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Development and Content Validity of the International Association for Disability and Oral Health Universal Case Mix Tool: A Consensus Study

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ABSTRACT

Objectives: To develop the International Association for Disability and Oral Health Universal Case Mix Tool (iADH UCMT) that rates case complexity in the delivery of oral healthcare.

Methods: A modified e-Delphi survey sought consensus on the content of a universal Case Mix Tool to rate the degree of adaptation over and above that required for the general population, with respect to time, resources and/or expertise necessary to provide high-quality care and equitable outcomes. The survey consisted of candidate domains, ratings and descriptors, following a scoping review of the literature. The consensus threshold was set a priori at ≥ 75% agreement. Expert agreement was sought on both content and wording, and free text comments were subsequently used to refine the exact wording of each domain and descriptor. A consensus meeting followed to rate descriptors for cultural acceptability and clarity, using 5-point Likert scales. Terms were aligned linguistically to ensure consistency across domains, scores and descriptors, and a glossary of definitions was refined.

Results: From the 70 registrants, 40 completed the survey (participation rate 59.7%). Respondents demonstrated a high level of agreement regarding the appropriateness of the seven domains, with agreement ranging from 90% to 100%. Consensus for rating descriptors was also high (85%–95%). Twenty-seven panellists and five development team members attended the consensus meeting, where cultural acceptability (means ranged from 4.6 to 4.8) and clarity (means ranged from 4.2 to 4.7) were demonstrated across domains. This consensus process produced an iADH Universal Case Mix Tool consisting of seven domains: *Communication; Dental behaviour support; Medical status; Risk factors for oral disease and dysfunction; Autonomy; Legal and ethical barriers;* and, *Access to adapted care at the services, systems and policies level*. Each Domain has four possible ratings to reflect the degree of adaptation required with respect to time, resources and/or expertise necessary to provide high-quality care and equitable outcomes. The domains, ratings and descriptors were found to be appropriate, clear and culturally acceptable.

Conclusions: An international panel developed a Universal Case Mix Tool to rate complexity in the delivery of oral health care. Acceptable content validity was confirmed, and further psychometric testing is planned.

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1 | Introduction

Inequality in health is unfair, unjust and unnecessary. People living with disabilities, vulnerable older people and those experiencing disadvantage have poorer oral health compared to the general population, in part attributable to reliance on ill-adapted and underfunded oral healthcare services [1–3]. These patient groups depend on the ability of oral healthcare services to accommodate their specific needs in order to deliver high-quality, appropriate treatment. Such adaptations often necessitate additional training, expertise, equipment and time, leading to increased costs for healthcare providers [4].

Healthcare providers and policy makers have difficulty identifying who requires additional support to access appropriate high-quality healthcare, and identifying what factors add to case complexity in the delivery of healthcare [5]. Initiatives to promote access to care are undermined by the lack of a specified target population or by purely medical definitions of disability and disadvantage [6]. To ensure that healthcare is optimised and personalised to the patient's needs, it is necessary to explicitly identify these needs. In terms of policy, epidemiology and health economics, the lack of identification is inefficient and untenable. Moreover, in terms of access to care, it is inequitable [7].

Regarding oral healthcare, a number of countries have addressed this problem by developing or adapting Case Mix Tools (CMT) to describe the complexity of the provision of dental treatment for patients with disabilities and disadvantages [4, 8, 9]. In particular, CMTs have been used to justify financial resource allocation and to commission services locally [10–12]. CMTs could, however, have much wider use; for example, they could identify the adaptations needed for oral health care and service provision, support data-driven policy and planning, justify resource allocation for both continuing and undergraduate education, quantify and qualify the need for adjuncts such as sedation or general anaesthesia services, and provide practical criteria for patient referral across primary, secondary and tertiary services [8]. Additionally, if a universal CMT were available, it could standardise the description of care needs in clinical research, improve inclusivity for disadvantaged and disabled groups, and enhance the reproducibility and impact of research into adapted care solutions.

