The Power of Prevention

Using Novel Technology to Facilitate Oral Health and Hygiene Habits for People with IDD

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Introduction & Overview

Barriers to Oral Health Access and Utilization Among People with IDD

Oral health is a critical component of overall health, yet for individuals with intellectual and developmental disabilities (IDD), it remains one of the most persistently unmet healthcare needs.[1-3] Despite national guidelines promoting preventive dental care, adults with IDD continue to face disproportionate rates of dental caries, periodontal disease, and associated systemic conditions.[2] These disparities are not rooted in personal neglect but in long-standing systemic barriers that hinder access to timely, inclusive, and appropriate care. [2,4]

People with IDD encounter multiple obstacles to oral healthcare utilization. These include physical and behavioral challenges, communication impairments, and a reliance on caregivers for daily hygiene practices, making even routine tasks like brushing twice daily a significant hurdle.[4] Dental offices may lack staff trained in managing behavioral or sensory needs, and Medicaid reimbursement models often disincentivize preventive approaches for this population.[2] As a result, care tends to be reactive rather than preventive, compounding oral health issues over time.

Physical and Behavioral Risk Factors

The high prevalence of oral disease among people with IDD is amplified by a constellation of chronic disease and behavioral risk factors. Concomitant medication use increases the risk of xerostomia (dry mouth), a condition known to promote caries and oral fungal infections.[5] People with IDD take more medications than people without IDD and therefore evaluating the impact on oral health was important to this pilot program. Frequent snacking elevates acid exposure and caries risk, especially when paired with sugary or processed foods.[6-8] As such, nutritional risk factors were also assessed through this pilot.

Obesity and diabetes risk are critical considerations. A BMI between 25.0 and 29.9 is considered overweight, while a BMI between 30 and 39.9 is categorized as obese. Only individuals with a BMI between 18.5 and 24.9 are considered to be within the normal weight range. [9] Given that individuals with intellectual and developmental disabilities (IDD) experience significantly higher rates of obesity and related comorbidities compared to the general population, assessing BMI and diabetes risk is essential for identifying and addressing critical health disparities in this group. [2-5, 9] These conditions exacerbate inflammation and reduce immune function, further impairing periodontal health. [10-14]

The Role of Technology in Advancing Oral Health

Emerging technologies now offer a path forward to improve access to and overall oral health. Innovations such as salivary diagnostic tools and connected oral hygiene devices provide accessible, personalized, and data-driven ways to monitor and improve oral health outside traditional dental settings.[1,15-19] In this pilot, the Oral Genome™ salivary test and TruthBrush™ smart toothbrush device enabled real-time monitoring of oral disease biomarkers and daily hygiene behaviors. The efficacy of these tools in bridging communication gaps between caregivers and providers were assessed.

By integrating biologic, behavioral, and contextual data, technology-supported oral health solutions hold immense promises for reducing disparities in underserved populations. They allow for proactive identification of risk, facilitate communication across care teams, and support caregiver engagement—all of which are critical in advancing equitable, person-centered oral health for people with IDD.[15-19]

Purpose and Framework for Piloting & Evaluation

This report was developed to evaluate the feasibility of using salivary diagnostics and smart toothbrush technology in an IDD population. Rather than aiming to influence clinical outcomes directly, this pilot study focused on assessing

whether the introduction of these novel technologies could serve as a potential facilitator of improved oral hygiene habits among individuals with IDD. The study was designed to measure feasibility and engagement, not to reduce disease burden or impact wait times for dental care. The pilot examined the feasibility of deploying technology-enabled tools in real-world care settings by exploring their potential to enhance preventive care, inform risk stratification, and support home-based oral hygiene interventions. The report details the implementation process, early outcomes, and lessons learned, with the aim of understanding whether digital innovations can help overcome longstanding gaps in oral health access and quality. Additionally, the current study outlines how these tools may be scaled to support broader efforts toward a more inclusive, data-driven, and person-centered oral healthcare system.

