuit communities. *Canadian Journal of Public Health* **107**, e188-e193.
- Mejia, G.C., Elani, H.W., Harper, S., Murray Thomson, W., Ju, X., Kawachi, I., Kaufman, J.S. and Jamieson, L.M. (2018): Socioeconomic status, oral health and dental disease in Australia, Canada, New Zealand and the United States. *BMC Oral Health* **18**, 176.
- Milling, E.P., Davila, M.E., Tomar, S.L. and Dodd, V.J. (2019): Impact of the promotora model on the improvement of oral health knowledge of caregivers. *Revista de Salud Pública* **21**, 64-69.
- Ogunbodede, E.O., Mickenautsch, S. and Rudolph, M.J. (2000): Oral health care in refugee situations: Liberian refugees in Ghana. *Journal of Refugee Studies* **13**, 328-335.
- Olaniran, A., Smith, H., Unkels, R., Bar-Zeev, S. and van den Broek, N. (2017): Who is a community health worker? - a systematic review of definitions. *Global Health Action* **10**, 1272223.
- Olsen, C.B., Brown, D.F. and Wright, F.A. (1986): Dental health promotion in a group of children at high risk to dental disease. *Community Dentistry and Oral Epidemiology* **14**, 302-305.
- Ouzzani, M., Hammady, H., Fedorowicz, Z. and Elmagarmid, A. (2016): Rayyan-a web and mobile app for systematic reviews. *Systematic Reviews* **5**, 210.
- Pallas, S.W., Minhas, D., Perez-Escamilla, R., Taylor, L., Curry, L. and Bradley, E.H. (2013): Community health workers in low- and middle-income countries: what do we know about scaling up and sustainability? *American Journal of Public Health* **103**, e74-82.
- Peres, M.A., Macpherson, L.M.D., Weyant, R.J., Daly, B., Venturelli, R., Mathur, M.R., Listl, S., Celeste, R.K., Guarnizo-Herreño, C.C., Kearns, C., Benzian, H., Allison, P. and Watt, R.G. (2019): Oral diseases: a global public health challenge. *Lancet* **394**, 249-260.
- Perry, H.B., Zulliger, R. and Rogers, M.M. (2014): Community health workers in low-, middle-, and high-income countries: an overview of their history, recent evolution, and current effectiveness. *Annual Review of Public Health* **35**, 399-421.
- Petersen, P.E. (2008): World Health Organization global policy for improvement of oral health--World Health Assembly 2007. *International Dental Journal* **58**, 115-121.
- Petersen, P.E. (2014): Strengthening of oral health systems: oral health through primary health care. *Medical Principles and Practice* **23**, 3-9.
- Petersen, P.E. and Ogawa, H. (2018): Promoting Oral Health and Quality of Life of Older People - The Need for Public Health Action. *Oral Health and Preventive Dentistry* **16**, 113-124.
- Pitts, N., Amaechi, B., Niederman, R., Acevedo, A.M., Vianna, R., Ganss, C., Ismail, A. and Honkala, E. (2011): Global oral health inequalities: dental caries task group--research agenda. *Advances in Dental Research* **23**, 211-220.
- Ponce-Gonzalez, I., Cheadle, A., Aisenberg, G. and Cantrell, L.F. (2019): Improving oral health in migrant and underserved populations: evaluation of an interactive, community-based oral health education program in Washington state. *BMC Oral Health* **19**, 30.
- Rifkin, S.B. (2009): Lessons from community participation in health programmes: a review of the post Alma-Ata experience. *International Health* **1**, 31-36.
- Righolt, A.J., Jevdjevic, M., Marcenes, W. and Listl, S. (2018): Global-, Regional-, and Country-Level Economic Impacts of Dental Diseases in 2015. *Journal of Dental Research* **97**, 501-507.
- Saparamadu, K.D. (1996): Preventive dentistry--a priority in Sri Lanka. *International Dental Journal* **46**, 97-102.
- Schneider, H. and Maleka, N. (2018): Patterns of authorship on community health workers in low-and-middle-income countries: an analysis of publications (2012-2016). *BMJ Global Health* **3**, e000797.
- Scott, K., Beckham, S.W., Gross, M., Pariyo, G., Rao, K.D., Cometto, G. and Perry, H.B. (2018): What do we know about community-based health worker programs? A systematic review of existing reviews on community health workers. *Human Resources for Health* **16**, 39.
- Sheiham, A. (2005): Oral health, general health and quality of life. *Bulletin of the World Health Organization* **83**, 644.
- Smith, L., Blinkhorn, F., Moir, R. and Blinkhorn, A. (2018): Results of a two year dental health education program to reduce dental caries in young Aboriginal children in New South Wales, Australia. *Community Dental Health* **35**, 211-216.

- Soble, R.K. and Chaiklin, H. (1973): Helping inner-city families obtain preventive dentistry for their preschool children. *Child Welfare* **52**, 602-610.
- The Lancet (2018): The Astana Declaration: the future of primary health care? *Lancet* **392**, 1369.
- Tricco, A.C., Lillie, E., Zarin, W., O'Brien, K.K., Colquhoun, H., Levac, D., Moher, D., Peters, M.D.J., Horsley, T., Weeks, L., Hempel, S., Akl, E.A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M.G., Garrity, C., Lewin, S., Godfrey, C.M., Macdonald, M.T., Langlois, E.V., Soares-Weiser, K., Moriarty, J., Clifford, T., Tuncalp, O. and Straus, S.E. (2018): PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Annals of Internal Medicine* **169**, 467-473.
- Vichayanrat, T., Steckler, A. and Tanasugarn, C. (2013): Barriers and facilitating factors among lay health workers and primary care providers to promote children's oral health in Chon Buri Province, Thailand. *The Southeast Asian Journal of Tropical Medicine and Public Health* **44**, 332-343.
- Watt, R.G., Daly, B., Allison, P., Macpherson, L.M.D., Venturelli, R., Listl, S., Weyant, R.J., Mathur, M.R., Guarnizo-Herreño, C.C., Celeste, R.K., Peres, M.A., Kearns, C. and Benzian, H. (2019): Ending the neglect of global oral health: time for radical action. *Lancet* **394**, 261-272.
- Williams, D.M., Mossey, P.A. and Mathur, M.R. (2019): Leadership in global oral health. *Journal of Dentistry* **87**, 49-54.
- Winters, N., O'Donovan, J. and Geniets, A. (2018): A new era for community health in countries of low and middle income? *Lancet Global Health* **6**, e489-e490.
- Yamalik, N., Ensaldo-Carrasco, E., Cavalle, E. and Kell, K. (2014): Oral health workforce planning part 2: figures, determinants and trends in a sample of World Dental Federation member countries. *International Dental Journal* **64**, 117-126.
- Zandee, G.L., Bossenbroek, D., Slager, D. and Gordon, B. (2013): Teams of community health workers and nursing students effect health promotion of underserved urban neighborhoods. *Public Health Nursing* **30**, 439-447.