Despite their potential for global impact, extant tools tend to be specific to the cultural and legal contexts of the source countries within which they were developed or adapted. A universal CMT, designed for use across regions and countries, could disperse these potential benefits globally. The International Association for Disability & Oral Health (iADH), as a global champion for equitable access to high-quality oral healthcare, is positioned to harness global expertise for this purpose. This study details the development and content validation of the iADH Universal Case Mix Tool (UCMT) using the Delphi approach with representation from low, middle- and high-income countries. The aim of this study was to develop the iADH Universal Case Mix Tool (UCMT) using a modified e-Delphi method with international representation. The question answered was: *Which Domains, Ratings and Descriptors should be included in a Universal Case Mix Tool, as agreed by an international group of experts?*

2 | Methods

2.1 | Design

A modified e-Delphi was employed, following a predefined protocol. The Delphi technique involves a process of gathering the opinions of experts to generate consensus on a topic [13]. In a modified Delphi, the process begins with structured materials on which experts provide comments [14]. This was achieved by the survey development panel (DF, GM, CMGP, AD, CM), who reviewed extant CMTs and related literature to develop a *Prototype UCMT* to present to the Delphi panel. Experts responded individually to an online survey and participated collectively in an online consensus meeting.

2.2 | Ethical Issues

Ethical approval was secured by the CIEIS Reina Fabiola Research Ethics Committee, Universidad Católica de Córdoba, Argentina, with a registration number ODON20230906bP. Consent was obtained from all participants. Data were managed and maintained in line with this approval.

2.3 | Survey Development

Using the results of a scoping review study [15], the development panel identified published CMTs. Next, they aggregated the CMTs' constituent domains by similarity (along with their ratings and descriptors) across studies (see Supporting Information 1 for details). This was undertaken in the following way. Domains that were felt to cover shared concepts, for example, the domains *Ability to cooperate* [9], *Cooperation* and *Need for sedation, general anaesthesia (GA) or other facilitatory techniques* [4], were extracted from published CMTs, and their ratings were aggregated for cross-referencing and discussion by the development panel. The panel refined each domain in this way. The development team then reviewed all domains for coverage to explore areas that were not covered by the published tools. Domains were then specified according to additional time, resources and expertise required. Ratings and descriptors were agreed upon under each domain, with reference to extant scores and descriptors from the source CMTs, where possible. The domains were thus defined and refined by the whole panel for coverage and consistency. This led to a Prototype UCMT with a conceptual and rating framework that was put to evaluation by the Delphi panel in the online survey.

2.4 | Recruitment

A panel of experts in the practice, teaching, research and/or commissioning of Special Care Dentistry was formed, adopting purposive and snowballing sampling techniques. Experts volunteering to take part in the panel were asked basic demographics so that the research team could assess the demographic spread of participants across gender, age and geography. Selection criteria were: a. Willingness to participate; and b. Dental or related professional with expertise in practice, teaching, research, or commissioning of Special Care

Dentistry. Experts were recruited from national member organisations of iADH. The registrant country was considered according to World Bank Income Classification to optimise coverage across high-, middle- and low-income countries. Expertise was established by registrants' responses to, and elaboration on, four questions: *Do you provide clinical Special Care Dentistry? Do you have experience in commissioning Special Care Dentistry? Do you have experience as an educator in Special Care Dentistry? Do you have experience in research related to Special Care Dentistry?* There were no firm quotas or proportions driving selection. Rather, this was to ensure optimal distribution of registrants across these criteria. Two authors reviewed the list of $n = 67$ registrants and felt that $n = 64$ were eligible to be retained in the sample (two exclusions were duplicate registrations and one was a person whose close ties to the project disqualified him as a panellist). Sample size was expected to be about 60 participants, well above the minimum expected for agreement processes with largely homogenous samples [16]. The recruitment window extended over 45 days, at which time the point of diminishing returns from additional registration against the risk of registrants falling from the study was considered to have passed.

2.5 | Data Collection and Agreement Threshold

Registrants who had been selected following sampling were invited to participate in the online Delphi survey and provided basic demographic data (Sept 2023). Data collection was planned for up to three rounds and a final consensus meeting. Two weeks were given for responses between rounds. SPSS was used for data analysis. Responses were analysed using descriptive statistics regarding the proportion of agreement for each item. A dichotomous variable (agree/disagree) was used to categorise responses. Since there is no universally agreed upon level of consensus for the Delphi process [17], consensus was set a priori using a percentage-based approach of $\geq 75\%$ agreement. Open-ended responses were analysed by aggregating responses under each domain and potentially modifying the wording of the Prototype UCMT to integrate panellist input.

