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Oral healthcare systems for an ageing population: concepts and challenges

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Oral healthcare systems (OHCS) are designed to maintain the health and function through Communication (Health promotion and education), Prevention, Assessment and Diagnosis, and Treatment. The complexity of these OHCS functions for the ageing are described utilizing the spectrum of dependency of the Seattle Care Pathway framework. Barriers and disparities which challenge the development of OHCS for the ageing can be universal but often vary between developed and developing countries. Recognizing that oral diseases are largely preventable, strategies to improve OHCS must be targeted locally, nationally, and internationally at oral health policy, education, research, and clinical care.

Key words: *Oral healthcare systems, oral health, healthcare systems, ageing, geriatric*

HEALTH SYSTEMS

The World Health Organization (WHO) defines health systems as 'all the activities whose primary purpose is to promote, restore, and/or maintain health; the people, institutions and resources, arranged together in accordance with established policies, to improve the health of the population they serve[1].' The key components of healthcare systems include (i) leadership and governance; (ii) information systems; (iii) financing; (iv) workforce; (v) resources; and (vi) service delivery[2]. Through administration and guidance, health systems define and can be defined by national health policies, strategies, and plans. Health information systems utilize economic, political, social, and health data to evaluate trends in prevalence and severity of disease to design health interventions[3]. Risk factors are identified and preventive health services are implemented to reduce incidence of disease. The necessary resources required include facilities, equipment, supplies as well as transportation and communication networks.

Oral healthcare systems (OHCS) maintain oral health and function through health promotion, prevention, and disease control. The priority given to OHCS affects the services provided, the population served, funding, programme sustainability, research priorities, data acquisition, and variation within a country and between countries[3]. Unfortunately, in many countries with extensive, competing healthcare needs, OHCS may not reach a high level of priority when national agendas are developed.

Tomar and Cohen[4] defined the attributes of ideal OHCS by reviewing policy statements and position papers of the WHO, Institute of Medicine (IOM), American Public Health Association, Healthy People 2010 Objectives for the Nation, and American Association of Public Health Dentistry (see *Table 1*). No one OHCS can excel in all of these categories, but these characteristics should be used by an OHCS to prioritize goals and outcomes and develop evaluation criteria. Although in many developed countries, OHCS have historically been segregated from other healthcare with a focus on treatment for those financially privileged, it is recognized that OHCS must move to an integrated healthcare model with a focus on prevention which is accessible across socio-economic and cultural spectrums. Future research must

Table 1 Attributes of an ideal oral healthcare system

- Integrated with the healthcare system
- Emphasis on health promotion and disease prevention
- Monitors population oral health status and needs
- Evidence-based
- Effective
- Cost-effective
- Sustainable
- Equitable
- Universal
- Comprehensive
- Ethical
- Continuous quality assessment and assurance
- Culturally competent
- Empowers communities and individuals to create conditions conductive to health

From Tomar and Cohen[4].

focus on the development of cost-effective and sustainable models.

Helgeson and Glassman[5] adopted the Triple Aim defined by Berwick[6] and identified goals of new OHCS: (i) improve the experience of care; (ii) improve the health of populations, and (iii) reduce the cost of healthcare. To achieve these goals, the IOM has called for expanded research and demonstration of delivery systems that test new methods and technologies such as delivering oral health services in non-traditional settings, using non-dental professionals, expanding roles for existing dental professionals, creating new types of dental professionals, and incorporating telehealth technologies[7,8]. Further, recognizing that oral diseases are largely preventable, strategies to improve OHCS must be targeted at multiple levels – locally, nationally, and internationally and at oral health policy, education, research, and clinical care.

Oral healthcare systems must address socio-economic, cultural, and logistical challenges across age groups with innovative strategies. Given the ageing of the world population, there is an immediate necessity to develop OHCS tailored to provide 'appropriate' care for the ageing population whose needs are continuously morphing while travelling across the spectrum of dependency. IOM defines *appropriate* as care where the expected benefits exceed expected risks by a wide margin.