Methods

Pilot Design and Setting

A feasibility-focused, single-arm observational pilot was conducted across three types of care sites in Middle and East Tennessee: IDD specialty care settings, residential care facilities, and traditional private dental practices. These settings allowed for the assessment of technology implementation across varying levels of support and resources. Led by Harmony Health, the pilot program was developed in partnership with providers and caregivers across Tennessee to explore real-world implementation of new preventive tools.

The pilot deployed two core technologies: the Oral Genome™ salivary testing kits and the TruthBrush™ smart toothbrush attachment, which tracks brushing habits and technique through an interactive phone application. The Oral Genome™ device is a point-of-care saliva-based test that identifies a saliva profile that is indicative of caries (cavities), periodontal (gum) health and diabetes-related biomarkers. Designed for personal home use, the TruthBrush™ is a smart toothbrush device that connects to a mobile phone app, providing real-time feedback to users on brushing frequency, coverage, and technique. Both tools gathered data on caries and diabetes biomarkers, brushing behavior, caregiver support, and setting-specific challenges. This pilot was designed not only to assess the feasibility of deploying these technologies, but also to explore key behavioral and clinical patterns that impact oral health risk.

Interventions & Data Collection

Health care providers evaluated the Oral Genome™ salivary testing kit, and caregivers and/or IDD patients evaluated the TruthBrush™ connected toothbrush to support and monitor brushing habits in daily care routines. Data collected included demographics, clinical biomarker risks, oral health behaviors, and geographic location. Salivary testing assessed biomarkers associated with caries, periodontal, and diabetes risk. These categories reflect concentrations of key oral pathogens and inflammatory markers, with ‘high risk’ suggesting elevated susceptibility to oral disease due to microbial and biochemical imbalances. The TruthBrush™ provided data on brushing frequency, duration, and coverage (i.e., how thoroughly all tooth surfaces are reached).

The mHealth App Usability Questionnaire (MAUQ) and a customized Physician Satisfaction Survey – Implementation Subscale—were designed to capture feedback from healthcare providers and clinical sites. The MAUQ is a validated instrument that measures key elements of mobile health app usability—including ease of learning, functionality, satisfaction, and efficiency—using a 7-point Likert scale, where 7 represents the most favorable response. These tools were selected to evaluate how well the Oral Genome™ technologies integrated into provider workflows and day-to-day clinical operations.[20-21] This pilot focused its feasibility and usability evaluation specifically on the Oral Genome™ salivary testing device and its paired mHealth application. The TruthBrush™ app was not included in the feasibility assessment as it was used by caregivers or patients in addition to clinical teams. This resulted in a lower survey response percentage compared to the Oral Genome kit, which was administered exclusively by clinical care teams and resulted in a 100% response rate.

Outcomes for Evaluation

Primary Outcomes:

- Feasibility of implementing salivary testing and smart toothbrush technology in diverse IDD care settings.

Secondary Outcomes:

- Prevalence of oral health risks, including caries risk levels and associated behavioral factors.
- Oral health status and wellbeing of IDD patients across care settings.
- Satisfaction with technology application in relation to caregivers, patients, and providers.

Statistical Analysis

Descriptive statistics were used to summarize demographic and clinical characteristics. Ordinal logistic regression identified significant predictors of high caries risk. Analyses were conducted using R statistical software, with significance set at $p<0.05$.

This pilot study was reviewed by Sterling Institutional Review Board (IRB) and determined to meet the criteria for exemption under federal regulations governing human subjects research.