2.6 | Delphi Survey Tool and Consensus Meeting

The Delphi survey was accessed through an anonymous link. The survey instrument consisted of two sections. Firstly, regarding *Domains*, participants were presented with the list of the Prototype UCMT domains, ratings and descriptors. They were asked the following question: *Do you agree that this Domain is appropriate for the iADH Case Mix Tool?* The options were either to agree or disagree. Participants were encouraged to utilise free text to suggest modifications to domains. They were also invited to include their own domains. Secondly, respondents rated their agreement with the Prototype UCMT ratings and descriptors for each domain by answering the question *Do you agree that Scoring descriptions are appropriate?* Participants were encouraged to provide free text input to suggest modifications to the descriptors. Modifications were aggregated and assimilated by the development panel, and a second version of the Prototype UCMT was agreed upon.

In March 2024, the Delphi participants were invited to attend a consensus meeting online with five development team members. At the consensus meeting, the second version of the Prototype UMCT was presented and respondents were asked to rate each domain for cultural acceptability (*Does this item and its descriptors seem culturally acceptable to you in your context?*) and clarity (*How clear are the terms used in this item and its descriptors to you?*) using 5-point Likert scales ranging from very acceptable to very unacceptable, and very clear to very unclear, respectively. Free text comments were gathered, and the discussion was recorded. All comments were later discussed and integrated by the development team as appropriate. Terms were aligned linguistically to ensure consistency across domains, scores and descriptors, and a list of definitions was finalised.

3 | Results

3.1 | Prototype Universal Case Mix Tool

The Prototype UCMT consisted of seven domains: *Communication/Behaviour support/Medical status/Risk factors for oral disease and dysfunction/Access to adapted care at the services, systems and policies level/Dependency/and Legal and ethical barriers*. Each domain had four qualitative rating options in relation to the additional time, resources, and/or expertise necessary to adapt care for an individual patient (None/Minor/Moderate/Major). Descriptors were provided for each rating to aid in the differentiation between levels. A glossary of terms was developed to ensure universal clarity.

3.2 | Panel Characteristics

Following the removal of duplicate registrations, 64 registrants were invited to participate in the online Delphi process after sampling. Forty participants completed the Delphi survey (participation rate = 62.5%). Of these, 26 (65.0%) were female and 14 were male. Regarding age, 16 were 30–40 years old (40.0%), 14 (35.0%) were aged 40–50 and 10 (25.0%) were 50 years or older. Respondents came from all World Bank regions apart from Sub-Saharan Africa (SSA): $n = 16$ from East Asia and Pacific (EAP); $n = 10$ from Europe and Central Asia (ECA); $n = 8$ from North America (NAM); $n = 4$ from Latin America and the Caribbean (LAC); $n = 1$ from Middle East and North Africa (MENA); $n = 1$ from South Asia (SAR). The distribution of World Bank Income Classification category across the panel was as follows: High income $n = 28$; Upper middle income $n = 11$; Lower middle income $n = 1$. This was clearly skewed towards higher-income regions relative to the natural distribution globally. Figure 1 illustrates the distribution of respondents and development panel to demonstrate the international reach of those involved (credit: mapchart.net). Thirty-nine reported that they provide clinical Special Care Dentistry (SCD). Of these, 12 participants (31.6%) reported 10 or fewer years' experience in SCD, 14 (36.9%) reported 10–20 years and 12 (31.6%) reported more than 20 years (two non-respondents). Over a third of participants reported providing care for patients of all ages (37.5%, $n = 15$); 45.0% ($n = 18$) for adult patients only; 10.0% ($n = 4$) for both adults and children; and 7.5% (3) for child patients only. Twenty-four respondents (60.0%) reported that they had experience commissioning

