

CANADIAN JOURNAL OF DENTAL HYGIENE · JOURNAL CANADIEN DE L'HYGIÈNE DENTAIRE

CJDH



JCHD

QUARTERLY ISSUE · NOVEMBER 2012

VOL. 46, NO. 4

Exploring dental hygiene clinical decision making
Caries, iron deficiency and food security in children
Impact of oral hygiene education initiative by nurses
Halitosis in the absence of oral causes
Decoding qualitative research

Editorials

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Published four times per year: February, May, August, and November.
 Current volume 46, issues 1–4
 Canada Post Publications Mail #4063062.

CANADIAN POSTMASTER

Notice of change of address and undeliverables to:
 Canadian Dental Hygienists Association
 96 Centrepoin Drive, Ottawa, ON K2G 6B1

SUBSCRIPTIONS

Annual subscriptions are \$90 plus HST for libraries and educational institutions in Canada; \$135 plus HST otherwise in Canada; C\$140 US only; C\$145 elsewhere. One dollar per issue is allocated from membership fees for journal production.

ADVERTISING

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CDHA 2012

6176 CN ISSN 1712-171X (Print)
 ISSN 1712-1728 (Online)

GST Registration No. R106845233

Canadian Journal of Dental Hygiene is indexed in the databases of:
 CINAHL; EBSCOhost; ProQuest; Thomson Gale

The *Canadian Journal of Dental Hygiene (CJDH)* is the official peer reviewed publication of the Canadian Dental Hygienists Association. The CDHA invites submissions of original research, discussion papers and statements of opinion of interest to the dental hygiene profession. All manuscripts are refereed anonymously. *Guidelines for Authors* are available at www.cdha.ca/AM/Template.cfm?Section=Publications

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What makes research scientific?

Katherine Zmetana, DipDH, DipDT, EdD

The articles published in the *CJDH* are reflective of current research practice, deemed of timely interest to dental hygiene practice, and peer reviewed. The reason for such careful selection criteria is that evidence based practice relies on research that is reliable, topical and trustworthy. Oral healthcare practice must have solid scientific evidence to inform decision making. But what makes research “scientific”? In other words, what differentiates scientific research from research conducted for a term paper or for investigative news journalism?

Scientific research adheres to a set of strict guidelines, protocols, and long established methods of gathering and documenting information. It includes a synthesis and analysis of that information with the purpose of advancing knowledge. The word “science” comes from Latin, and essentially means “knowledge”. The rules for conducting scientific research are carefully laid out and monitored in universities and other institutes of higher learning and research. They are a result of time honoured traditions that date back to medieval times, evolving through the 17th and 18th centuries into what has become known as the scientific method. The process of measurement is central in the standard design method of most scientific disciplines. Scientific inquiry is generally intended to be as objective as possible in order to reduce biased interpretation of results.

It may seem strange to state what seems obvious to us all today, yet it was only in the last century that this particular understanding of science was considered the exclusive source of all authoritative knowledge. The Industrial Revolution—with its advances in technology and mass production—gave public credence to the “scientific way”. The Industrial Revolution embraced the mechanistic view of Newtonian physics—that breaking down a whole into its separate components to study each of the working components was an effective way to better understand the whole. This way of thinking greatly influenced the research of the 20th century, creating reliance in the pure sciences on what we generally label *quantitative* research methods.

Quantitative research is characterized by the collection of data in numerical form, such as statistics and percentages. Its objective is to apply mathematical models, theories and hypotheses to establish cause and effect. Various characteristics, or variables, are isolated or removed until causal relationships or trends are revealed. This type of research requires direct and impartial observation and objective analysis so that results are consistently achieved, regardless of the observer. Results are thus considered



Scientific Editor, *CJDH*

generalizable; they can be expected to occur in all similar situations. Objectivity is critical to quantitative research; introspection and intuition are rejected. We can see how this method of research has permeated everyday life when we hear the phrases: “Just give me the facts” or “Numbers don’t lie”.

Introspection, however, was a crucial element in the birthplace of philosophy—a field of study inextricably linked to the search for knowledge. Consider the Doctor of Philosophy (PhD) degree—the internationally recognized, highest level of scholarship that acknowledges scientific research ability. Many of these scholars have never taken classes in philosophy. Yet the significance of the title is simple enough. The word “philosophy” comes from the Greek; it means “love of wisdom”.

If we refer back to the Greek fathers of philosophy, we get a glimpse of what was considered wisdom in *circa* 400 BCE. They too believed that research was an essential part of their existence. We learn from Socrates that the unexamined life is not worth living. Plato explains that wisdom is found in “the good, the true, and the beautiful”; loosely translated in contemporary times as morals, nature, and art. Their scientific way was “love and pursuit of wisdom by intellectual means and moral self discipline.” One notable characteristic that we have in common today is the dependence on observable data to formulate questions, test theories and come to conclusions.

During the last century, many developing theories of research questioned the concept of a passive observer, claiming that research is biased because of the simple reality that researchers are human. Moreover, with the advent of quantum physics, there was a new belief that everything in this world is connected as a system. With the discovery that the whole can contain properties that none of the components contain independently, there was a growing interest in studying component parts in context and in relation to the other parts of the system. Systems theory, also dubbed the “new” science, claims that components cannot be effectively studied or understood when isolated from the whole; therefore, research is dependent on context. This new theory gives credence to conducting research in natural settings, with all variables remaining in place. It strives to understand the relationships and qualities of the experience under



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study, and has been instrumental in promoting research that is *qualitative* in nature.

Qualitative research acknowledges that the researcher is biased, and therefore requires that those biases must be documented in the research report. The researcher looks for themes and patterns in the gathered data as exclusive to that phenomenon or group of participants. Because it is context dependent, qualitative research cannot claim to make generalizable findings. That is, the results cannot be expected to be replicated by another researcher in a similar situation. Rather, the intent is to explore in depth, a particular phenomenon, issue or experience for an understanding of such immeasurable aspects as the perceptions and beliefs of the people involved.

Research design varies by field and by the question being investigated. Traditionally, the hard sciences have favoured the use of measurable, quantitative data. Today, more qualitative studies are being undertaken in the healthcare fields, perhaps because this is an area of science where interactions among people are relevant and important to wellbeing. Some researchers combine qualitative and quantitative forms of analyses to better answer questions that cannot be studied in isolation, particularly in the social sciences and in education. A combination of quantitative and qualitative methods is often referred to as *mixed methods* research, which frequently makes use of qualitative data to understand the findings of the quantitative data, or vice versa.

The perception and understanding of science can be dependent on the political, economic, social and educational theories of the moment in which we live. We see the world through the lens of our time, our personal and collective beliefs and values, and our cultural heritage. Scientific research, whether quantitative or qualitative, invites the critical analysis of fundamental assumptions or beliefs. If we did not challenge these views and consistently strive to learn more about ourselves and the world in which we live, then the world would still be flat.

When looking back on historical intolerances of discoveries that have challenged the existing way of thinking, it is rather remarkable that academic knowledge now embraces many perspectives of science and academic rigour. **In this issue**, we feature articles from a variety of research methods that demonstrate how these methods can answer topical questions, meet scientific research guidelines, and contribute to the knowledge of oral health and dental hygiene practice.

Zul Kanji provides a more complete discussion of qualitative research methodology in his Short Communication,^(p.239) particularly in its application to the practice of oral healthcare. He points out that understanding the purpose and process of this type of research can reassure dental hygienists of its usefulness when using its findings as well as encourage researchers to consider applying qualitative methodology when it may be appropriate and effective.

The recipient of this year's *CJDH Research Award*, **Dr Joanna Asadoorian**, used a mixed methodology in her ground breaking research on dental hygiene clinical decision making.^(p.207) This research is an excellent example of how both qualitative and quantitative methods can be used together to achieve an in depth exploration of a research area that relates to the social sciences as well as to the practice of clinical dental hygiene.

Ann Szeto's research contribution regarding early childhood caries and iron deficiency^(p.215) is part of a larger investigation of dietary patterns and micronutrient status in young children of low income families. It provides a comprehensive example of the process involved in quantitative research methodology.

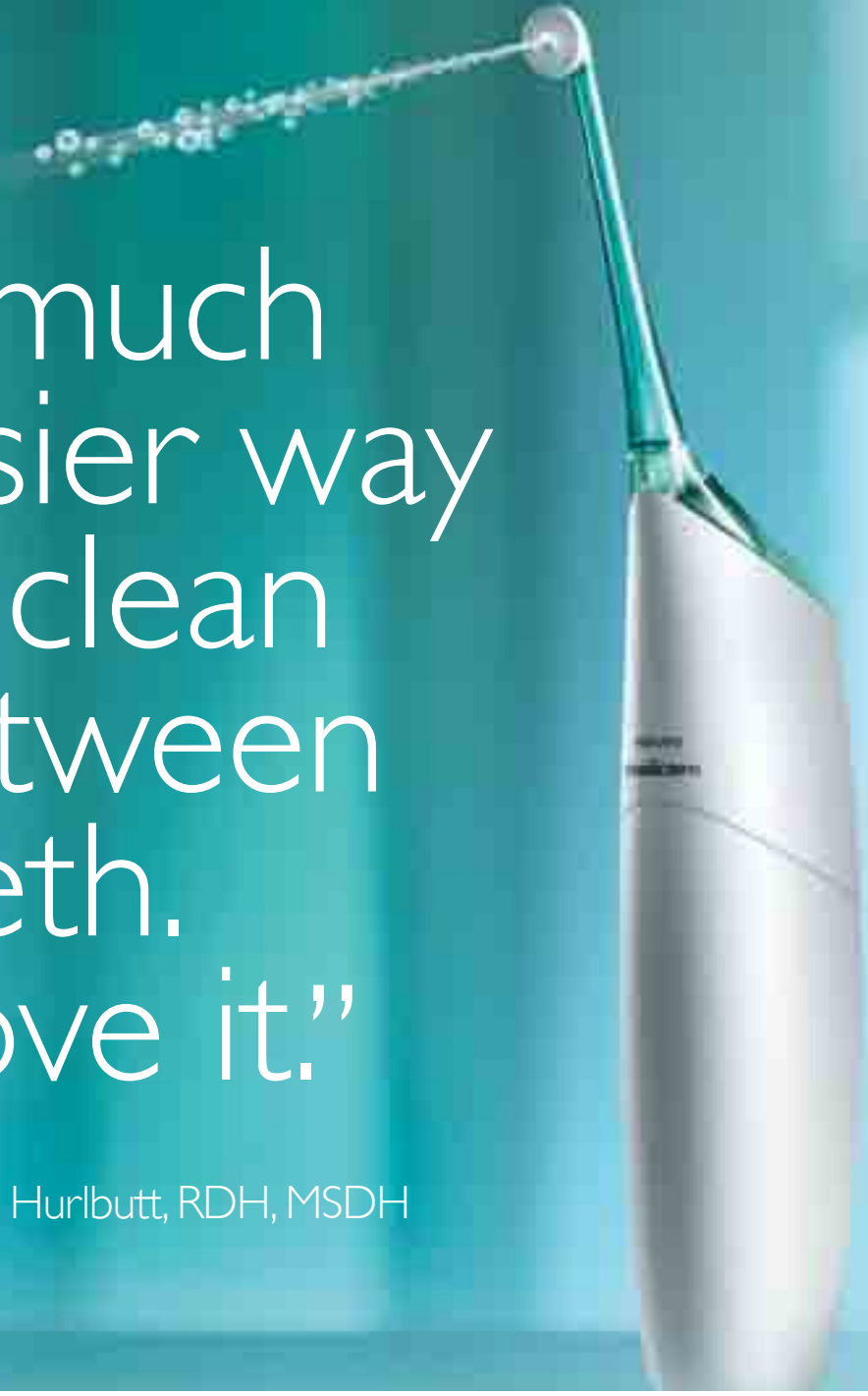
The evaluation and research study undertaken by **Joyce Wimmer** on the impact of an oral hygiene education initiative^(p.223) shows how statistical analyses can be used on qualitative data collected from interviews and questionnaires. This study resulted in positive outcomes that held many immediate implications for practice.