DEPENDENCY AND THE AGEING POPULATION

Worldwide, the ageing population is diverse in many aspects such as socio-economic status and level of dependency[9]. For example, of the 43 million elders in the United States in 2013, 8.3 million (19%) required long-term care [adult day care (0.6%), residential care (1.5%), hospice (2.8%), nursing home residence (3.2%), and contracted care through a home health agency for the homebound (10.9%)][10,11]. The 2014 Survey of Older Persons in Thailand reported 11.2% of community-dwelling persons aged 75–79 needed assistance for daily living. This proportion increased to 24.2% in persons aged 80 or above[12]. Therefore, OHCS interventions for the ageing must be uniquely tailored to reflect level and changes of dependency.

The Seattle Care Pathways (SCP) is a structured, evidence-based approach to defining oral healthcare for the ageing based on five levels of dependency: (i) None (fit, exercise regularly); (ii) Predependency (well controlled chronic systemic conditions); (iii) Low dependency (chronic conditions affect oral health); (iv) Medium dependency (chronic conditions impact access to oral healthcare); (v) High dependency (complex medical problems; unable to access dental clinic)[13]. The SCP further defines actions required to maintain oral health across the spectrum of dependency. The categorization of these interventions mirrors the four OHCS functions and will serve as the framework for further discussion: (i) Communication: Health promotion and education; (ii) Prevention; (iii) Assessment and diagnosis; and (iv) Treatment (*Table 2*)[13]. Without simultaneously addressing the dependency spectrum in OHCS development for ageing populations, lack of consideration of critical components such as interdisciplinary collaboration, comorbid conditions, surrogate caregivers, and mobility constraints would render these intervention models ineffective.

HEALTH PROMOTION AND EDUCATION

Health promotion and education foster individual ownership by empowering persons to manage their own oral health. A decline in effective oral hygiene and an increase in medication use are a few of the challenges experienced with ageing which result in an increase in caries and periodontal disease risk and subsequent need for increased surveillance. Areas of focus for oral health education are the impact of ageing on oral health, appropriate daily and professional care, and available resources and funding.

Although oral health professionals such as dentists and dental hygienists commonly provide oral health education, a more expansive workforce is required. Models utilizing healthcare providers from primary care, nutrition, physical and occupational therapy, and social work involved in oral health promotion and education are critical to OHCS development. The Ministry of Public Health of Thailand has developed the Health Development Strategic Plan for the Elderly

Table 2 The Seattle Care Pathway: actions required to maintain oral health at different levels of dependency

Actions	Level of dependency				
	None	Pre	Low	Medium	High
Communication	Explain implications of increased dependency	Explain to patients and healthcare providers the significance of conditions likely to complicate the management of oral health as dependency increases	Expand to all members of the healthcare team; emphasize preventive strategies to manage the risk of oral disease and maintain oral function	Maintain communication with members of the interprofessional healthcare team; increase vigilance regarding daily oral care plan	Monitor established communication and include family and friends to allow for continuous adjustments to palliative care by everyone involved
Prevention	Homecare plan for better oral health	Consider prescribing for oral disease; risk modification for oral cancer, tooth surface loss, and mucositis; develop daily oral care plan	Base preventive plans on identified aggravating factors; adjust methods of delivering predependency prescriptions; assess risks and manage adverse effects of polypharmacy; monitor daily oral care plan	Monitor and help contributions to oral health regimens; reassess the need to increase prescriptions for oral disease; reassess risks and manage the adverse effects of polypharmacy; reassess the effectiveness of daily oral care plan	Focus on the increasing challenges of preventing and managing oral infection and disorders; emphasize the management of pain and infection; maintain the use of prescribed agents for oral disease; manage severe mucositis
Assessment	Appropriate dental recall	Systemic conditions; appropriate dental recall; strategic healthcare plan delivery; recognize risk is elevated by increased dependency; long-term viability of oral health; assess for elder abuse	Risk of oral disease; Increase dental recall; strategic healthcare plan delivery; growing risk of oral disease; long-term viability of oral health and management strategies	Participate in social and other medical services; reassess long-term viability of oral health-related preventive strategies	Identify barriers to emergency palliative and elective oral care; monitor burden of oral care on the patient and others; monitor the oral healthcare plan; increase vigilance for elder abuse
Treatment	Routine	Long-term viability of existing treatment plans; plan treatment outcomes for easy maintenance	Treatment to maintain function; maintain function and oral health	Conservative treatment; use prosthetics to simplify hygiene and maintenance	Offer palliative treatment on demand from the patient to control pain and infection and maintain social contacts and activities

From Al-Sulaiman and Jones[10], and Pretty *et al.*[13]

(2013–2023). The concept of care for the elderly at advanced age is based on the integrated community-based approach of care by the family and the health and social support system[12]. The Ministry of Health and Wellness in Botswana (www.moh.gov.bw) provides primary health care services to the entire population through District Health Management Teams (DHMTs). DHMTs, which include oral health staff, are responsible for running a network of health facilities, hospitals, clinics, health posts and mobile stops, as well as community-based preventative and promotive services[14].