Results

Participant Characteristics

The pilot enrolled a total of 151 participants, with a median age of 49 years. The interquartile range for age was 34 to 63 years, and the full age span ranged from 18 to 82 years, capturing a broad adult population with intellectual and developmental disabilities. Gender distribution was relatively balanced, with 70 participants identifying as female (46%), 80 identifying as male (53%), and one individual (0.7%) choosing not to disclose their gender. The majority of participants (80%) identified as white with 18% of the sample identifying as Black or African American and 1.5% identified as Hispanic and/or Latino. One participant (0.7%) identified as Asian. Race and ethnicity data were unknown for 9.3% of participants. (See Table 1)

Participants were primarily recruited from specialized IDD care settings, which accounted for 63% of the sample (95 participants). The remainder were divided between residential care facilities (21%, or 31 participants) and private dental practice settings (17%, or 25 participants). This mix of care environments allowed for assessment of oral health trends across a variety of support structures and living arrangements.

The caries risk assessment biomarker results indicated the majority of participants (55%, or 83 individuals) fell into the moderate risk category. A substantial proportion (44% of participants, 66 individuals) were categorized as high risk, while only 1.3% (2 participants) were considered low risk. Taken together, a striking 99% of participants were classified as either moderate or high risk for dental caries.

In examining systemic health considerations and chronic disease conditions, the diabetes risk assessment biomarker results indicated that 42% of participants (64 individuals) were identified as high risk for diabetes, while the remaining 58% (87 individuals) were classified as low risk.

Table 1: Descriptive Statistics (Demographics and Overall Risk Assessments)

Characteristic	N = 151[1]
Gender	
F	70 (46%)
M	80 (53%)
Prefer Not To Say	1 (0.7%)
Age (years)[2]	49 (34, 63)
Site Type	
Assisted Living	31 (21%)
Private Practice (new)	25 (17%)
Traditional IDD	95 (63%)
Caries Risk Assessment Biomarker Result	
High	66 (44%)
Low	2 (1.3%)
Moderate	83 (55%)
Diabetes Risk Assessment Biomarker Result	
High	64 (42%)
Low	87 (58%)

[1] n (%)
[2] Median (IQR)

Risk Factors Impacting Oral Health

Several behavioral and clinical indicators associated with increased oral health risk were observed among participants in this pilot (Table 2). A large majority—83% of respondents—reported daily use of medications, Similarly, 79% of participants reported engaging in daily snacking. Xerostomia was reported by 36% of participants, aligning with the anticipated impact of polypharmacy in this population. Approximately 80% of participants reported consuming liquids daily. Visible plaque accumulation was observed in 72% of participants and 15% of participants had visible cavities at the time of data collection. However, 48% of participants self-reported they were unsure if they had cavities, suggesting either limited awareness or an inability to accurately communicate or assess their own oral condition.

In terms of daily oral hygiene practices, about 41% of participants endorsed brushing their teeth two times per day for two minutes, which is the minimum recommendation set by the American Dental Association. More than half of participants (54%) indicated they did not brush their teeth twice a day and an additional 3.8% were unsure of their routine. (See Table 2) Taken together, these findings outline both behavioral and environmental risk factors that contribute to the high prevalence of oral health issues within the IDD population. They also reinforce the importance of integrating caregiver engagement, technology-enabled tracking, and personalized education into preventive care strategies for individuals with IDD.

Table 2: Descriptive Statistics (JSON Parsed Data for Caries Risk Assessment Questions)

Characteristic	N = 151[1]
Do you take medications daily?	
Yes	104 (83%)
Unknown	25
Do you feel as though you have a dry mouth at any time of the day or night?	
Yes	50 (36%)
Unknown	14
Do you drink liquids other than water more than 2 times daily between meals?	
Yes	109 (80%)
Unknown	14
Do you snack daily between meals?	
Yes	108 (79%)
Unknown	14
Do you notice plaque build-up on your teeth between brushings?	
Yes	98 (72%)
Unknown	14
Can you see cavities on your teeth?	
Yes	20 (15%)
I Don't Know	66 (48%)
No	51 (37%)
Unknown	14
Were cavities seen on your x-rays in the past that have been left untreated?	
Yes	20 (15%)
I Don't Know	24 (18%)
No	93 (68%)
Unknown	14
When was your last dental visit for a cleaning and checkup?	
I Don't Know	5 (6.5%)
Less than a year ago	68 (88%)