Although not mentioned earlier, an important component of scientific research is the literature review. A preliminary investigation into studies already undertaken can establish what direction to take if further research is required. It can also answer questions that may not require further research. **Susan Badanjak** contributed a comprehensive review on the etiology of halitosis in the absence of oral causes.^(p.231) Her detailed description of the search strategy shows a well documented and reliable methodology.

Finally, it is important to remember, as **Sandy Lawlor** states in her editorial,^(p.203) that healthcare has evolved over the years and will continue to evolve. In the same way, oral healthcare will need to adapt to changing demographics and the needs of those demographics. Practitioners are better able to meet those needs and adapt to change if well informed. That is possible only if the consulted resources are reliable sources of information. The strict criteria for publication in the *CJDH* ensure that the research information is valid and trustworthy; and we are committed to upholding those standards.

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¹ de Jager M, Jain V, Schmitt P, DeLaurenti M, Jenkins W, Milleman J, Milleman K, Putt M. Clinical efficacy and safety of a novel interproximal cleaning device. *J Dent Res* 90 (spec iss A), 2011

² Krell S, Kaler A, Wei J. In-home use test to evaluate ease of use for Philips Sonicare AirFloss versus Reach string floss and Waterpik Ultra Water Flosser. Data on file, 2010

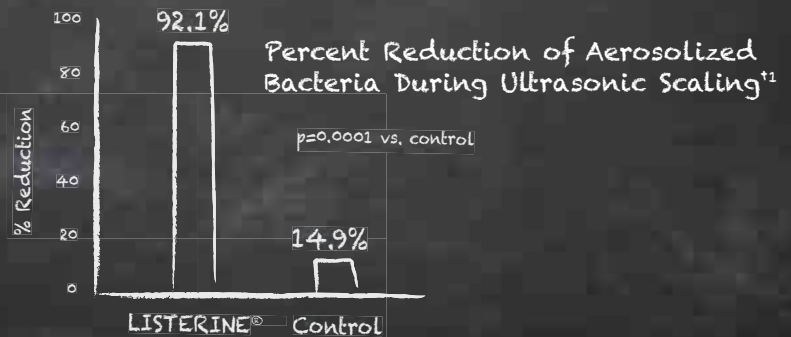
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Dental hygienists as advocates: Put on your purple cape

Sandy Lawlor, RDH, BA(Psych), BSW



CDHA President

A couple of my closest colleagues tease me about my need to “put on my purple cape” when dental hygiene issues arise and change needs to occur. While being an advocate is often a role that challenges and sometimes intimidates us, we often take on that very role without realizing it. Being an advocate can be as simple as speaking up on someone’s behalf or it can be something more involved, such as championing a cause to bring about legislative change. Many of our members advocate for others in their day to day lives—the parent who speaks up for a child bullied at school or the dental hygienist who approaches community agencies for additional services for a parent whose health is failing.

Being an advocate is recognized as one of the core abilities within the standards for Canadian dental hygienists.¹ Advocacy is “speaking, writing or acting in favour of a particular cause, policy or group of people - often aims to reduce inequities in health status or access to health services”.² Dental hygienists are expected to create change at both the individual and community levels.

Advocacy demands actions that are expected to increase access to dental hygiene care. Many dental hygienists across Canada have already worked with their associations over the years—both nationally and provincially—to lobby for change in dental hygiene practice legislation through the advocacy of their legislators. As a result, many Canadian provinces granted self regulation status to the profession along with the right to self initiate scaling. While this was a good start to increasing direct access to dental hygiene care and to making oral health services more affordable, there is much work to be done.

At the core of Canada’s healthcare system is the philosophy of access for everyone. It is essential to highlight that oral healthcare was not included. Given that research has consistently demonstrated a link between oral and general health, this is a grave oversight. Because of this, oral health services are delivered in a free market framework. That led and has continued to lead to imbalances between advantaged and disadvantaged population groups.³

With current research making it clearly evident that good oral health and access to oral health are components that contribute to good overall health,⁴⁻⁶ change needs to occur. Advocacy for prevention and health promotion is key to reducing costs to the healthcare system. Society and healthcare professions need to commit to an approach

Les hygiénistes dentaires, comme des avocates : Revêtez votre cape pourpre

Sandy Lawlor, RDH, BA(Psych), BSW

Certaines de mes collègues les plus proches me taquent parce que je sens le besoin de « revêtir ma cape pourpre » quand surgissent des problèmes d’hygiène dentaire et des besoins de changement. Si l’intervention comme avocate pose souvent des défis et parfois nous intimide, nous en assumons souvent le rôle sans le réaliser. L’intercession peut être aussi simple qu’intervenir au nom de quelqu’un, mais elle peut impliquer beaucoup plus, comme promouvoir une cause visant à modifier la loi. Beaucoup de nos membres agissent comme des avocates dans leur vie quotidienne — plainte parentale pour défendre un enfant persécuté à l’école ou démarche de l’hygiéniste dentaire auprès des organismes communautaires visant à obtenir des services pour un parent ayant une santé défaillante.

Agir en avocate est reconnu comme étant une des aptitudes fondamentales selon les normes des hygiénistes dentaires canadiennes.¹ L’intervention consiste à « parler, écrire ou agir particulièrement en faveur d’une cause, d’une politique ou d’un groupe de personnes — souvent afin de réduire les iniquités face aux états de santé ou à l’accès des services de santé ».² L’on s’attend des hygiénistes dentaires qu’elles produisent des changements au niveaux individuel et communautaire.

Comme celle d’une avocate, l’intervention comporte des gestes qui accroîtront l’accès aux soins d’hygiène dentaire. À travers le Canada, beaucoup d’hygiénistes dentaires exercent déjà des pressions depuis plusieurs années avec leurs associations — nationale ou provinciales — auprès de leurs législateurs pour faire modifier la loi régissant l’exercice de l’hygiène dentaire. Il en est résulté que plusieurs provinces canadiennes ont accordé un statut d’autoréglementation professionnelle ainsi que le droit à l’autodétermination. Bien que ce fut un bon départ pour accroître l’accès direct aux soins d’hygiène dentaires et rendre les services de soins buccodentaires plus abordables, il reste encore beaucoup à faire.

THIS IS A PEER REVIEWED ARTICLE.

This article is based on one of the CDHA Ends as determined by the CDHA board of directors.

Correspondence to: Sandy Lawlor, CDHA President; president@cdha.ca

that will affect public policy.⁷ It is essential to note that healthy public policy focuses on examining the social determinants of health such as education, poverty, location and working conditions, and therefore goes beyond basic healthcare policy.⁸

It is in this environment and spirit that the Canadian Dental Hygienists Association (CDHA) has established two well defined "Ends" or goals:


1. "Members practise as primary healthcare providers in an environment in which the Canadian public has direct access to dental hygiene care" and
2. "Members practise in a supportive public policy environment".⁹

As dental hygienists, we need to advocate and lobby where necessary to create effective and healthy public policy that will bring preventive oral health services to those who need it, especially seniors, First Nations populations and the underserved.

Ranked sixth in size among regulated healthcare professions in Canada, dental hygiene has a strong voice, and therefore has the ability to make itself heard. It is critical that the CDHA and the provincial associations work together to create an ongoing advocacy plan. Every Member of Parliament at the federal level and every Member of the Provincial Parliament should receive a yearly visit from a dental hygienist to remind him or her of the value dental hygiene brings to healthcare. When policy needs to be changed, all dental hygienists have a responsibility to lobby their legislators frequently.

With consistent and coordinated efforts to deliver key messages to our elected officials, we can be catalysts of change both at the federal and provincial levels. Be a part of that change. All dental hygienists are advocates. Put on your purple cape!

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Au cœur du système de soins buccodentaires au Canada se situe le principe fondamental d'accès pour tous. Il est essentiel de souligner que les soins buccodentaires n'avaient pas été inclus. Comme la recherche a constamment démontré qu'il y a un lien entre la santé buccodentaire et la santé en général, il y a là une grave omission. Il s'ensuit donc que les services de santé buccodentaire sont dispensés dans un cadre de libre marché. Cela a entraîné et maintient un déséquilibre entre les groupes de population favorisés et défavorisés.³


Alors que la recherche courante établit clairement qu'une bonne santé buccodentaire et l'accès aux soins buccodentaires sont des éléments qui contribuent à la bonne santé générale,⁴⁻⁶ des changements s'imposent. L'éveil de la protection et de la promotion de la santé devient un élément clé de réduction des frais du système de soins de santé. La société et les professions de la santé doivent s'engager dans une voie qui affectera l'ordre public.⁷ Il est donc essentiel de noter que les mesures politiques en matière de santé publique doivent viser l'examen des déterminants sociaux de la santé, comme l'éducation, la pauvreté, la localisation et les conditions de travail, donc aller au-delà d'une politique de base limitée aux soins de santé.⁸

C'est dans ce contexte et avec cet esprit que l'Association canadienne des hygiénistes dentaires (ACHD) a établi deux « Fins » ou buts bien définis :

1. « Les membres exercent comme des prestataires de soins buccodentaires primaires dans un environnement où la population canadienne a directement accès aux soins d'hygiène dentaire » et
2. « Les membres exercent dans un environnement soutenu par des politiques publiques ».⁹

En tant qu'hygiénistes dentaires, il nous faut intervenir et faire des pressions là où, en matière de santé publique, il faut prendre des mesures politiques efficaces pour mettre au point des services sanitaires et de prévention en santé buccodentaire pour les personnes qui en ont besoin, particulièrement les aînés, les populations des Premières Nations et les personnes mal desservies.

Classée sixième relativement à la taille parmi les professions de soins de santé au Canada, l'hygiène dentaire a une voix forte; elle peut donc se faire entendre. Il est crucial que l'ACHD et les associations provinciales travaillent ensemble pour créer un plan de sensibilisation continue. Chaque membre du parlement au niveau fédéral et chaque membre des parlements provinciaux devrait recevoir rapidement la visite d'une hygiéniste dentaire pour lui rappeler l'importance qu'occupe l'hygiène dentaire dans les soins de santé. Lorsqu'il faut modifier la politique, il incombe à toutes les hygiénistes dentaires d'intervenir souvent auprès de leurs législateurs.

Avec des efforts constants et coordonnés pour livrer des messages clés à nos représentants élus, nous pouvons être des catalyseurs de changements aux deux niveaux, fédéral et provincial. Participez à ce changement. Toutes les hygiénistes dentaires agissent en avocates. Mettez votre cape pourpre! 



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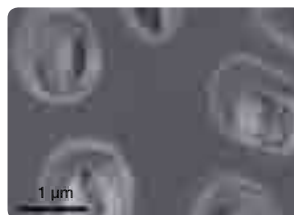
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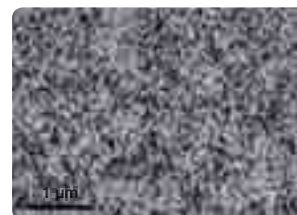
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Exploring dental hygiene clinical decision making—a mixed methods study of potential organizational explanations: Phase I

Joanna Asadoorian, RDH, PhD

ABSTRACT

Background and purpose: Dental hygienists have been targeted for practice expansion to improve public access to oral healthcare, specifically by changing their scopes of practice and healthcare delivery models. Dental hygienists must demonstrate their decision making capacity within existing and new frameworks to support such an expansion. This paper presents the Phase I findings of a mixed methods study. The aim was to explore dental hygiene decision making, identify key influences on decision making and develop a qualitative dental hygiene decision making model based on those influences tested in Phase II. Organizational and feminist theories underpinned the study. **Methods:** A phased mixed methods research approach was used. Phase I involved a series of focus groups interviews. Collected narrative data underwent qualitative thematic analysis to identify key themes believed to influence decision making capacity. These themes served to inform the development of a qualitative dental hygiene decision making model. **Results:** Qualitative analysis of focus group data yielded over 75 codes, and six themes emerged as being influential in dental hygiene decision making capacity. Of these themes, five reflected organizational constructs whereas one was shown to be individualistic. An additional organizational theme arose from the literature. A qualitative dental hygiene decision making model was developed using these interrelated key themes along with environmental features. **Conclusions:** While most of the key themes influencing dental hygiene decision making capacity were found to be organizational, one was individualistic and more aligned with previous research. It was concluded that both the organizational structure and one's individual agency influenced dental hygiene decision making capacity.