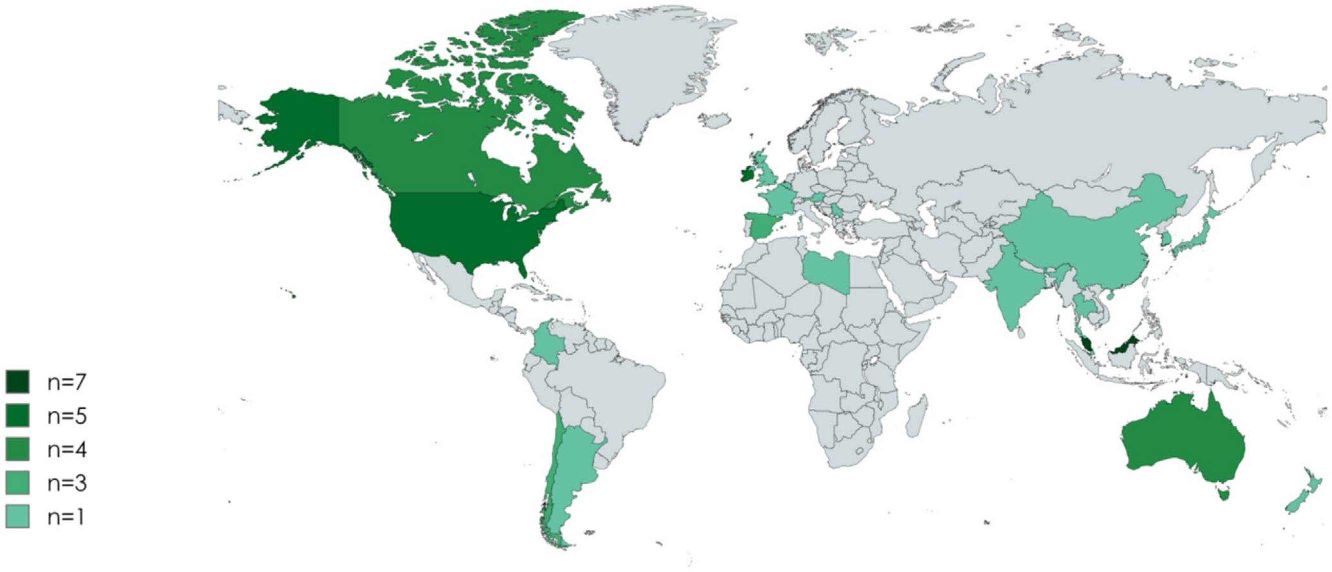

FIGURE 1 | Distribution of panellists and research team.

TABLE 1 | Round 1 consensus (threshold = 75%).

	Domain appropriate		**Rating descriptor**	
	n	**%**	***n***	**%**
1. Communication	40	100	38	95.0
2. Behaviour Support	40	100	32	80.0
3. Medical status	40	100	34	85.0
4. Risk factors for oral disease and dysfunction	38	95.0	34	85.0
5. Access to adapted care at the services, systems and policies level	36	90.0	35	87.5
5. Dependency	37	92.5	36	90.0
6. Legal and ethical issues	40	100	34	85.0

SCD services. A wealth of experience was reported, including the setting up of national and regional SCD services, university services, general anaesthesia services, or registering SCD as a registerable specialty in their country of origin. Thirty-four respondents (85.0%) reported that they had experience in SCD education at the postgraduate or undergraduate level, and 35 ($n = 87.5\%$) reported experience in research related to SCD.

3.3 | Round 1 and Refinement

Participant ratings demonstrated a high proportion of agreement regarding the appropriateness of the seven domains, with agreement ranging from 90% to 100% (see Table 1). Qualitative analysis of free text data led to the modification of one Domain name ('*Dependency*' was removed and changed to '*Autonomy*'). The order of the Domains also changed. Three further panel-generated domains were suggested: '*Complexity*', '*Compliance*' and '*Social/Environmental*' *context*. These were mapped to existing domains by the development panel, illustrating that these concepts were covered by existing domains. Participant ratings also demonstrated a high proportion of agreement regarding the appropriateness of the rating descriptors for each domain, with agreement ranging from 85% to 95% (see Table 1). Based on qualitative responses, significant changes to the wording of all rating descriptors were also made without changing the conceptual basis of each. Given the high level of consensus at Round 1, the Delphi progressed directly to a consensus meeting, without further rounds.