As a person ages, their ability to care for themselves declines. Therefore, oral health promotion and education need to be directed both to the aged persons as well as their professional and non-professional (e.g., family) caregivers (*Table 2*)[13]. Methods to spread knowledge include direct verbal communication during office visits and seminars, written communication, and mass media. Ageing institutions can assist in the dissemination of health promotion and education through meal delivery programmes, senior centres, and long-term care facilities. Research from the ElderSmile program using system dynamics methodology models social dimensions of oral health among older adults to explore how interpersonal relationships influence older adults' participation in oral health promotion. This analysis is used to assess the effectiveness and systemic cost savings of various oral health promotion strategies and the impact of programme interventions[15].

However, as proposed by Watt *et al.*[16], a focus on the individual is a failed approach to address the underlying causes of oral disease as 'downstream individualistic interventions alone will not reduce oral health inequalities'. The London Charter on Oral Health Inequalities calls for an upstream public health agenda to address the underlying social, economic, and political causes of oral health inequalities. Recognizing that oral diseases are largely preventable, action is targeted locally, nationally, and internationally at policy, healthcare, education, and research. Dental professionals act as advocates in their local communities by educating on the public health

significance of oral diseases and need for public health policies.

PREVENTION

The goals of prevention for oral health of ageing persons are to maintain good oral function and quality of life. Prevention of the progression of dental disease such as caries and periodontal disease requires adequate daily oral hygiene, as well as professional care. Every older adult should have an appropriate Daily Oral Care Plan established based on their level of oral disease and ability to independently perform daily hygiene (*Table 2*)[13]. Typically, this will include daily toothbrushing and adjunctive therapies (e.g., prescription fluorides, interdental cleaning). A prophylaxis recall should be determined based on oral disease progression.

Workforce training is required for adequate daily and professional care. As cognitive and/or functional abilities decline, the need for assistance from caregivers for daily oral care increases. The workforce in long-term care has a critical role in prevention of oral disease through daily oral care. These healthcare providers need adequate training and accountability structures based on ongoing relationships between oral healthcare providers and direct care staff.

Professional intervention through regular dental hygiene services plays a role in reducing the burden of oral disease. Through oral assessment, radiographs, and teeth cleaning, critical information is obtained to provide diagnoses and determine further treatment needs. However, residents of long-term care facilities are often not able to access professional services due to cost and transportation limitations. A direct access model (or collaborative dental hygiene practice model) addresses barriers to preventive care by reducing care costs and relieving burdensome oversight requirements. Through a direct access model a dental hygienist is able to initiate treatment based on assessment of a patient's needs without the specific authorization of a dentist, treat the patients without a dentist present, and maintain a provider-patient relationship[17]. For residents of long-term care facilities with mobility and cognitive challenges, on-site or portable preventive services provide access to oral health care to maintain their dentition, function, and quality of life.

There are many documented examples of effective prevention and oral health education programmes and models. Community-based health promotion and oral disease prevention focusing on the vulnerable elderly have been successful in reducing oral and systemic diseases[18]. Daily and professional oral care (toothbrushing after each meal by nurses or caregivers with weekly professional care by dentists or dental hygienists in nursing homes) demonstrated a decrease in pneumonia-related complications and improved cognitive and physical function[19]. Oral healthcare education of caregivers resulted in improved daily oral care for nursing home residents[20]. Oral healthcare programmes including both professional care and caregiver instruction in long-term care facilities demonstrated reduction in oral disease[21].