RÉSUMÉ

Contexte et objet : Les hygiénistes dentaires se sont donné pour objectif d'élargir leur pratique afin d'améliorer l'accès de la population aux soins buccodentaires, notamment en modifiant l'étendue de leurs modes d'exercice et de prestation des soins de santé. Elles doivent démontrer leur capacité décisionnelle dans les cadres existants et de nouveaux cadres pour soutenir un tel élargissement. Cet article présente les données de la Phase I d'une étude à méthodologie mixte, dont le but était d'étudier la prise de décisions en hygiène dentaire, d'identifier les facteurs clés d'influence sur la prise de décisions et d'élaborer un modèle qualitatif de prise de décisions en hygiène dentaire, fondé sur les influences testées dans la Phase II. Les théories organisationnelles et féministes ont étayé l'étude. **Méthodes :** L'on a utilisé une approche de recherche par phases, fondée sur des méthodes mixtes. La Phase I comprenait une série d'entrevues avec des groupes cibles. Les données recueillies sous forme narrative ont fait l'objet d'une analyse thématique qualitative pour identifier les thèmes principaux qui ont influencé la capacité décisionnelle. Ces thèmes ont servi à informer l'élaboration d'un modèle qualitatif de prise de décisions. **Résultats :** L'analyse qualitative des données du groupe cible a donné plus de 75 codes et il s'en est dégagé six thèmes influençant la capacité de prise de décisions en hygiène dentaire. Cinq de ces thèmes reflétaient les concepts organisationnels alors qu'un thème s'avérait individualiste. Un thème additionnel s'est manifesté dans la littérature. Un modèle qualitatif de prise de décision en hygiène dentaire a été élaboré à l'aide des thèmes clés interactifs ainsi que des caractères environnementaux. **Conclusions :** Alors que la plupart des thèmes clés influençant la capacité de prise de décisions en hygiène dentaire s'avérèrent organisationnelles, un seul était individualiste et plus aligné avec les recherches précédentes. L'on a conclu que la structure organisationnelle et une agence individuelle personnelle avaient influencé la capacité de prise de décisions en hygiène dentaire.

Key words: clinical decision making, knowledge translation, organizational, gender

INTRODUCTION

Expanding allied healthcare providers' scopes of practice and providing options for alternate healthcare delivery models through changes to legislation is an increasingly utilized policy approach to improve public access to healthcare.¹ Allied healthcare providers comprise a large proportion of the healthcare workforce and, where practice expansion occurs, can make a significant impact

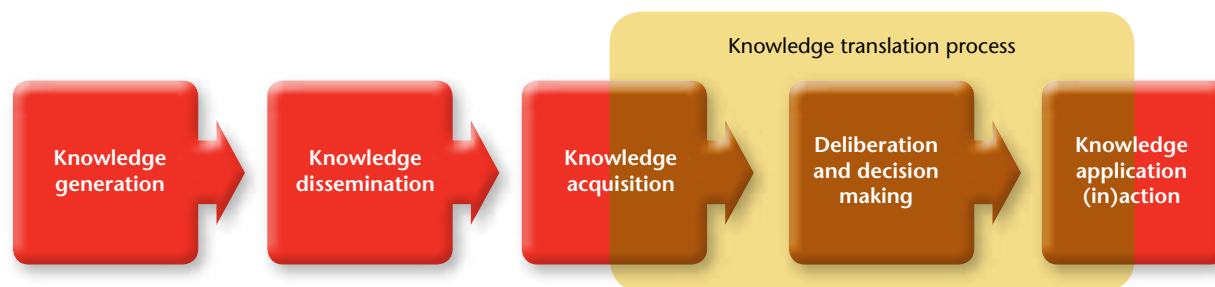
on mitigating lack of access.²⁻⁴ Dental hygienists can be viewed as the primary allied oral health professionals and have been targeted within various jurisdictions, both in Canada and the US, for such an expansion to practice. Permitting direct public access to broadened dental hygiene services has the potential to improve access to oral healthcare and mitigate oral health disparities.^{4,5}

Despite the impact dental hygienists could potentially

THIS IS A PEER REVIEWED ARTICLE. And winner of the CJDH Research Award 2012. Submitted 28 June 2012. Revised 19 Sept. 2012. Accepted 20 Sept. 2012.

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Figure 1. Knowledge translation process.



make in improving access to oral healthcare, some stakeholders have questioned whether dental hygienists are capable of the clinical decision making required in an expanded practice, which would make demands beyond their technical skill set.^{2,5,6} Having decision making capacity—the central component of professional healthcare practice—can be summarized as having the freedom to act intentionally within one’s environment to achieve positive outcomes.^{7,8} It falls within the broad field of knowledge translation, which is the process of generating, disseminating and implementing knowledge in its various forms to improve health outcomes.^{9,10} The clinical decision making component of the knowledge translation process is sometimes referred to as the “black box” because of its poorly understood, largely cognitive and unobservable characteristics (Figure 1).¹⁰

The assumption that healthcare providers make decisions and deliver care in a rational manner has not been demonstrated. Awareness of knowledge does not ensure its rational and expedient application to practice, and it generates a disconnection between what practitioners know and what they do.^{11,12} This contributes to the phenomenon referred to as the theory–practice gap.^{9,10} The purpose of Phase I of this study was to explore and identify key influences on dental hygiene decision making capacity. Based on these influences, a dental hygiene decision making model was developed to be tested in Phase II of the study.

Many theoretical perspectives have attributed the individual to be responsible for the disconnect between current research and practice.¹³ Others assert that it is the organizational structural forces that influence worker behaviours rather than individual personality traits or socialization processes.^{14,15} In this study, the researcher used organizational and feminist theory to guide the exploration of clinical decision making capacity of dental hygienists. Through this theoretical approach, an examination of the full contextual environment of dental hygienists contributed to a better understanding of their clinical decision making and associated behaviour in two ways:

1. describing the structure and position in the organizational and general environments of the dental hygienist, and
2. discussing the multiple interests and relationships

of workers within the dental practice organization and how these shaped issues of power, control and conflict surrounding the achievement of goals.^{15–18}

This two phased, sequential mixed methods research study was conducted utilizing Creswell’s mixed methods framework¹⁹ for collecting and integrating qualitative and quantitative data (Figure 2). Phase I included a series of focus group interviews and Phase II involved an electronic survey questionnaire and key informant interviews. Focus groups provide in depth data well suited for exploring poorly understood topics and elucidate a range of experiences, and they have been used extensively for developing survey instruments.²⁰

METHODS

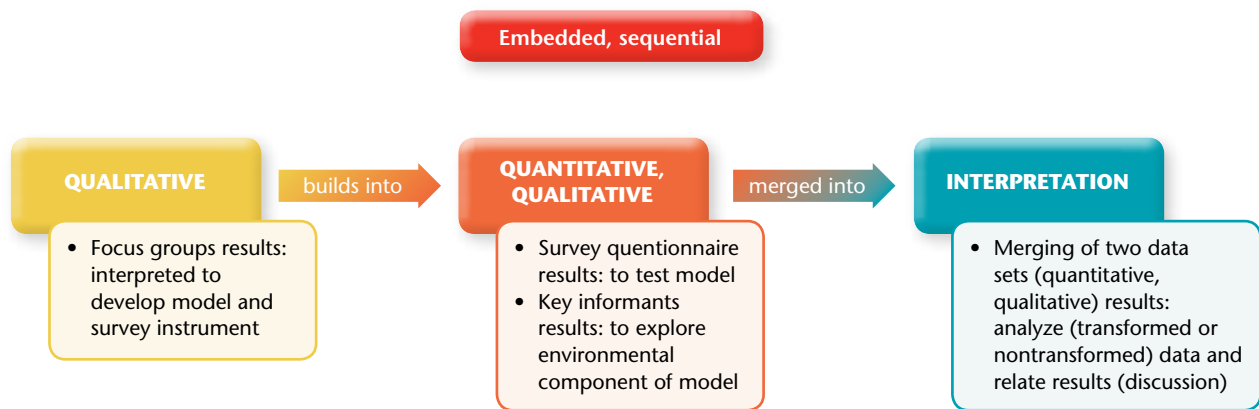
Data collection

Subsequent to receiving ethical approval from the University of Manitoba Health Research Ethics Board (HREB), study participants were randomly selected from a publicly available list of all 584 registered Manitoban dental hygienists and contacted by telephone to participate in the study. Participants were not well known to the researcher and were not aware of the research project prior to participating. A brief description of the study was provided and those interested in participating were given letters of information and informed consent that were obtained from participants at the interview. A minimum of three focus groups ideally with six to eight participants are typically needed to achieve saturation of themes, but this is not known *a priori*.²⁰

The interview guide was developed specifically for the study and provided areas of inquiry that emerged from the literature primarily in organizational and feminist theory. Specifically, topics were designed to examine the organization’s horizontal and vertical differentiation and levels of centralization and formalization, and how these factors specifically influenced dental hygiene decision making capacity. Organizational relationships, negotiating multiple interests and the gendering of practice were added as topics for discussion.

Prior to the first focus group, the researcher conducted a pilot interview with a convenience sample to test questions, develop moderating skills, check logistics and get general feedback from participants; and consequently, appropriate modifications were made. Subsequent to the pilot group,

Figure 2. Mixed methods design.



focus groups were arranged so that they comprised participants having homogeneous levels of experience, so experience related views would surface within groups and provide comparative data across groups.²⁰ Interviews were scheduled for approximately 90 minutes, allowing adequate time for participants to share views and capture a range of opinions. Interviews took place at the University of Manitoba, and the principal investigator acted as the sole moderator. Interviews were audiotaped and professionally transcribed. Field notes were taken as needed. Transcriptions were returned as electronic word documents. The use of NVivo™ qualitative research software (version 8), compatible for all of the following analytic steps—coding, thematic analysis, memos and displays—was used as a data management tool for this study.

Analysis—coding data

Qualitative analysis of the narrative focus group data began by reading each individual interview transcription through in its entirety. Transcriptions were then re-read with the intent to begin coding. Codes are labels classifying a group of words or phrases and act as organizing devices.²¹ Text with similar meaning and that fit together were, as customary, given the same code. Text that had no relevance to the research was left uncoded. As recommended, codes were defined and given clear operational definitions for consistent application.²¹ It was planned that data would be coded as the interviews were conducted. To expedite the research process, professional transcription was used.

For this study, codes were allowed to emerge both inductively and deductively, meaning they were both unanticipated and derived from previous research respectively.^{21,22} The researcher attempted to achieve this duality by having an open mind and by maintaining objectivity while simultaneously approaching the data with a set of “sensitizing concepts” that provided a sense of reference to masses of raw data.²³ For this study, sensitizing concepts were theoretically focused on the gendered organizational influences on dental hygiene decision making capacity.