3.4 | Consensus Meeting and Refinement

Twenty-seven panellists attended the consensus meeting. Of the 23 attendees with available data, 13 were female (56.2%) and 34.5% were aged over 50. All but one reported being involved in the clinical care of people with disabilities. Participants included six from Malaysia, and three each from Canada, Spain and the United States. The domains, ratings and descriptors of each domain were discussed at length. Detailed comments and questions were discussed in real time and recorded for integration into each domain. Further changes were made to the wording of descriptors for all the domains at the consensus meeting. Each domain rated highly for cultural acceptability and clarity (Table 2). Table 3 presents the domains, ratings and descriptors arising from this process and that subsequently made up the iADH UMCT. This is expanded in Supporting Information 2, where the full *iADH Universal Case Mix Tool* and *Glossary of terms* are presented.

4 | Discussion

4.1 | Summary of Main Findings

This study was undertaken to develop the iADH Universal Case Mix Tool (iADH UCMT) to rate case complexity in the delivery of oral healthcare. This objective was achieved using a single

TABLE 2 | Cultural acceptability and clarity of domains.

Domain	Mean score (standard deviation) Cultural acceptability	Mean score (standard deviation) Clarity
1. Communication ($n = 26$)	4.73 (0.45)	4.69 (0.47)
2. Dental Behaviour Support ($n = 25$)	4.60 (0.65)	4.20 (0.87)
3. Medical status ($n = 23$)	4.65 (0.65)	4.30 (0.63)
4. Risk Factors of oral disease and dysfunction ($n = 23$)	4.52 (0.66)	4.41 (0.59)
5. Autonomy ($n = 23$)	4.78 (0.42)	4.70 (0.47)
6. Legal and ethical barriers ($n = 24$)	4.75 (0.53)	4.71 (0.55)
7. Access adapted care ($n = 23$)	4.64 (0.66)	4.59 (0.66)

survey round and a consensus meeting. The iADH UCMT consists of seven appropriate, clear and culturally acceptable domains and descriptors. The tool was constructed systematically and iteratively between expert and development panels. The panel of 40 international experts agreed that together, these domains cover the concept of complexity in delivering oral healthcare. The Delphi panel, therefore, provides a strong conceptual basis and valid content in a case mix tool.

4.2 | Findings in Context of Extant Literature

The UCMT is the first case mix tool specifically designed for universal adoption across multiple purposes in multiple regions. It covers typical domains used to rate complexity across France, UK, Scotland, Canada and Australia [4, 9, 18, 19]. Together, these tools cover *anxiety, need for sedation, ability to cooperate, medical history, oral risk factors, communication skills, ability to consent, cognitive autonomy, physical independence and administrative burden* [15]. These domains naturally align closely with those of the iADH UCMT, which incorporated and often redefined domains found across existing tools. This gave the research team an opportunity to update the concepts and terms within older oral case mix tools, based on current concepts of disability and function, shifting legal frameworks and innovations in clinical concepts [20–22]. Thus, the UCMT builds on the strengths of existing tools to serve a wide range of purposes for the widest spectrum of people.

4.3 | Conceptual Framework and Scoring

The UCMT assesses case complexity based on the additional time, resources and expertise needed to provide high-quality, equitable oral healthcare. It includes seven domains, the first of which is *Communication*. Complexity arises from communication impairments affecting diagnosis, pain management, consent, behaviour support and therapeutic alliance. Adaptations, such as using technology or human aids, require expertise and time. The second domain is *Dental Behaviour Support*. Many patients benefit from a spectrum of non-pharmacological, pharmacological and physical supports in order to accept and participate in care [20]. The selection of specific techniques carries huge implications for resource allocation, complexity of care and skill mix. *Medical Status* reflects complexities due to current medical or psychiatric status that require additional investigations, hospital-level care, or collaboration with the wider medical team. The fourth domain, *Risk factors for oral disease and dysfunction*, covers a wide range of biological, sensorimotor and behavioural attributes, from dysphagia to support for oral hygiene, which necessitate adaptations for effective care. The fifth domain, *Autonomy*, relates to the patient's degree of independence in accessing care, particularly in relation to the need for caregiver intervention and accompaniment. Elements include the ability to recognise the need for care, transport issues, administrative support, need for domiciliary care, etc. The *Legal and ethical barriers* domain recognises the time, communication skills and knowledge that underpin the complex ethical processes required to assure patient autonomy. For example, this includes time spent in consultation with third parties involved in supported decision making, difficulties identifying the financial status of some patients, or the necessity to consult with guardians, advocates, or seek the opinion of a court of law or a multi-professional team. The final domain relates to the patient's difficulty in accessing *adapted care at the services, systems and policies level*. Availability, physical accessibility, financial accessibility and accommodation of services are considered, as these factors increase complexity for the professional attempting to provide care for complex patients.