ASSESSMENT AND DIAGNOSIS

The goal of diagnosis is to triage care for the appropriate treatment. Not only are diagnostic services provided during routine professional preventive oral care, direct care staff providing daily oral care assist in determining treatment needs. Social services to the aged can assess access to dental services through admission forms. Daily oral care assessment can be provided by caregivers for persons with cognitive and functional limitations. To determine appropriate interventions oral conditions, social support, and level of dependency are evaluated (*Table 2*)[13]. Minimal intervention dentistry, promoted in the United Kingdom in the care of older adults, utilizes risk assessment tools for early detection of oral disease and development of minimally invasive treatment with a focus on prevention[22].

For the ageing population with mobility constraints, severe chronic conditions, or cognitive impairment, transfer to a clinical setting may be prohibitive thereby eliminating access to oral healthcare. Some countries, like Japan and Korea, provide direct access of dentists to elderly institutionalized in long-term care facilities for assessment and diagnosis under the coverage of National Health Insurance[23].

New methods for diagnosis are emerging with technological advancement. Telemedicine uses telecommunication and information technologies to provide clinical healthcare at a distance thus eliminating distance barriers and improving access to medical services[24]. Virtual dental examinations have been shown to be an acceptable substitute for in-person examinations[25]. Through use of telemedicine in dentistry, the concept of a virtual dental home has evolved. The virtual dental home is 'based on the principles of bringing care to places where underserved populations live, work, or receive social, educational, or general health services, integrating oral health with general health, social and educational delivery systems, and using telehealth technologies to connect a geographically distributed, collaborative dental team with the dentist at the head of team-making decisions about treatment and location of services'[26]. Evidence is emerging for improving both healthcare delivery and health outcomes while reducing oral healthcare costs utilizing the virtual dental home model[5].

TREATMENT

Oral healthcare services needed to address the prevention of pain and infection while maintaining function and aesthetics include preventive, periodontal, restorative, oral surgical, endodontic, prosthetic, and implant services. The workforce required to provide these services include dentists, dental hygienists, and dental assistants. In many countries, expanded roles such as the utilization of dental therapists have shown to be effective in improving access to oral healthcare while reducing care costs. Dental therapists typically work under the supervision of a dentist providing restorative and simple surgical care as well as preventive and diagnostic services.

Knowing that the ability to provide adequate oral care will decrease with cognitive and functional decline and that access to funds typically reduces with ageing, oral healthcare needs must be addressed early in the ageing process. Preparing patients for a future decline in oral health requires treatment planning to create a functionally stable oral environment that will withstand the insults of decay and inflammation. As more older persons are retaining their teeth for a lifetime, a comprehensive plan is necessary to create a stable dentition and maintain that condition over the years[27]. As the elderly progress to a high level of dependency, treatment focus shifts to palliative treatment to control pain and infection as well as to maintain social contacts and activities (*Table 2*)[13].

The location in which treatment occurs is varied and dependent on treatment needs, funding, and access. Most treatment occurs in dental clinic settings within a local community: private practice offices, group practices, and community health clinics. However, if a person presents with behavioural or medical challenges, a hospital setting may be more appropriate especially if intravenous sedation or general anaesthesia is required. Clinical models may be privately funded, government based providing care to eligible military veterans, or public health clinics supported by federal funds.

The Programs of All-Inclusive Care for the Elderly (PACE) in the United States incorporates oral health care into a comprehensive medical and social services model for frail, community-dwelling elderly. A comparable example is found in Botswana where dental treatment services are offered to the entire population through the 22 public dental clinics spread across the country. The dental clinics are manned by dentists and dental therapists. Dental therapists are supervised by dentists, but can provide extractions, cleanings, and restorations where there is no dentist and refer as needed. Most of the dental clinics are located within hospitals (primary, district, and referral), which allows for interdisciplinary interaction and referrals.

As the cognitive and functional limitations of elders progress, many are not able to be transported to a dental clinic and must obtain care within their residence or a long-term care facility. Mobile dentistry is underutilized and oftentimes unavailable to those requiring this service due to the cost of care and the limited workforce. Telemedicine and the virtual dental home, as described under Assessment and Diagnosis, utilize technology to increase care to those unable to access traditional settings.

Successful, innovative, and replicable OHCS models for the ageing address limited access to care and financial challenges. Apple Tree Dental utilizes a non-profit model to provide on-site comprehensive, oral health care to elders living in long-term care facilities as well as significant contributions in education, research, policy, and advocacy[28]. The mission of Volunteer for Dental Care (http://www.volunteerdental.org/) is to provide access to dental care and oral health education through a pay-it-forward dental partnership for low-income, uninsured adults. Persons who are retired and/or disabled are required to perform community service in exchange for dental care they are unable to afford.