Concern surrounding understanding how one’s values and biases influence the research needed to be addressed and mitigated.²⁴ Triangulation is a key technique used in mixed methods research projects and refers using multiple and differing combinations of data sources, methods, analyses, and investigators or research paradigms or both.²⁵ It is a technique used in mixing of methods and as a research tool dependent on the overall research objectives;²⁵ it can improve the overall rigour and quality of the work.

Focus group analysis: Developing themes

After coding, the next analytic step was thematic analysis—an iterative and reflexive process—where themes that emerged from the coding were advanced.²² Themes are like “meta codes,” in that they are more inferential than codes and pull data together into more overarching groups.²¹ As a guide, it was suggested that three to ten themes were expected to emerge.²¹ For this study, major themes were used in the qualitative model, potentially to serve as “variables” in the second phase of the study.

Focus group analysis: Displays

As recommended in qualitative research,²¹ a causal network was constructed as a precursor for the development of the qualitative decision making model. A causal network is a display or model providing a visual representation of the most important themes, which are independent and dependent variables, and the relationships between them.²¹ In this study, it facilitated the development of the second phase of the research.

Focus group analysis: Memos

During the entire analytic process, the researcher recorded “memos”—notes to ensure that subjective experiences were not lost over time from when the field work was done to when the interpreting and reporting had taken place. These uncensored thoughts occurred spontaneously in response to the research at any point in the process and were used in thinking about the data in Phase I and II of the study and in the final interpretation.²¹

Table 1. Themes and theme descriptions.

Theme	Theme description
Individual factors	Features or traits of dental hygienists as individuals that contribute to decision making capacity in a positive or negative way.
Organizational attributes	Microlevel features of the organization that contribute in a positive way to the capacity of decision making of dental hygienists.
Organizational limitations	Those features of the organization that limit decision making capacity of dental hygienists.
Distillery of practice	Those attributes of the practice that could be facilitative of dental hygiene decision making capacity but alternately could further stifle capacity depending on the unique dynamics of the practice.
Incorporating new knowledge	This surrounds the qualities of knowledge, who and how knowledge is brought into the practice and how it is used.
Characteristics of decisions	The actual qualities of the decision that is being considered and how that affects the decision making process.
Miscellaneous	Others not fitting well elsewhere.

RESULTS

Three dental hygiene focus group interviews were conducted in 2010 on March 29, April 6 and April 12 with eight, six and six participants present in each group respectively. The first group comprised recent graduates having approximately one year of work experience, the second group had more than one year to approximately five years of experience and the third group had the most experience having worked in the field for more than eight years.

While the intent was to analyze the data from one focus group prior to conducting subsequent interviews, this was not possible due to a delay in receiving completed transcripts. Thus, analysis was conducted after the completion of all three interviews. By the end of the third interview, the researcher tentatively proposed that saturation had been reached negating the need for additional interviews.

More than 75 codes were initially identified from the three interviews falling within one, two or all three transcripts. Narrative material that was left uncoded was fairly minimal in that transcripts were dense with pertinent data. Six major themes emerged from the coded data plus a miscellaneous category housing data that did not readily fit elsewhere. The major themes identified were: individual factors, organizational attributes, organizational limitations, practice distillery, new knowledge incorporation and decision characteristics. All of the themes were given operational descriptions for ongoing referral (Table 1).

After the themes were developed, coded data within themes underwent further refinement—some codes were changed, amalgamated or deleted altogether. In addition,

the theme ‘practice distillery’ was assessed to determine if more specific themes could be teased out, but it became evident that the theme was an accurate reflection of the codes housed within it. Memos were developed as important ideas took the attention of the researcher through the data collection and analytic procedures.

Five main memos emerged: the relationship between dental hygienists’ time and production, failure to recognize the organizational hierarchy, dental hygienists’ lack of knowledge rights, silences surrounding the influences of sexuality on decision making and, finally, the differences between the groups in relation to experience levels.

The first memo was how time influences dental hygienists in a unique manner in that time must be accounted for through production of fees. Time is a finite resource that healthcare providers have repeatedly identified as a barrier to changing practice.^{26,27} It appeared from the focus groups that dental hygienists, depending on practice dynamics, may have had more or less control over their time and over the amount of time available which would have influenced their decision making capacity.

The second memo was the perception of study subjects regarding the organizational hierarchy. Most of the study subjects reported their practice setting had a flat organizational structure and did not perceive authoritarianism by the dentist/employer. However, the study subjects described an expectation that dental hygienists conform to a role as “one of the girls” and affiliate with the other allied or female support staff as opposed to the other providers (i.e. dentists or associates), despite dental hygienists being clinicians and “producers” themselves.

The third memo was dental hygienists were found to be not active in introducing new knowledge to the practice. Instead, it was primarily the dentist bringing in new ideas and knowledge to the practice through going to conferences, doing readings and suggesting changes. The dental hygienists appeared to be more passive and await new knowledge to be presented, and in turn be implemented.

Another memo was the “silence” surrounding the influence of sexuality on decision making capacity. Despite prompting from the researcher, study subjects were silent on the influences of gender and sexuality on dental hygiene decision making and practice. In qualitative research, investigators are cautioned to not disregard such silences particularly because it seemed unlikely, based on knowledge from feminist theory, that no such influence existed.^{28,29}

The final memo surrounded the differences between the focus groups in their level of content with their work environment and decision making capacity. Specifically, the least experienced group seemed enthusiastic and content to be doing the work they were trained to do, and they reportedly had little awareness of the organizational influences on their decision making capacity as demonstrated in the following excerpts:

We have a hygiene manager and she takes care of all the hygiene, coordinating and arranging our schedules,

...so she's kind of the liaison between us and...the dentists...she's kind of the go to person. DH Focus Group 1

...there was so many hygienists at my office that all had more experience than me, like my first year was all aboutasking them certain things about what they do in this situation, you know because you come up across stuff like that's not in your textbook...it was nice being able to talk to somebody who had more experience... DH Focus Group 1

My dentist graduated in the seventies...I think that he has a certain way of doing things, like he sort of does a recall exam and then dictates treatment, now you can write what you want him to take a look at on a post-it note but I think that he sort of knows what he knows in the sense he'd never be demeaning or ever be mean about it, but he sort of, like I don't feel like there's very much discussion... DH Focus Group 1

When I first started...they didn't really do a lot of perio referrals, so there were certain patients that I would have thought right away would benefit from a perio referral but they didn't... at the beginning I think I was seeing patients that, I would bring them back for you know four appointments and...I think that, that probably they were affected negatively because it probably wasn't a perfect job that they could have gotten in a perio office... DH Focus Group 1

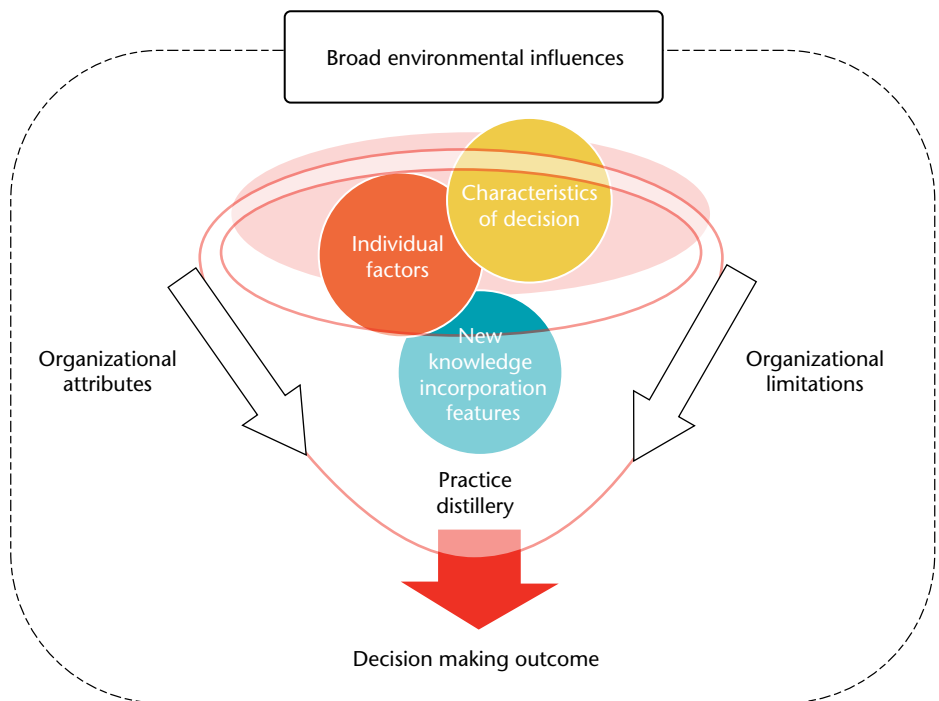
The middle level group seemed to be going through some challenges and discontent as they attempted to challenge the status quo and find their way in their practice. Participants in this group seemed acutely aware of organizational impositions placed upon them in their clinical decision making as demonstrated in the following examples:

I'd say the main contributing factor would be production and [the employer/dentist] as well has mentioned a few times if we are bringing people back for a three or four month recall just as a scaling not to book like fifty minutes or an hour, squeeze them into a half hour or forty minutes. DH Focus Group 2

If we really think a change needs to be made, it has to be like formally typed out, like what, why we want it to change, what the proposal, like what we want it to actually be and how it's going to work and then we just give it to the dentist and she usually just decides. DH Focus Group 2

Last time when we all needed new instruments and he [the employer/dentist] had just ordered in [piece

Figure 3. Hypothetical model of dental hygiene decision making.



of equipment], so budget is tight and he said no. DH Focus Group 2

I just want [dental product] at my office and it's just one of those things where it's like I've asked him, I've told him about it, like I just want it, it just makes more sense than like [alternate dental product], but I can only say it so many times and if he doesn't want to order it. DH Focus Group 2

A lot of the instruments that we use could probably use replacing but I know that [the employer/dentist] is kind of stingy with her money so we don't; we just sharpen them until they fall apart pretty much. So there probably is some need where we need to speak up more and ask for things or ask for things to change but we just don't for whatever reason, we feel like we won't be, won't be received well. DH Focus Group 2

The most experienced group, on the other hand, were apparently beyond these challenges and had seemingly found their way in that their decision making and practice more closely reflected their ideals. The following demonstrate a higher level of confidence and autonomy:

We each have our own responsibilities and everybody just does what they need to do. I actually feel like I have a lot of autonomy because I'm allowed to make decisions about what I do without having to go and consult somebody whose higher cause there isn't anyone above me, we're kind of all in the same place, so my employer really supports making my own decisions. DH Focus Group 3

When it comes to something dental hygiene related, the dental hygienists in my practice are kind of able to make those decisions on their own, and generally if we're discussing it with him it's more like this is what we would like to do or this is what we're planning to do, not is that okay with you or there's no permission involved. DH Focus Group 3

I think that you know the dentists they think you know like if the dental hygienist is making a decision then its, you know we have more training than they do in that field so they're quite ok with that because they don't have the training that we have, so they feel yes we'll listen to you for what you want for that client. DH Focus Group 3

With the codes, themes and memos established at this stage, the researcher developed the qualitative dental hygiene decision making model (Figure 3). The researcher applied all six of the emergent themes in the qualitative model in addition to another theme, "organizational structure". The latter was a key theoretical construct from the literature. It would not necessarily be expected that organizational structural elements would emerge from the participants as being influential to decision making, and yet, based on the theoretical background, the researcher believed it was an important component to be included and examined in the second phase of the study.