More than a year ago	4 (5.2%)
Unknown	74
Please select the answer that best describes your home oral hygiene routine.	
I do not regularly brush my teeth everyday, two times a day or for two minutes each time.	42 (54%)
I Don't Know	3 (3.8%)
I regularly brush my teeth everyday, two times a day and for two minutes each time.	32 (41%)
My child does not regularly brush their teeth everyday, two times a day or for two minutes each time	1 (1.3%)
Unknown	73

Risk Factors for Chronic Disease

Chronic disease risk factors were evaluated to understand the influence on oral health status and associated outcomes. The median body mass index (BMI) of participants was 27.1, with an interquartile range of 23.0 to 30.5. This distribution places half of the participants within the "overweight" category, as defined by the Centers for Disease Control and Prevention (CDC) BMI classifications.[9] Almost 1 in 10 participants (9%) had a history of gestational diabetes with 22% of participants reported having a family member with diabetes. (See Table 3)

Table 3: Descriptive Statistics (JSON Parsed Data for Diabetes Risk Assessment Questions)

Characteristic	N = 151[1]
BMI[2]	27.1 (23.0, 30.5)
Unknown	15
Race and Ethnicity	
Asian	1 (0.7%)
Black or African American	24 (18%)
Hispanic and/or Latino	2 (1.5%)
White	110 (80%)
Unknown	14 (9.3%)
Have you ever been diagnosed with gestational diabetes?	
No	125 (91.3%)
Yes	12 (8.7%)
Unknown	14
Endorsed family member with diabetes (Y)	30 (22%)

[1] n (%)
[2] Median (IQR)

Inferential Analyses: Caries Risk Assessment and Predictive Factors

To identify predictors of high caries risk, ordinal logistic regression analyses were conducted using participant-level data from the pilot. The results revealed statistically significant associations between care setting, home oral hygiene practices, and caries risk assessment (CRA) biomarker outcomes.

Practice setting emerged as a meaningful predictor of caries risk. When compared to participants residing in residential care facilities, those receiving care in private dental practices had 76.1% lower odds of a high caries risk biomarker result (odds ratio [OR]: 0.24, 95% CI: 0.07–0.81; p = 0.02) (Table 4). The association was even stronger for individuals in IDD specialty care settings, where the odds of having a high caries risk were 86.1% lower compared to those in residential care settings (OR: 0.14, 95% CI: 0.05–0.37; p < 0.001).

In the second model adjusting for gender, age, and site type, home oral hygiene practices were also found to significantly influence CRA outcomes. Participants who reported brushing their teeth twice a day for two minutes had 86.5% lower odds of being categorized as high caries risk (OR: 0.14, 95% CI: 0.02–0.99; p = 0.0496) (Table 5). In contrast, individuals who were unsure of their brushing routine did not exhibit a statistically significant difference in caries risk (OR: 2.97, 95% CI: 0.20–45.5; p = 0.43). Gender and age did not have a significant influence on CRA biomarkers.

Table 4: Ordinal Logistic Regression Results for the outcome of Caries Risk Assessment Biomarker Result Among Participants

	Odds Ratio (OR)	2.5%	97.5%	p-value[1]
Male	0.74	0.36	1.53	0.42
Age	0.99	0.96	1.01	0.20
Private Practice Site Type	0.24	0.07	0.81	0.02*
IDD Specialty Care Site Type	0.14	0.05	0.37	<0.001*

[1] *Result considered statistically significant at p < 0.05

Table 5: Adjusted 1 Ordinal Logistic Regression Results for the outcome of Caries Risk Assessment Biomarker Result Among Participants, based on reported oral hygiene routine