Ratings are qualitative with four rating options for each domain to indicate the level of complexity (no adaptation, minor adaptation, moderate adaptation and major adaptation required). Each domain is rated independently, as the domains are conceptually independent of each other. A rating of major adaptation needed in just one domain may imply, for example, that specialist services are required despite having no problems in any other domains. On the contrary, a minor score in multiple domains may imply a level of adaptation that is appropriate for general practice. Therefore, ratings in the UCMT are not intended to be routinely summed to give a summative score. This approach aligns with the French case mix tool [4], emphasising domain-specific adaptation, unlike the British Dental Association Case Mix tool, which was originally summed for banding purposes [9]. However, because the UCMT is designed to work across purposes and regions, its specific application, of course, will depend on local needs. For example, what constitutes complexity for specialist service planning purposes will differ from cut-offs for patient allocation in undergraduate clinics. Similarly, rating can be undertaken prospectively or retrospectively (e.g from treatment records), as needed.

4.4 | Application and Future Research

The UCMT can be used for many reasons, including justification of financial or human resources, costing service delivery, commissioning and development of referral pathways [10, 11], as well

TABLE 3 | The iADH Universal Case Mix Tool.

Definition	Rating options and descriptors			
	None	Minor	Moderate	Major
1. *Communication*				
The additional time, resources and/or expertise necessary to adapt care to the patient, in terms of communication between the patient and the dental team	No adaptation to communication required.	Minor adaptation to communication required e.g., simplified verbal communication, patient with partial auditory or visual impairment, minor cognitive impairment, etc.	Moderate adaptation to communication required e.g., *augmentative or alternative communication* required, patient communicates via *pictograms*, an *IT interface*, a *caregiver*, or an interpreter; patient with limited verbal communication or moderate cognitive impairment; significant auditory or visual impairment, etc.	Major adaptation to communication required e.g., no verbal communication possible; patient with incoherent verbal communication or limited non-verbal communication because of severe dementia, severe autism, severe cognitive impairment, etc.
2. *Dental behaviour support*				
The additional time, resources and/or expertise necessary to adapt care to the patient, because of the need to provide *dental behaviour support* and/or to reduce *dental anxiety* and its physiological manifestations	No adaptation needed to support behaviour.	Minor adaptation required to support behaviour, e.g., need for basic non-pharmacological behaviour support techniques that can be used in the moment, such as positive reinforcement, distraction, tell-show-do, music use, etc.; no need for sedation/anxiolytics; no physical supports used	Moderate adaptation required to support behaviour, e.g., need for moderately complex non-pharmacological behaviour support such as visual supports, preparatory visits, progressive muscle relaxation, etc., and/or basic pharmacological techniques, such as anxiolytic premedication/nitrous oxide inhalation sedation; and/or basic physical techniques, such as low level holding	Major adaptation required to support behaviour, e.g., need for complex non-pharmacological behaviour support, such as systematic desensitisation, Cognitive Behavioural Therapy, clinical hypnosis and/or complex pharmacological techniques, such as conscious or deep sedation, general anaesthesia, medium/high level holding or protective stabilisation

(Continues)

TABLE 3 | (Continued)