DISCUSSION

Phase I focus groups' data were analyzed to identify important influences on dental hygiene decision making capacity and these informed the qualitative decision making model, which subsequently served in structuring the survey instrument used in Phase II. In addition to thematic analysis, memos were also considered in the analytic process. It is important to be critical of the limitations of research, and these should be recognized when considering the findings. This study used self reported data in all phases, and the limitations of its use have been well described in the literature.^{30,31} However, focus groups by nature utilize self reported data and this is considered to be a strength of qualitative research. Social desirability bias can be of concern in focus groups,³² as individuals can feel pressured to respond in a publicly desirable manner. However, apprehensions about using self reported data primarily surround issues of reliability about absolute figures,³¹ which was not an issue in Phase I of the study.

When considering the Phase I findings, it was interesting to the researcher that the middle level experience focus group demonstrated the most critical view to decision making capacity and practice. While their view was similar to the pilot group who were also critical of practice, the pilot group were educators and individuals from organized dental hygiene professional groups who likely possessed a broader view of dental hygiene practice. The most experienced focus group was relatively uncritical of their practice experiences regarding decision making.

The focus group data suggested that dental hygienists

were becoming more autonomous in decision making capacity as they became more experienced; the researcher hypothesized about this transformation. Several potential scenarios were thought possible. First, dental hygienists could be staying in the same constraining environments but "learning to become" more autonomous as part of a maturation and confidence building process. Alternatively, dental hygienists could be moving to new practice settings that were more accommodating to their needs for autonomy and decision making freedom. A third possibility was that autonomy was reflective of selection bias, a possibility not easily accepted in that it did not appear in the other focus groups. Another hypothesis was that perhaps being more experienced prevented dental hygienists in this group from being critical of their practice environments and their lack of autonomy given that they had reached what was analogous to "adulthood" relative to their "adolescent" and "childhood" counterparts. The study participants in this most experienced group could be exhibiting a social desirability bias and reporting based on perceived social pressure to have achieved a certain level of autonomy in their decision making.³²

It was also interesting to the researcher that all of the focus groups generally described having fairly flat organizational structures and did not recognize a hierarchy to their practice. Whereas, from the focus group data, it appeared to the researcher that the dentist controlled and subjugated the dental hygienists, minimizing their autonomy and decision making capacity. Further, the silences surrounding the gendering of the workplace were found somewhat surprising. The researcher hypothesized that gendering may be "built in" to practice operating on a macro social level which would be further investigated in the second phase of the study.

As reported, six major themes emerged through the thematic analysis. In spite of the organizational theoretical underpinning of the study, one of the major influences on clinical decision making capacity that emerged was the influence of the individual—personality characteristics were influential to one's decision making capacity. The remaining five themes were more aligned with the hypothesis in that they surrounded organizational influences. Thus, organizational structure and individual agency were advanced for further investigation in Phase II, and included in the model.

The decision making model was developed to demonstrate dental hygiene decision making is a non linear process, in alignment with recent knowledge translation literature describing the process.³³ Informed by the memos and applying all of the major themes, the model intends to illustrate that *specific characteristics of a decision*—the perceived importance or impact—provide the "push" for the entire decision making process. The translation of a decision being applied to practice was hypothesized to be mediated by *individual clinician factors* and how *knowledge is incorporated into practice*. Together these factors were posited as being influenced by varying levels of both the *organization's attributes*, described as being facilitative to decision making, and the *organization's limitations*, which are inhibitory. The *distillery of practice* was believed to be

those other organizational factors that are unique to the practice and that can be either enhancing or stifling to one's decision making capacity.

There was an assumption that the entire decision making process is influenced by broad environmental and social conditions, and this element was included in the model. This reflected the macro level features influencing dental hygiene decision making capacity, which was proposed to include gendering. In Phase II, the survey questionnaire was implemented with a larger cohort of practitioners to test the influence of each of these themes on dental hygiene decision making capacity; the broad environmental influences were examined through the key informant interviews. Phase II will be reported in a subsequent publication.

CONCLUSIONS

The researcher hypothesized that organizational and gender factors were key influences on dental hygiene decision making capacity. While this was demonstrated in Phase I of the study, individual factors also emerged as being an important influence. Thus, both organizational and individual themes were included in the qualitative dental hygiene decision making model. As well, more broad environmental features were believed to be influential on the overall practice dynamic and dental hygiene decision making capacity. While it was not surprising that these social features did not emerge in the focus groups from grassroots dental hygienists, they had to be considered, and were therefore included in the model to be examined in Phase II of the study.

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Caries, iron deficiency and food security in low income, minority children

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ABSTRACT

Objective: Early childhood caries (ECC) and iron deficiency (ID) are conditions of early childhood that affect an alarming number of Canadian children. This study was part of a larger investigation of dietary patterns and micronutrient status in young children of low income families in Vancouver, Canada. Our part of the study investigated risk factors for caries in these children to determine which factors were also associated with iron deficiency. **Methods:** Parents and children were recruited at community locations in Vancouver. Data collection—a two stage process—included sociodemographic, dietary and oral health questionnaires; a dental assessment; and hematological, biochemical and anthropometric measurements. **Results:** Of the 96 children who completed the study, 64.6% had dental caries and 25.0% were iron deficient. For 38.5% of the children, weight for age, height for age, and weight for stature were above the 75th percentile. Multivariate analysis demonstrated a significant relationship between dental caries and age and food security ($p < 0.005$). Caries was significantly more prevalent in older children but ID was found primarily in the younger children. From the bivariate analysis of data for children under 36 months, ID was related to daily consumption of more than 3 cups of milk, ($p < 0.05$). **Conclusion:** No risk indicators common to both ECC and ID were identified in this group of multi ethnic, inner city Vancouver children of low income families. Daily milk consumption was associated with ID in younger children. Food security, an issue related to poverty, demonstrated an association with caries in older children that warrants further study.

RÉSUMÉ

Objet : Les caries précoces de l'enfant (CPE) et la carence en fer (CF) sont des problèmes de petite enfance, qui affectent une quantité alarmante d'enfants canadiens. Cette étude faisait partie d'une recherche plus étendue des modes alimentaires et de la nature des oligoéléments chez les jeunes enfants de familles à faible revenu de Vancouver (Canada). Notre partie de l'étude a porté sur les facteurs de carie chez ces enfants afin de déterminer les facteurs qui étaient aussi associés à la carence en fer. **Méthodes :** Parents et enfants ont été sélectionnés dans diverses communautés de Vancouver. La collecte des données, procédure à deux étapes, comprenait des questionnaires sociodémographiques, diététiques et de santé buccodentaire; ainsi qu'une évaluation dentaire et des mesures hématologiques, biochimiques et anthropométriques. **Résultats :** Parmi les 96 enfants qui ont complété l'étude, 64,6 % avaient des caries dentaires et 25,0 %, une carence en fer (CF). Chez 38,5 % des enfants, le poids par rapport à l'âge, la grandeur par rapport à l'âge et le poids par rapport à la taille dépassaient le 75^e percentile. Une analyse à variables multiples a démontré une importante relation entre les caries dentaires, l'âge et la sécurité alimentaire ($p < 0,005$). Les caries prévalaient davantage chez les enfants plus âgés, mais la CF se trouvait principalement chez les plus jeunes. Selon l'analyse à double variables pour les enfants de moins de 36 mois, la CF était reliée à la consommation quotidienne de plus de 3 tasses de lait, ($p < 0,05$). **Conclusion :** Aucun indicateur de risque de CPE ni de CF n'a été identifié dans ce groupe multiethnique d'enfants de familles à faible revenu des milieux défavorisés de Vancouver. Le problème de sécurité alimentaire, lié à la pauvreté, a démontré une association entre les caries des enfants plus âgés, ce qui justifie d'autres études.

Key words: children; dental caries, iron deficiency, poverty; minority health, nutrition assessment

INTRODUCTION

Early childhood caries (ECC) and iron deficiency (ID) are conditions of early childhood that affect many children worldwide, including an alarming number of children in industrialized countries like Canada.¹⁻⁴ In British Columbia, Canada about seventeen per cent of children aged 4–6 years are reported to have visible, untreated dental caries.⁵ For many of these children, this dental decay may have profound effects on their daily lives.⁶

Overall in Canada, nearly five per cent of non aboriginal⁷ preschoolers and 14 to 24 percent of First

Nations and Inuit infants and children experience iron deficiency anemia (IDA).^{3,4} ID during the brain growth and development that occurs in childhood can have long term consequences⁸ despite restitution of an adequate diet in future.⁹ Not unexpectedly, both of these common childhood conditions are most prevalent in young children from lower socioeconomic backgrounds.¹⁰⁻¹²

Families with lower income often report concerns regarding "food security" or the adequacy and availability of healthy foods.¹³⁻¹⁵ Moreover, living in poverty leads to

THIS IS A PEER REVIEWED ARTICLE. Submitted 14 Oct. 2011. Revised 30 Jan. 2012. Accepted 9 Feb. 2012.
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unhealthy dietary and feeding practices such as frequent consumption of economical, but calorie dense and nutrient poor, foods.¹⁶ These types of foods customarily have high sugar content.¹⁷ Such child feeding practices are linked to both ECC and ID. Furthermore, recent evidence suggests that excessive beverage consumption, especially cow's milk, may increase a child's risk to both conditions.¹⁸

Improving the overall health of children living in poverty are concerns of all Canadian health professionals who work with families at risk. A better understanding of the factors that influence the development of both ECC and ID will serve to enhance our current preventive and health promotion interventions. This study was part of a larger investigation of dietary patterns and micronutrient status in young children of low income families in Vancouver, Canada. An invitation to investigate dental health as part of the research was a unique opportunity. The purpose of our cross sectional study was to investigate risk to caries in young children and to determine those risk indicators also associated with iron deficiency.

METHODS

Ethics approval for the study was received from the University of British Columbia's Clinical Research Ethics Board.

The first stage of this study involved the collection of sociodemographic data and information relating to feeding behaviours and diet. Parents of young, healthy children, 18–72 months of age, were approached at dental public health programs, food depots and publicly funded daycare centres and speech therapy programs in Vancouver, Canada. Each parent who volunteered to participate completed a screening questionnaire (SQ) that included information about their child's dietary habits, food preferences, dental care behaviours and sociodemographics. Information was also collected on whether or not the child consumed meat, fish and poultry, cow's milk, fluids other than milk, the number of snacks and meals per day, and parental concerns regarding feeding behaviours. The parent and child were then invited to attend a follow up appointment at a later date.

Follow up or Stage 2 took place at a public health clinic where data were collected at four "stations":

1. Roger Ruler: Measurement of child's height and weight by a calibrated project staff member.
2. Amazing Apple: A pre tested,¹⁹ validated food frequency questionnaire (FFQ)—administered by trained nutritionists—recorded types and amounts of foods.
3. Mister Molar: Dental healthcare questionnaire completed by parent; dental assessment conducted by one calibrated dentist examiner with the children in the dental chair or knee to knee position using a dental light. A modification of the "iceberg" model was utilized to determine the extent and severity of the caries present.²⁰ No radiographs were exposed. Plaque was also assessed and categorized as "light" and "heavy" according to the amount present on teeth—51 buccal, 54 buccal and 84 lingual.
4. Brave Bee: Venous blood drawn by a phlebotomist

for hematological and biochemical measures of iron status.

The Statistical Package for the Social Sciences (SPSS), version 11.5, was used for analyses. Frequency tables were generated and variables (e.g., children's age and total number of decayed, missing [due to decay], and filled tooth surfaces or DMFS) were plotted to assess their distribution. Because of the "non normal" distribution of the dependent variables, caries and iron status, non parametric tests—Chi-square and Fisher's Exact Tests—were used for bivariate analyses. Logistic regression was applied, as appropriate, for multivariate analyses. Statistical significance was established at $p=0.05$.

Measurements of the height- and weight for age, as well as the weight for stature were used to calculate Z-scores—the standard deviation above or below the mean, based on age and gender—according to the Centers for Disease Control and Prevention (CDC) Growth Charts.¹⁰ This method allows anthropometric results for children of different ages and genders to be combined and compared to reference charts. Total energy intake and the intake of cow's milk and other beverages were estimated from the food records using the ESHA Food Processor Program.¹⁹ Each child's DFMS was calculated.