DISPARITIES IN ACCESS TO CARE

Disparities in access to OHCS exist for older adults. Use of professional oral health services is low among older people, particularly among the socio-economic disadvantaged[18]. In the US in 2012, 42% of persons aged 65 years or above had a dental visit; however, stratified by income the access was 24% *versus* 57% (federal poverty level <100% *vs.* FPL 400%+, respectively). Being in the labour force is a strong predictor of dental coverage. Access to dental benefit status for US persons aged 65 years or above in 2012 varied with 67% having private, 13% public, and 37% uninsured[29].

Disparities in access to care result in disparities in oral health status. In a study of Korean elderly, reported tooth loss was associated with lower socio-economic status indicators such as rural dwelling and lower education[30]. In 2007, in persons aged 75 years or above in Thailand, tooth loss was found to be associated with social inequality. Having 19 or fewer teeth was associated with lower level of education, lower income, not owning luxury goods as well as non-married status[31]. Elderly who were poor were more likely to choose tooth extraction due to inability to afford expensive treatment options and travel costs for multiple appointments. In 2012, 6.5% of elderly Thai people reported seeing a dentist for routine check-ups *versus* 44% for toothache[32]. Socially disadvantaged Thai elders were less likely to use dental services[33]. The access challenges Thai elders experience are exacerbated by geography as 70% reside in rural areas.

BARRIERS IN ACCESS TO CARE

Cognitive, physical, functional, and behavioural decline in the ageing population create unique barriers to access to OHCS requiring additional interventions as detailed in the SCP (*Table 2*)[13]. Comorbid conditions create complexity in the medical management necessitating an interdisciplinary team approach. Impaired mobility and lack of access to transportation especially in rural areas significantly reduce the ability to obtain oral healthcare.

Lack of perceived need for care or inability to afford care can preclude persons from seeking necessary treatment. Cultural perceptions such as a lack of dental care tradition or negative attitudes towards oral health can also inhibit obtaining care[18]. Barriers which challenge access to OHCS for the ageing can be universal but often vary between developed and developing countries. Subjective assessment of oral health has been found to be a predictor of medical expenses in Japanese, community-dwelling elderly persons as medical expenditures increased as perceived oral health status declined[34].

STRATEGIES TO DEVELOP OHCS FOR THE AGEING

Barriers and low priority in development of OHCS and research for the ageing are often encountered due to non-existent oral health policies, absence or low commitment of third-party payers, negative attitudes of oral health professionals, and absence or lack of interest or knowledge on the part of the patients about predisposing risk factors, poor oral hygiene, cultural beliefs, and healthcare traditions[3].

The WHO Global Oral Health Programme has defined specific strategies to improve the oral health of older people through oral health policy, oral healthcare, education and training for service and care, and research[18]. Since few countries have clearly stated policies and goals specifically for oral health promotion and care for older adults, WHO recommends that national health authorities develop policies, measurable goals and targets for oral health. National public health programmes should incorporate oral health promotion and disease prevention based on a common risk factor approach. Target groups in both developed and developing countries need to be the disadvantaged and vulnerable. WHO recognizes the challenge to provide primary oral healthcare in developing countries due to a workforce shortage while in developed countries the focus of healthcare services needs to be reoriented towards prevention with prevention-oriented third-party payment systems. Educational programmes for health professionals and caregivers in oral health need to expand to overcome barriers in oral health service utilization,

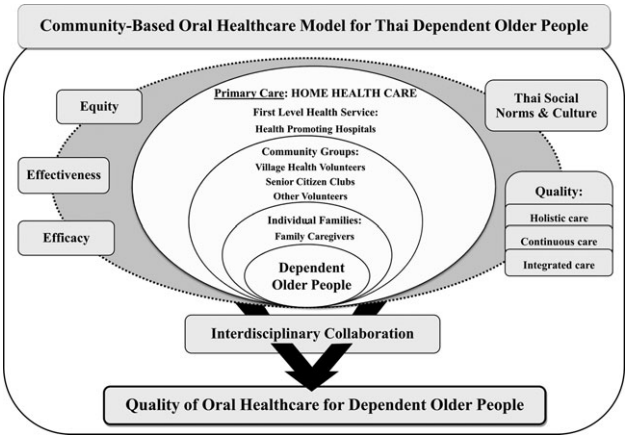

Figure 1. Community-based oral healthcare model for Thai dependent older people. From Prayoonwong *et al.*[35]

improved self-care capacity, and provide a healthy diet and nutrition. Research providing outcomes of oral health intervention programmes are needed for policy development[18].