Definition	Rating options and descriptors			
	None	**Minor**	**Moderate**	**Major**
3. *Medical status*				
The additional time, resources and/or expertise are necessary to adapt care to the patient because of the patients' medical status	No adaptation required in relation to medical or psychiatric status	One or more stable medical or psychiatric conditions that compromise oral health and/or provision of oral healthcare to a small degree, e.g., minor *functional limitations*, cardiac conditions requiring oral antibiotic prophylaxis, stable asthma, well-controlled diabetes, well-controlled dysthymia or schizophrenia, etc.	One or more complex or unstable medical or psychiatric conditions that compromise oral health and/or provision of oral healthcare considerably, e.g., substantive *functional limitations*, frailty of older age, anticoagulant or antiresorptive therapy, post-traumatic stress disorders, etc.	One or more complex, unstable, severe and/or acute medical or psychiatric conditions that compromise oral health and/or provision of oral healthcare significantly or such that *multidisciplinary* consideration is required prior to dental treatment e.g., severe *functional limitations*, need for intravenous therapy prior to dental treatment, unstable asthma, poorly controlled diabetes, end stage organ failure, current head and neck cancer therapy, stroke rehabilitation, palliative care, patients hospitalised with acute mental health crisis, etc.
4. *Risk factors for oral disease and dysfunction*				
The additional time, resources and/or expertise necessary to adapt care to the patient, because of the need to support patients' risk factors for oral disease and/or oral *dysfunction*	Patient is able to maintain their own oral hygiene and a *healthy diet*, and the patient has adequate *oromotor and orosensory function*	Oral hygiene and/or dietary needs are effectively met with support from the *caregiver*; regular tobacco or alcohol use; and/or the patient has some oromotor or orosensory impairment, e.g., mild *dysphagia*, moderate psychomotor or oromotor impairment, mild *bruxism*, etc.	Oral hygiene and/or dietary needs are partially met by the patient with/without support from a *caregiver*, and/or the patient has considerable oromotor or orosensory impairment, e.g., *dry mouth*, moderate *dysphagia*, modified diet, moderate craniofacial *dysmorphology*, *trismus*, severe *bruxism*, etc.	Oral hygiene and/or dietary needs are unmet by the patient with/without support from *caregiver*; and/or patient with care-resistant behaviours, and/or severe oromotor or orosensory impairment, e.g., severe dry mouth, severe *dysphagia*, *gastrostomy*, *nasogastric tube feeding*, *tracheotomy*, etc.

(Continues)

TABLE 3 | (Continued)

Definition	Rating options and descriptors			
	None	**Minor**	**Moderate**	**Major**
5. *Autonomy*				
The additional time, resources and expertise are necessary to facilitate access to *adapted care* in terms of patient independence relating to transport, administration and physical access	No difficulty accessing *adapted care* independently	Some dependency accessing *adapted care* requires some help from a *caregiver* with administrative coordination, physical access, communication and/or other needs, e.g., help making appointments, transport issues, etc.	Considerable dependency accessing *adapted care*; requires substantial help from a *caregiver* with administrative coordination, physical access, communication and/or other needs, e.g., to organise and/or coordinate care, to manage financial payment or coordinate with health insurance, to provide transport, to transfer to a dental chair, etc.	High dependency accessing *adapted care*; patient is unable to recognise their need for care and/or is completely reliant on a *caregiver* for administrative coordination, physical access, communication and/or other needs, e.g., *caregiver* required to organise and/or coordinate almost all aspects of access to *adapted care*; need for domiciliary care, etc.
6. *Legal and ethical barriers*				
The additional time, resources and/or expertise are necessary to ensure legal and ethical adaptation to care. These adaptations for the provision of care will depend upon the age of the patient and the legal framework in different countries	No legal or ethical issues requiring adaptation of process, e.g., the patient has the capacity to consent freely, is financially responsible, etc.	Some legal or ethical issues. Patient can *consent* or *assent* but requires support for their decision-making process, e.g., time to process information, use of simplified language, or provision of information in different formats. Financial responsibility is clear	Considerable legal or ethical issues. Patient does not have *capacity to consent*, requiring a standard alternative process, e.g., supported decision making based upon *best interests, wills and preferences*, coordination and correspondence with *caregivers*/relatives/legal representatives and/or requiring clarification of financial responsibility	Complex and/or multiple legal or ethical issues. Patient does not have capacity to consent, requiring a complex alternative process, e.g., supported decision making based upon *best interests, wills and preferences* with significant additional coordination and correspondence (multi-professional consultation for assessment of capacity, *advanced care directive*, *care order*, etc.); and/or unclear legal and financial status

(Continues)

TABLE 3 | (Continued)