Blood samples were analyzed for hemoglobin, serum ferritin as a marker of iron stores, and zinc protoporphyrin as a measure of iron deficient erythropoiesis.¹¹ The children were categorized in four classifications of iron status according to their hematological and biochemical results as:

- i. normal = serum ferritin ≥ 12 $\mu\text{g/L}$ plus hemoglobin >110 g/L;
- ii. iron deplete = serum ferritin <12 $\mu\text{g/L}$ plus hemoglobin >110 g/L;
- iii. iron deficient erythropoiesis (IDE) = ID plus zinc protoporphyrin >70 $\mu\text{mol/mol}$; and
- iv. iron deficient anemic (IDA) = IDE plus hemoglobin <110 g/L.

For statistical analyses, the categories of iron status were further collapsed to "normal" and "deficient" (iron deplete, IDE and IDA) due to the low number of children within each category.

RESULTS

Of the 191 children whose parents completed Stage 1 of the study, 99 proceeded to Stage 2 and attended all four "stations". The results are presented in "valid per cents" and are based only on data with a subject response. Hence the calculations vary among the stations and questionnaires and reflect a response rate between 89 to 98 subjects. The characteristics of the 99 children and their parents are in Table 1.

Anthropometrics: The percentage of children in the study who were above the 75th percentile of the CDC Growth Charts^{19,21,22} for weight for age was 43.5 per cent (40/92); height for age was 33 per cent (30/91); and weight for stature was 38.2 per cent (34/89), while 19.6 per cent (18/92), 19.8 per cent (18/91), and 18 per cent (16/89) children scored below the 25th percentile for the same anthropometric measures, respectively. For 38.5 per cent

Table 1. Demographics of study sample.

Age (months)		
Range	20 – 71	
Mean (SD)	43.4 ± 14.7	
	Number	Valid %
< 36 months	35	35.4
≥ 36 months	64	64.6
Gender		
Male	62	62.6
Female	37	37.4
Ethnicity		
Caucasian	22	23.9
Asian ^a	30	32.6
Multi ethnic/Other	40	43.5
Post-secondary education		
Mother		
Yes	63	67.0
No	31	33.0
Father		
Yes	51	63.8
No	29	36.3
Total family income		
< \$20,000	47	50.5
≥ \$20,000	46	49.5
Data is based on the screening questionnaire.		
^a Includes population groups as defined by Statistics Canada ⁴⁰ (Chinese, Filipino, Southeast Asian, Korean, Japanese).		

(35/91) of the children, all three Z-scores, weight for age, height for age, and weight for stature, were above the 75th percentile.

Caries status: The DMFS, mean (SD), was 7.2 (11.3), range 0–45. About one-third or 35.4 per cent (34/96) of children were caries free (DMFS=0). Another one-third or 32.3 per cent (31/96) had a moderate caries score, (DMFS >0 and ≤5). A further one-third or 32.3 per cent (31/96) with DMFS >5 were categorized as having a high caries score. For the analyses, caries free and moderate caries children (DMFS ≤5) were combined into a “low caries” group (65/96 or 67.7%) and the remaining 31 (31/96 or 32.3%) children with DMFS >5 were designated the “high caries” group (Table 2). Bivariate analysis demonstrated significant relationships between caries severity (“high” versus “low”) and age, gender, family income and “food security” concerns (Table 2). Multivariate analyses further explored the relationship between various explanatory variables on caries severity. Only two variables—age and food security—remained in the final model (Table 3).

Table 2. Selected variables and caries status for all children (n=96)^a

	Caries status		
	DMFS≤5 (n=65)	DMFS>5 (n=31)	p-value
Demographic variables			
Child's age (months)			
Mean (SD)	38.5 (14.7)	54.4 (10.2)	<0.001 ^b
Gender			
Male	37 (56.9%)	24 (77.4%)	0.009
Female	28 (43.1%)	7 (22.6%)	
Family income			
< \$20,000	28 (45.2%)	18 (64.3%)	0.05
≥ \$20,000	34 (54.8%)	10 (35.7%)	
Food security			
Concern	25 (39.1%)	18 (60.0%)	0.03
Not a concern	39 (60.9%)	12 (40.0%)	
Dental variables			
Daily toothbrushing by parent			
Yes	44 (72.1%)	15 (51.7%)	0.06
No	17 (27.9%)	14 (48.3%)	
Child's dental visits			
At least once a year	27 (43.5%)	23 (76.7%)	0.003
When something hurts/not yet	35 (56.5%)	7 (23.3%)	
^a Of the 99 children in Stage 2 of the study, dental exams were completed on 96 children.			
^b P-value determined by t-test (all other p-values determined by Chi-square or Fisher's test).			

Table 3. Logistic regression for variables associated with caries.

	Standard error	Wald statistic	p-value
Age	0.026	14.268	0.000
Food security	0.660	7.945	0.005

Iron store status: Iron status was normal in 75 per cent (72/96) of children, and 25 per cent (24/96) of children were iron deficient. Among the children with ID, 58.3 per cent (n=14) were iron deplete, 25.0 per cent (n=6) had iron deficiency erythropoiesis (IDE), and 17 per cent (n=4) had iron deficiency anemia (IDA). Children under 36 months had a significantly higher prevalence of ID compared to children over 36 months (p<0.05); 38.2 per cent (13/34) of young children compared with 17.7 per cent (11/62) of the older children had ID. For the entire group of children,

no associations of significance were found between iron status and any of our explanatory variables. However, for the subgroup of children under 36 months, total daily milk consumption was related to iron status, $p=0.03$. Young iron deficient children were more likely to consume 3 or more cups of milk per day than their peers with normal iron status.

Eating patterns: Most parents (62.0% or 59/95) reported in the screening questionnaire that they had concerns about their child's eating. The most frequent concerns were that the child was a "picky eater" ($n=33$) and "won't try new foods" ($n=27$). The issue of finances affecting the quality or variety of foods that the family eats or "food security" was a concern for 44.4 per cent (44/98) of the families.

According to the SQ data, children consumed an average of 3.1 ± 1.3 cups of milk daily, indeed 65 per cent (61/94) of children drank three or more cups of milk daily. The average daily consumption of juice was 2.8 ± 1.4 cups and 50 per cent (47/94) of children drank three or more cups daily.

DISCUSSION

About three-quarters of the volunteer participants in this study were from ethnic minority families who resided in an inner city area of Vancouver. Despite their low socioeconomic status (SES), more than half of the parents had received post secondary education—a finding not uncommon in new immigrant communities.²³ In spite of their education, more than 50 per cent of the parents reported an annual family income of less than \$20,000, and thus were below the 2000 Statistics Canada after tax low income cut offs (LICO) of \$23,415 for a family of three.²⁴ The proportion of low SES Vancouver families in our sample was much higher than the 20.9 per cent living below the LICO reported in the 2006 Canada Census.²⁴ This alarming proportion of low income families probably reflects the inner city location of our study as well as the opportunity provided by the study for parents to obtain a free dental exam plus screening for iron deficiency for their child all in one appointment.

The percentage of children in our sample who were above the 75th percentile of weight for height is higher than the 16 per cent previously reported in a somewhat similar, but hospital based, sample of children with ECC in Toronto.²⁶ The differences may reflect the fact that the Toronto study included children who were scheduled for general anesthetic, and had not yet had their extensive caries treated. Our study, however, included children dwelling in the community who in most cases had already received dental treatment. Further, the lower percentage of overweight children reported by Clark²⁶ may be related to the chronic pain associated with extensive caries and its affect on the children's ability to eat. Indeed, our observed proportions of weight for height were similar to other Canadian reports.²⁶

Regardless of low family income, the problem of being overweight was common among this sample of primarily non Caucasian, young children. This situation may be the result of the regular consumption of affordable, but

high sugar, calorie dense foods.²⁶ The juice consumed by the study children was likely fruit "beverages" or "drinks" rather than the more expensive "100% fruit juice". These sugary beverages added further calories but offered minimal nutritional value. Further investigation into the children's daily activity level may provide insight into the relationship between their physical activity and excess body weight.²⁸ Based on the Food Frequency Questionnaires (FFQ), the estimated average intake of energy was a staggering 2200 kcal/day, almost twice the recommended 1000–1400 kcal intake for children 2–5 years of age.²⁹ While such high caloric intakes may help explain the observed proportion of overweight children, a recognized limitation of FFQs is their tendency to overestimate actual food intake.³⁰ Because beverage consumption estimated from the FFQs was higher than that reported in the screening questionnaire (SQ), our analysis used the more conservative parental estimates of beverage intake from the SQ.

The categories for caries severity, low and high, used in our analysis were based on the observed distribution of DMFS in the study. These categories were similar to—but slightly more conservative than—the categories of early childhood caries (ECC) and severe early childhood caries (S-ECC) defined by the American Academy of Pediatric Dentistry (AAPD).³¹ Applying the AAPD definition to our study sample, 62 (64.6%) children had ECC and 47 (47.5%) had S-ECC. These prevalences are much higher than those reported in recent kindergarten surveys of the province of British Columbia.⁵ However, given the low SES of our children, the increased prevalence of S-ECC was an unfavourable, but not surprising, finding.³² Further, children in the study obtained on average 27 per cent of their total daily caloric intake from sugar, thereby exceeding the American Heart Association's³³ current recommendation of 12.8–15 per cent. This elevated and likely frequent intake of sugary foods would have contributed to an increased prevalence of ECC.

Our finding that about a quarter of the children were iron deplete was similar to the 28 per cent reported in the Toronto study.²⁶ We had theorized that excessive milk consumption might be a common risk factor for both ID and ECC; however, no such association was observed between caries severity and amount of milk consumed. Consumption of more than three cups of cow's milk daily was associated with a greater prevalence of ID in children less than three years of age. Cow's milk contains very low amounts of iron, and, unlike the iron in human milk, has low bio availability.³⁴ Younger children require a higher ratio of dietary iron from the foods they consume compared to older children but tend to consume lesser amounts of food. Further an excessive consumption of milk may displace nutrients from more iron rich foods.

Eating patterns and related behaviours are a common concern of most parents of young children. Similar to studies of other groups of children, about one in five of our financially challenged parents reported that their child "was a picky eater".³⁵ Such a concern has previously been reported to be more common in higher income parents because children in better off households would

have access to a great variety of foods, and thus become more “fussy” eaters.³⁶

The tendency to be overweight exhibited by a large proportion of children in the study was likely linked to parental beliefs about children and eating. Low income ethnic minority parents are known to have a tendency to “encourage” their children to eat.³⁶ Such behaviour is related to cultural beliefs that the provision of excess food is a demonstration of love, and that excess weight equates to health.³⁷ According to their parents, children in our sample consumed large quantities of juice and milk. High beverage consumption, especially juice, may have decreased their appetite during mealtime, thereby contributing to the reported “picky eating”.

We also explored the relationship of “food security” to caries and ID. Food security refers to a parent’s feeling that financial concerns affect the quality or variety of foods that the family eats. Other investigators have shown an inverse relation between food security and normal child health and development.³⁸ As demonstrated by our bivariate and multivariate analyses, severity of caries in these children was positively correlated to parental concerns about food security. Issues of food security have also been positively correlated to reports of poor oral health and disease, and are a barrier in accessing dental care due to financial constraints.¹⁵ Food choices are affected, and high calorie, nutrient poor food is purchased to save money. Families with limited funds to buy better quality foods also have limited finances to purchase toothbrushes and toothpaste.³⁹ Unlike caries, no relationship between food security and ID was observed in the children in this study. Food security and its relationship to dental health and other childhood disorders warrant more detailed study.