A Thai community-based oral healthcare model was launched to improve the quality of oral healthcare for dependent older people. The project entailed four stages of research methodology: (i) Identify older healthcare stakeholders; (ii) Gain more understanding about the oral healthcare situation and needs of the stakeholders and home health care project; (iii) Construct a draft model from literature review; and (iv) Refine and confirm the model. The final model (*Figure 1*)[35] demonstrates the importance of interdisciplinary collaboration in the development of OHCS for the ageing with multilevel interventions.

The Tokyo Declaration on Dental Care and Oral Health for Healthy Longevity goals include promotion of health policy that focuses on recognition of risks common to both oral and non-communicable diseases (NCD) in an interprofessional, collaborative practice environment[36]. In Japan, Health Japan 21 (the second term; 2013–2022) which includes oral health as a basic factor for achieving health longevity, works to reduce health disparities through interdisciplinary cooperation. Not only are individuals encouraged to improve oral health, but public health measures have been established. Cooperations between oral health and NCD programs (cancer, diabetes, dementia, metabolic syndrome) work to prolong a healthy life expectancy and promote general health through improved lifestyle habits and social environments[37]. The Gerontological Society of America (https://www.geron.org/) has launched an Oral Health Initiative to identify interprofessional solutions for improving oral health in older adults. These solutions address access barriers and create oral health champions through interprofessional education and practice opportunities, expansion

Table 3 Strategies to develop OHCS for the aging

Oral health policy
International oral health organizations: Establish policies to enhance importance of oral health for the ageing and develop guidelines for policy and direction for research
National health authorities: Develop policies, funding, measurable goals, and targets for oral health for the ageing including mandates for services in long-term care facilities
Local coalitions and community organizations: Develop collaborative partnerships with stakeholders and promote the implementation of policies that support evidence-based strategies to provide optimal oral health for the ageing
Oral health care
National public health programs: Incorporate oral health promotion and disease prevention based on a common risk factor approach
Investigate alternative models through mobile dentistry, telemedicine, and home care to improve access to professional oral health care for the ageing
Enhance access to preventive daily oral care for the ageing through trained caregivers
Education and training
Create interdisciplinary collaboration and training with healthcare team and caregivers
Establish oral health care resources for providers of care for the ageing targeting the patient, family, and caregivers
Address workforce shortage through training program funding, enhanced training of oral health care professionals in the care of the ageing, and alternative workforce models
Research
Provide outcomes of oral health intervention programs and workforce models for policy development
Include oral health for the ageing as a component of ageing and chronic disease research
Fund further research to define disease burden, investigate risk factors (SES/dependency), and compare developed *versus* developing countries

of dental insurance coverage, and coalition development.

Multidisciplinary coalition development is an effective component of OHCS development. With a mission to improve the oral health of older people through advocacy, professional education, public education, and research by focusing on prevention, health promotion, and evidence-based practices, the Coalition for Oral Health for the Aging (micoha.org) works nationally (i) to be a resource for providers of care for the ageing; (ii) to promote the implementation of policies that support evidence-based strategies that provide optimal oral health for the ageing; and (iii) to develop collaborative partnerships that address the oral health needs of the ageing.[38] As stakeholders in the oral health for the ageing extend beyond dentistry, ageing organizations provide additional funding opportunities and resources.

CONCLUSIONS

Achieving oral health in an ageing society is a daunting task and will require changes in priorities in most countries worldwide with a focus locally, nationally, and internationally on policy, education, research, and clinical care (*Table 3*). The urgency of need for oral health care for a growing, ageing population has only recently been widely recognized. Tailored interprofessional solutions focusing on both individuals and public health are being developed. Initiatives across the globe are developing successful programs which are being shared, replicated, and modified.

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Conflict of interest

The authors declare no conflict of interest.

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