Definition	Rating options and descriptors			
	None	**Minor**	**Moderate**	**Major**
7. *Access to adapted care at the services, systems and policies level*				
The additional time, resources and/or expertise are necessary for the patient to access *adapted care* to ensure equitable outcomes in relation to services, systems and policies	No difficulty accessing *adapted care*, e.g., no or short waiting list, local adapted care available, cost within universal health coverage, etc.	Some difficulty accessing *adapted care* because of restricted availability of services in the local district and/or some financial burden, e.g., moderate waiting list, limited adapted services within the local district, out of pocket payment that is affordable for the individual patient, etc	Considerable difficulty accessing *adapted care* because of restricted availability of services in the wider region and/or considerable financial burden, e.g., long waiting list, adapted services are outside of the local district, out of pocket payment that is burdensome for the individual patient, etc.	Severe difficulty accessing *adapted care* because of a lack of adapted services in the wider region and/or unaffordable financial burden, e.g., absence of services, inaccessible urgent care, or adapted services are outside of the wider region, out of pocket payment that is unaffordable for the individual patient, etc.

Note: The iADH Universal Case Mix Tool consists of seven domains that can add complexity to oral healthcare. These domains were developed using a scoping review of the literature and a Delphi process. The Domains are defined below. Each Domain has four possible ratings to reflect the degree of adaptation over and above that required for the general population, with respect to time, resources and/or expertise necessary to provide high-quality care and equitable outcomes. Ratings are based on the rater's own assessment, in consideration of the patient's personal context, social environment and local services. Words or terms appearing in *italics* feature in the accompanying glossary (Supporting Information 2).

as identifying patients requiring specialist referral, or research selection criteria. This list is not exhaustive. A web-app (available at https://play.google.com/store/apps/details?id=com.penta.iadhmixtool) and related training tools are currently being tested by the iADH to support its use. Research into the psychometric properties of CMTs reveals mixed attributes despite broad similarities across tools [4, 23]. This means that research is needed to empirically confirm the assumed conceptual model of the UCMT, as well as its underlying dimensionality and the independence of each domain. Further research is ongoing to explore criterion and construct validity, as well as agreement within and between practitioners using the iADH UCMT, and will be shared in due course.

4.5 | Strengths and Weaknesses

The universal development of the iADH uCMT was limited due to challenges in building the panel. It was impossible to achieve participation from experts in sub-Saharan Africa and low-income countries. This likely reflects a dearth of potential participants with the opportunity to participate in such countries, using the recruitment techniques applied. Further efforts are needed to enhance engagement. The strength of this study comes from the international participation of experts, many of whom had developed CMTs in the past, and the fact that the UCMT builds on significant groundwork invested in developing (and identifying) the source tools. Despite the international reach and focus on cultural suitability, the use of a single language is restrictive. While every effort has been made to address variation in regional, national and local administrative systems, healthcare infrastructure, legal frameworks, social norms, etc., they are bound to challenge the standardised application of the tool.

5 | Conclusions

An experienced, international panel developed the International Association for Disability and Oral Health Universal Case Mix Tool. This tool demonstrates content validity by covering seven domains: *Communication, Dental behaviour support, Medical status, Risk factors for oral disease and dysfunction, Autonomy, Legal and ethical barriers*, and *Access to adapted care at the services, systems and policies level*. Each domain is represented by a single item with four rating options reflecting the degree of adaptation over and above that required for the general population, with respect to time, resources and/or expertise necessary to provide high-quality care and equitable outcomes. Ratings are based on the practitioner's own assessments, in consideration of the patient's personal context, social environment and their local services. The domains, ratings and descriptors were found to be appropriate, clear and culturally acceptable. Further research is being undertaken to ensure the tool meets the needs of potential users.

Author Contributions

Conception: G.M., D.F., A.D., C.M. Design: G.M., C.M.G.P., D.F., C.M., A.D. Data collection: C.M.G.P., G.M. Data analysis: C.M.G.P., G.M., D.F., A.D., C.M. Data management: C.M.G.P. First drafting: G.M., D.F., A.D., C.M., C.M.G.P. Redrafting: C.M.G.P. Reading and approval of final version: All authors.

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Disclosure

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Ethics Statement

Ethical approval for this study was granted by CIEIS Reina Fabiola Research Ethics Committee, Universidad Católica de Córdoba, Argentina, with a registration number ODON20230906bP.

Consent

Consent was obtained from all participants.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All relevant data are presented in the study and Supporting Information. Further data are available from the author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.