Limitations

By nature, cross sectional studies are limited in their ability to demonstrate associations between risk indicators and health problems like caries and ID that develop at different stages in a child’s life. Furthermore, ethical concerns prohibit longitudinal studies that do not intervene with children identified as “at risk”. This pilot project’s modest sample composed of volunteer parents, the limited number of children diagnosed with iron deficiency and the broad age range of the children (20–71 months) also complicated the search for common risk factors. Caries was significantly more prevalent in older children while ID was found primarily in the younger children. While exploratory, this study suggests many research questions worthy of investigation in follow up projects.

A further limitation was that although the FFQ provided information on the types, amounts and frequency of foods consumed, the FFQ did not provide information on snacking behaviours or whether beverages were consumed with or separate from meals. Daily diaries, either prospective or by recall, may be more useful in future studies to investigate relationships between the dietary patterns associated with ECC and ID.

CONCLUSIONS

This study explored potential shared risk factors between dental caries and iron deficiency in a group of multi ethnic inner city children of low income families. No risk indicators common to both disorders were identified. Most children had a high intake of beverages other than water. Daily milk consumption was associated with iron deficiency in younger children. Food security, an issue related to poverty, demonstrated an association with caries that warrants further study.

Acknowledgements

The authors acknowledge the Vancouver Coastal Health Authority for their support of personnel and facilities at the North Community Health Unit. Dr. Pamela Glassby’s contribution to the clinical phase of the research is recognized with appreciation.

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Impact of an oral hygiene education initiative on the practice of oral care by unregulated care providers guided by registered nurses

Joyce A. Bruan-Wimmer, DipDH; Patricia Ruiz-Skol, MN, GNC(C)

ABSTRACT

Observation: Research has demonstrated that oral care provided by nursing staff is often “inadequate or non-existent”, and points to the need for training in specific oral care strategies. This study explored the impact of an oral hygiene education program for unregulated care providers, and examined the nurses’ perception of their role in directing the oral care practices of the unregulated care providers. **Methods:** An intervention study was performed by a dental hygienist and a nurse educator on the neuromuscular unit of the hospital. It was implemented by using pre- and post questionnaires, education sessions and evaluations. An oral care audit was completed by the Toronto Public Health Dental Unit. **Discussion:** It was determined that nurses had a strong belief in looking after their own oral health and that of their patients, yet some nurses were unsure of their accountability. Some of the unregulated care providers demonstrated that they were not comfortable with providing certain aspects of mouth care and providing mouth care to patients who had behavioural issues. Role clarification in oral care practice for both groups was addressed during the sessions. They felt that the knowledge learned gave them confidence. **Conclusion:** The study demonstrated that there was a change in the approach to oral care practices of the nurses and the unregulated care providers. They worked as a team to provide proper mouth care to their compromised patients.

RÉSUMÉ

Introduction : La recherche a démontré que des interventions dentaires agressives réduisaient l’occurrence de la maladie et, en conséquence, de la morbidité dans les services de soins. Néanmoins, la littérature démontre que la prestation des soins buccodentaires par le personnel soignant est souvent « inadéquate ou inexistante », et pointe le besoin de formation dans des stratégies spécifiques de soins buccodentaires. Cette étude a porté sur l’impact d’un programme de formation en hygiène buccodentaire pour les dispensatrices de soins et examiné la perception qu’ont les infirmières de leur rôle de direction des pratiques non réglementées chez les dispensatrices de soins buccodentaires. **Méthodes :** Une étude d’intervention a été effectuée par une hygiéniste dentaire et une infirmière monitrice dans l’unité neuromusculaire de l’hôpital. Elle comprenait des questionnaires avant et après l’intervention, des séances de formation et des évaluations. Une vérification des soins buccodentaires a été menée par l’Unité de santé buccodentaire publique de Toronto. **Discussion :** L’on a établi que les infirmières croyaient fermement aux soins qu’elles prenaient de leur propre santé buccodentaire et celle de leurs patients, mais certaines d’entre elles n’étaient pas assurées de leur responsabilité. Certaines dispensatrices de soins non réglementées ont démontré qu’elles n’étaient pas à l’aise de dispenser certains aspects des soins de la bouche et d’administrer ces soins à des patients qui avaient des problèmes de comportement. Les sessions ont porté sur la classification des rôles des infirmières et des dispensatrices non réglementées dans la pratique des soins buccodentaires. Celles-ci estiment que l’apprentissage des connaissances pertinentes leur donnait confiance. **Conclusion :** L’étude a démontré un changement dans la façon des infirmières d’aborder les soins buccodentaires et la prestation de soins non réglementée. Celles-ci travaillaient en équipe pour procurer des soins buccodentaires appropriés à leurs patients compromis.

Key words: oral care, oral hygiene education, nursing personnel, unregulated care providers

INTRODUCTION

Oral care in long term care settings is often neglected. Researchers have demonstrated that good oral care can yield important health benefits to improve long term care quality of life.¹ Yet, studies have shown that oral care is poorly provided.^{2,3}

The literature shows that unregulated care providers, who receive little formal training in mouth care, deliver most of the daily oral care in long term care facilities.⁴⁻⁶ Therefore, it has been suggested that training and having continued oral health education interventions may be effective means of promoting improved oral care in long

term care facilities.⁷ Dr. J.A. Gil-Montoya⁸ pointed out, “Establishing an oral hygiene protocol for the frail and functionally dependent elderly should be of special concern to health care providers...this type of protocol should include regular collaboration with dental professionals and provide a program of continuous training for nursing staff on oral health issues.” The specific purpose of this project was to determine whether an education program for unregulated care providers, under the guidance of the registered nurses, was effective in leading to improved oral health and knowledge base of oral care for the participants.

THIS IS A PEER REVIEWED ARTICLE. Submitted 30 May 2012. Last revised 17 Sept. 2012. Accepted 19 Sept. 2012.

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A variety of factors, such as fiscal restraints, technological advances, and shorter hospital stays, have increased the use of unregulated care providers.⁹ Consequently, the role of the registered nurse has expanded to include teaching, delegating, assigning and supervising unregulated health care providers.⁹ Registered nurses are accountable for their actions within these domains of nursing practice when utilizing unregulated health care providers. While the College of Nurses of Ontario specifies practice guidelines for registered nurses to work with unregulated care providers, the beliefs and perceptions of staff nurses—related to the impact of directing care routines such as oral care for patients—need further examination.

METHODS

The project, led by a dental hygienist and a nurse educator, had the following research questions:

1. What is the impact of an oral hygiene education initiative on the practice of oral care by unregulated care providers (known as personal service providers at Bridgepoint Hospital)?
2. What is the perception of the registered nurses regarding their role in directing this practice by unregulated care providers?

An intervention study was performed to evaluate the effect of the education in terms of changes in practice. The study was conducted at Bridgepoint Hospital, which provides complex care and rehabilitation to individuals living with chronic disease and disability. The hospital's neuromuscular unit (post stroke, multiple sclerosis, amyotrophic lateral sclerosis [Lou Gherig's disease], Huntington's disease, Dandy Walker syndrome) was chosen because of the health complexity of the patients whose duration of stay in the hospital had been more than five years and whose need of assistance from the staff was higher. The staff's shifts of work and number of staff in each shift differed:

- the day shift had four registered nurses and nine unregulated care providers;
- the evening shift had four registered nurses and four unregulated care providers, and
- the night shift had two registered nurses and two unregulated care providers.

The unit was divided into four modules. Each module had twelve patients. During the study, there were approximately forty-five to forty-eight patients. The number fluctuated when patients were discharged to an acute care hospital or when they were on a visit/stay with family and/or friends for a day or weekend. An oral hygiene education initiative was implemented using the following:

- *Pre questionnaires* — These questionnaires (see Supplementary Information) were distributed to the participants prior to the first session. The questionnaires were developed by the dental hygienist and nurse educator to establish knowledge, attitude and behaviours of the staff towards oral care and oral health.
- *Three education sessions* — Each session included a Powerpoint presentation (created by the dental

hygienist) and time for discussion. The nurse educator gave additional information on the role of the registered nurses in oral care and on strategies working with patients who had behavioural issues. One session focused on the importance of oral health and the provision of oral care to our compromised patients. Another focused on the normal and abnormal oral conditions found in our patients' mouths. The last session offered oral care techniques and strategies when working with patients with behavioural issues. During this session, the staff had an opportunity to demonstrate the learned skills on each other. The information presented at each session was tailored specifically for the patient population on the neuromuscular unit. The duration of the sessions was also considered due to the time constraints experienced by the staff during their shifts.

- *Post questionnaires* — These were administered after all the education sessions were delivered to compare with the pre questionnaire results.
- *Evaluations* — These evaluations (see Supplementary Information) were completed by the study participants after each session. These were used to determine if the sessions were appropriate and whether they had met the participants' expectations. This was an opportunity to obtain qualitative data.

The purpose of the study was communicated at staff meetings and through recruitment letters and flyers. At first, the staff's perceptions of the study were negative. They felt that there was too much time investment on their part, and also felt that this was an opportunity for a job performance evaluation. These issues were clarified through discussions with the staff during meetings. Therefore, their perceptions changed. All nursing staff on the unit had the opportunity to participate in the study; if staff did not want to voluntarily participate, they could attend the education sessions if they wished.

Initially, eight unregulated care providers and five registered nurses were recruited for this study; however, four of them withdrew due to conflicts with schedules. Five unregulated care providers and four registered nurses participated in this study. These participants worked the day shift; later in the study, some of them rotated to work the evening shift and therefore, some sessions were offered during the evening. Although the sample size was small, it was an example of research in practice and the small sample size was a reflection of the nature of the practice environment. When the study participants were involved in the education sessions, the other staff provided care to the patients with higher needs. We found that the speech-language pathologist, nurse clinician, manager, physiotherapist, occupational therapist and pharmacist of the unit would attend some of the sessions. It was emphasized by the staff that most of the direct personal care, such as showering, oral hygiene of the patients, was provided by the unregulated care providers.

During the study, the dental hygienist and nurse educator were visible in the unit and were available if the staff had had questions or concerns about some of the learned strategies implemented at the bedside. The

Toronto Public Health Dental team—a dental hygienist and a dental assistant—was asked to assess the unit one month after the last education session.

Data analyses of the project included answers from questionnaires to ascertain knowledge, beliefs, and judgement about oral care, feedback from participants on the education initiatives, and results of the oral care audit—generated by Statistical Package for the Social Sciences (SPSS), the computer program used for statistical analysis. A flow chart of the education initiative is shown in Figure 1.