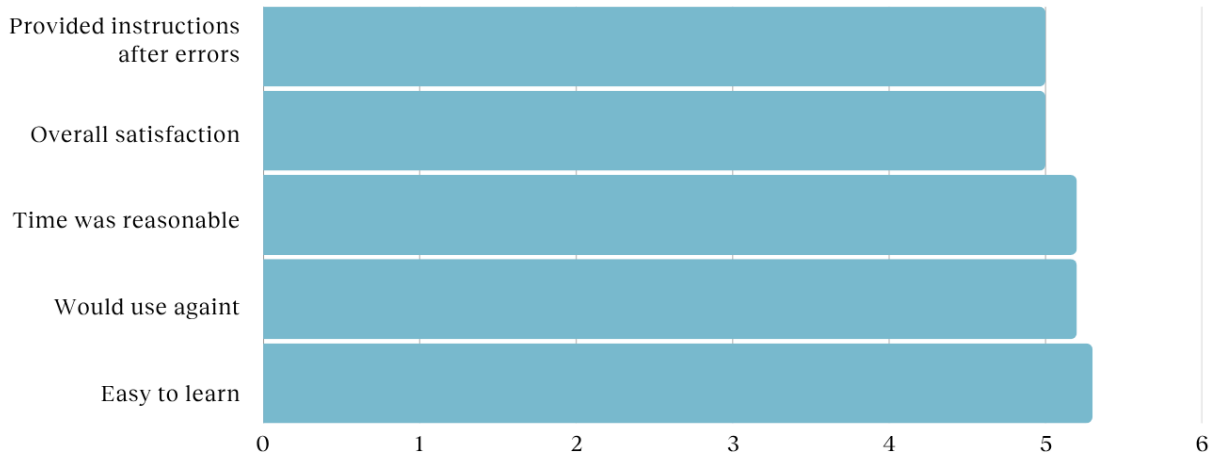
	Odds Ratio (OR)	2.5%	97.5%	p-value[1]
"I regularly brush my teeth everyday, two times a day and for two minutes each time"	0.14	0.02	0.99	0.0496*
"I don't know"	2.97	0.20	45.5	0.43

[1] *Result considered statistically significant at p < 0.05

MAUQ Findings: Encouraging Usability and Adoption

Feedback from five clinical sites revealed encouraging usability ratings. The app earned its highest score (6 out of 7) for “It was easy for me to learn to use the app”, suggesting that providers found the initial onboarding intuitive. Respondents also showed strong interest in continued use, with a 5.4 score for “I would use this app again” and gave similarly positive marks for time efficiency. Importantly, the app’s overall satisfaction rating was 5.0, signaling that users felt the technology added value to their routine, even amidst some transitional hurdles.

Figure 1: MAUQ Usability Scores



Discussion

This pilot offers critical insights into how emerging technologies, such as salivary testing with mHealth applications and connected oral health tools, can be meaningfully integrated into the care of people with IDD. Taken together, the findings present a compelling case for reimagining oral healthcare delivery, not just through better tools, but through more inclusive systems that account for behavior, environment, and technology access.

One of the pilot’s most striking findings is the overwhelming burden of oral disease risk among participants: 99% of IDD participants were classified as moderate or high risk for dental caries based on salivary biomarkers. Factors such as high medication usage (83%), frequent snacking (79%), and widespread plaque accumulation (72%) point to entrenched behavioral and physiological risk factors. Despite these negative oral health outcomes, the pilot also uncovers promising leverage points: participants who adhered to basic brushing standards (twice daily for two minutes) had 86.5% lower odds of high caries risk, even after adjusting for age, gender, and site type.

Importantly, care setting emerged as a powerful determinant of risk. People with IDD living in residential care facilities were significantly more likely to have high caries risk compared to those in private practice or specialized IDD care environments. This suggests that environmental factors, such as staffing ratios, caregiver training, the complexities of toothbrushing, or even access to supplies, play a critical role in oral health outcomes. (22-25) These pilot study results also challenge the field to look beyond individual risk factors and assess the systems in which they live. These findings should spark renewed focus on equipping long-term care providers who support care delivery in IDD populations with oral health training, simplified tools, and system-level supports such as Medicaid reimbursement for preventive efforts outside the dental office.

These findings affirm the importance of personalized, caregiver-supported home care plans. Oral health habits and hygiene behaviors cannot be viewed as a one-size-fits-all task; they must be tailored to each person’s physical, cognitive, and environmental context.[26] The pilot results reinforce oral hygiene habits, like brushing twice daily, are not always feasible in an IDD population. Interventions should therefore focus on sustaining foundational health behaviors in both caregivers and IDD patients.

Technology, such as the TruthBrush™ smart toothbrush device, holds promise in facilitating positive home care interventions. This device provides real-time feedback to users, assessing thoroughness during toothbrushing for both caregivers and IDD patients. When used by caregivers and shared with providers, these insights can guide adaptive interventions, such as adjusting technique or selecting better-suited tools.[27-28] This feedback also fosters richer caregiver-provider-patient collaboration, enabling oral health strategies that are proactive rather than reactive.

The Oral Genome™ salivary test further extends this vision by offering a biologically grounded snapshot of oral and systemic health that can be obtained at the point of care. Its potential to inform triage decisions and reduce unnecessary dental visits is particularly meaningful in IDD care, where transportation, sedation needs, or behavior management can make clinic-based services difficult or infrequent.[29]

Utilizing novel technologies and tools is not without unique challenges. The variation in satisfaction scores suggest integrating mHealth technologies into traditional dental workflows requires cultural and infrastructural change. Barriers such as inconsistent Wi-Fi, limited staff experience with technology, and the absence of organized digital processes for completing tasks (digital workflows) must be addressed to fully benefit from these tools. Still, providers' responses to the mHealth App Usability Questionnaire (MAUQ) indicate that once introduced, the Oral Genome™ app is perceived as intuitive and efficient, scoring well on adoption and usability. These findings suggest a favorable trajectory if paired with effective implementation training.

While overall usability scores were favorable, some providers did report occasional app glitches, such as delayed loading times or intermittent connectivity when syncing the Oral Genome™ mHealth application. The data indicates that while the app experience was not without imperfections, its interface, adoption, and usability are viewed favorably—especially given that this is a novel technology entering a traditionally low-tech clinical space. While Oral Genome™ device users experienced significantly less glitching than the industry standard, in fast-paced clinical environments, even minor disruptions can impact provider efficiency, extend chair time, and reduce confidence in the reliability of the tool, particularly when staff are unfamiliar with troubleshooting mobile technology. Addressing these pain points through regular updates, offline functionality, and responsive technical support will be essential for scaling mHealth adoption in dentistry.

Conclusion

This pilot study underscores the feasibility and promise of integrating salivary testing and mHealth applications into the oral health care of people with IDD. The prevalence of moderate to high caries risk, coupled with behavioral and environmental predictors such as care setting and oral hygiene routine, highlights the urgent need for personalized, preventive strategies that extend beyond the dental chair.

While the initial findings are encouraging, especially regarding usability and the potential of digital tools to enhance caregiver-provider collaboration, additional research is needed to fully understand their long-term impact. Future studies should include larger, more diverse samples and track outcomes across multiple touchpoints, including pre- and post-dental visits, to evaluate how these technologies influence clinical decision-making and patient outcomes over time.

Qualitative data from patients, caregivers, and providers will be critical for identifying the nuanced barriers and facilitators to adoption, including attitudes toward technology, workflow integration, and perceived value. By combining longitudinal and experiential data, future work can build a more comprehensive roadmap for scaling inclusive, tech-enabled oral health care for IDD populations. Ultimately, these findings reinforce that technology can facilitate improved oral health for people with IDD when we equip caregivers, providers, and systems with the right tools and data to act.

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