Ethical considerations

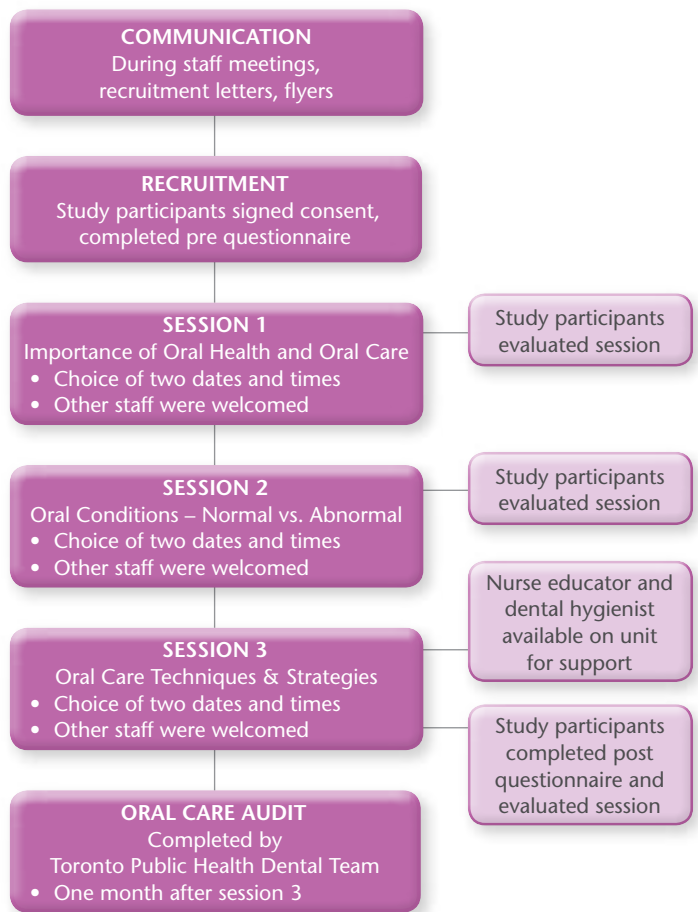
A research ethics board application was submitted to and approved by the Joint Bridgepoint-West Park Research Ethics Board. Ethical considerations were met by gaining informed consent, ensuring the dignity, confidentiality and prevention of harm to the participants, and by giving assurance that their participation did not have any negative impact on their job responsibilities or their colleagues. A numerical coding to identify each participant was used on the data collection forms. Data were stored in computerized files and as hard copies. All files were kept in a locked cabinet in the principal investigator's office. All data were then destroyed upon completion of data analyses. The benefits of this study were the enhancement of the knowledge base of oral care for the participants and the reduction of the occurrence of illnesses such as acquired pneumonia and other lung infections for our patients. There were no known risks associated with this study. All participants voluntarily participated in the study and were informed of all aspects of the study and were asked to sign a consent form.

FINDINGS

Tables 1 and 2 show the results of the pre- and post questionnaires for the registered nurses and unregulated care providers. In both the tables, only those questions answered incorrectly or those that depicted a certain belief or perception were highlighted. The tables show that there was an improvement for both groups.

Table 1 shows that in the “True and False” section, there was only one question in the pre questionnaire that the

Figure 1. Flow chart of the education initiative.



nurses had answered incorrectly. They all felt that oxygen therapy, suctioning, mouth breathing and NPO status (“nil per os” meaning “nothing by mouth”) did not affect the oral mucosa of older adults. The pre questionnaire also revealed the following:

- half of the nurses did not realize that they were accountable for their own and that of the unregulated care providers oral care practices;
- all the nurses knew that it was important to report

Table 1. Results of the registered nurses questionnaire.

	Results	Pre questionnaires	Post questionnaires
Q. 6	Questions 1 to 9 (True and False section) Effects of medical treatments on oral status (Oxygen therapy, suctioning, etc.)	All nurses had this answer incorrect – all were unaware that the medical treatments would affect the oral status	All scored perfectly – awareness of the medical treatments increased
Q. 10	Accountability of their own and that of the UCPs oral care practices	50% knew	All knew
Q. 11	Who to report changes in oral status to	All answered correctly – Physician	Same response
Q. 12	Obtaining oral care products on unit/hospital	All nurses were unfamiliar	All nurses were very familiar
Q. 13	Their own belief of seeing the dentist	They all had the same belief that it is important to see the dentist regularly	Same response

Table 2. Results of the unregulated care providers responses.

	Results	Pre questionnaire	Post questionnaire
Q. 2 Q. 5 Q. 6 Q. 9	Questions 1 to 9 (True and False section) Effect of dry mouth Massaging and cleaning of gums Toothbrush maintenance Food can get trapped in the cheek folds	<ul style="list-style-type: none"> • 100% answered this incorrectly • 50% answered this incorrectly • 100% answered this incorrectly • 80% answered this incorrectly 	All were answered correctly
Q. 10	Obtaining oral care products on unit/in hospital	All were unfamiliar on how to obtain the oral care products	All participants were familiar
Q. 11	Who to report changes in oral status to	All answered correctly - RN in charge	Same response
Q. 12	Barriers to providing mouth care to patients	<ul style="list-style-type: none"> • 80% indicated that the patients' behavioural issue was the main barrier while • 20% experienced no challenges 	The same 80% - No longer experienced barriers
Q. 13	Years of providing mouth care	<ul style="list-style-type: none"> • 50% provided mouth care for 1 to 5 years • 50% - 6 to 10 years 	Same response
Q. 14	Mouth care services	<ul style="list-style-type: none"> • 100% brushed teeth • 50% used mouthwash for patients with teeth • 80% cleaned and inserted dentures • 50% checked the mouths of patients with or without teeth 	<ul style="list-style-type: none"> • 100% brushed teeth • 60% flossed • 80% brushed/wiped inside mouth and tongue • 80% used mouthwash for patients with and without teeth • 100% cleaned and inserted dentures • 50% used saliva substitute for patient with and without teeth (depended on the patients' needs) • 100% checked the mouths of all patients
Q. 15	Level of comfort in different aspects of mouth care	<ul style="list-style-type: none"> • 80% felt that they were adequately prepared 	<ul style="list-style-type: none"> • 80% felt they were excellently prepared
Q. 16	Their own belief of seeing the dentist	<ul style="list-style-type: none"> • 50% saw the dentist regularly • 50% saw the dentist when there was a problem 	<ul style="list-style-type: none"> • 100% saw the importance of seeing the dentist regularly

findings like a sore, lump or bump in the mouth to the attending physician;

- nurses were not familiar as to where to obtain the products needed to provide the proper oral care for their patients, and
- nurses had a strong belief in looking after their own oral health and that of their patients.

Table 2 demonstrates that four out of the nine "True and False" questions had posed a challenge. None of the unregulated care providers realized that dry mouth led to serious tooth decay and mouth infections, and that a toothbrush should not be stored in a container after each use. Half of the staff did not know that the massaging and cleaning of the gums were necessary for denture wearers, while most did not know that food would get trapped in the folds of the cheeks. All of the unregulated care providers were unfamiliar with how to obtain oral care products. Although all of them experienced barriers to providing the mouth care, they felt that they were adequately prepared on this topic. Half of the staff indicated that they had more than five years' experience in providing mouth care.

Half of the staff indicated that they saw the dentist only when there was a problem such as a toothache.

The next three Tables show the results of the evaluations from each session. In the first education session (refer to Table 3), all the participants felt that the information presented was relevant to their practice of oral care, and liked having the opportunity of participating in the session. Most of them strongly agreed that they intended applying their new learning. The only concern that was flagged in this session was its duration, which the nurses felt was too long for them. It was indicated in the "comment" section that they were short of staff and had had heavy caseloads (about 16 patients per nurse per day or evening shift). During this session, the importance of oral care and oral health was discussed. There was participation from the other disciplines such as speech-language pathology, pharmacy and social work. The manager of the unit also took an interest in the presentation since she wanted to show her support to her staff. She also wanted to be a resource for her staff in case any questions or issues arose.

Some of the qualitative data collected for the first

session were:

It doesn't hurt to review a topic that we should all know.

The session was very informative. It's good to be reminded of how important oral care is.

All information is relevant to my knowledge.

It's all important info to know. Thanks for the overview!

I'm glad that our roles were clarified. Now I understand what I am accountable for.

The results for the second session (refer to Table 4) depicted that overall, all the participants felt that learning about the normal and abnormal oral conditions of the mouth were very relevant to their work and that they intended to apply this knowledge. The speech-language pathologist also participated in this session.

I definitely learned a lot of new conditions of the mouth.

The pictures were really helpful.

I would like this lesson to be taught throughout the hospital.

The last session involved learning about oral care strategies and working on each other (refer to Table 5). Again all the participants strongly agreed that the information was relevant to their practice. The participants were not as comfortable working on each other, but felt it was necessary for them to experience this to increase their comfort level with using the oral care products on their patients. They had had the opportunity to feel what it was like to be on the receiving end of services. It was a “wake up call” to their senses—they tasted and felt the different products in their mouths.

I liked having the hands-on experience of using the products.

The hands-on experience helped me feel comfortable with the products.

In addition to our findings from the pre- and post education questionnaires and evaluations, the results of the hospital's oral care audit that the Toronto Public Health CLC (Collective Living Centres) dental team conducted every year at the hospital were also available. The audit involved 10 to 15 patients per unit who were randomly chosen and examined. An audit tool (refer to Figure 5) was completed for each patient. The numbers for only the neuromuscular unit from the years 2000 through to 2006 were extrapolated; therefore, these numbers do not reflect the hospital as a whole (as shown in Table 6).

DISCUSSION

From the pre questionnaires, we found that the participants, especially the personal service providers, had some knowledge about oral care in general. However, they felt uncomfortable with providing certain mouth care routines such as brushing dentures and inserting them, flossing and checking patients' mouths. It was also determined that the registered nurses had a strong belief in looking after their own oral health and that of their patients; however, provision of oral care was difficult due to the behaviour of certain patients who were resistive to basic care needs like showering, shaving, and changing clothes. While the nurses had strong beliefs about their own oral care, the personal service providers did not hold

Table 3. Results: Evaluation of session 1.

All information presented is relevant to my practice of oral care.	• 100% strongly agree
I intend to apply my new learning to my work.	• 80% strongly agree • 20% agree
All questions or concerns I had were answered.	• 80% strongly agree • 20% agree
I liked having the opportunity to participate in the session.	• 100% strongly agree
I liked the photographs that were used in the slides.	• 80% strongly agree • 20% agree
The length of time for session 1 suited my needs.	• 80% strongly agree • 20% disagree (nurses)
The presenter(s) was/were clear and understandable.	• 100% strongly agree
Session 1 met my expectations.	• 100% strongly agree

Table 4. Results: Evaluation of session 2.

All information presented is relevant to my practice of oral care.	• 100% strongly agree
I intend to apply my new learning to my work.	• 100% strongly agree
All questions or concerns I had were answered.	• 100% strongly agree
I liked having the opportunity to participate in the session.	• 100% strongly agree
I liked the photographs that were used in the slides.	• 80% strongly agree • 20% agree
The length of time for session 2 suited my needs.	• 70% strongly agree • 30% agree
The presenter(s) was/were clear and understandable.	• 100% strongly agree
Session 2 met my expectations.	• 80% strongly agree • 20% agree

Table 5. Results: Evaluation of session 3.

All information presented is relevant to my practice of oral care.	• 100% strongly agree
I intend to apply my new learning to my work.	• 60% strongly agree • 40% agree
All questions or concerns I had were answered.	• 80% strongly agree • 20% agree
I liked having the opportunity to participate in the session.	• 90% strongly agree • 10% agree
I liked the photographs that were used in the slides.	• 80% strongly agree • 20% agree
The length of time for session 3 suited my needs.	• 60% strongly agree • 30% agree • 10% strongly disagree (nurse had heavy caseload)
The presenter(s) was/were clear and understandable.	• 100% strongly agree
Session 3 met my expectations.	• 90% strongly agree • 10% agree

Figure 5. Oral care audit tool.

Bridgepoint Hospital ORAL CARE AUDIT Winter 2005/06

Item	Yes	No	Comments
Bedside audit:			
• Does patient have own teeth?			
• Edentulous (no teeth)			
• Dentures_____ Upper_____ Lower_____			
• Oral cavity clean (good oral hygiene)			
• Dentures clean			
• Dentures in use			
• Toothbrush present			
Documentation:			
• Activity flowsheet completed			

Patient's initials _____ Room number _____ Date _____ Auditor's initials _____

such strong beliefs, with some of them indicating that they saw the dentist only when they had an issue like a toothache.

Before the education initiative, 80 per cent of the participants felt that behavioural issues were the main barrier in providing oral care for patients in their unit. After the education, the same 80 per cent indicated that behavioural issues were no longer a barrier due to the strategies discussed and learned. They also felt that the knowledge learned gave them the confidence in providing mouth care such as looking after dentures and assessing patients' mouths. They felt excellently prepared.

Another significant finding was definitely the role clarification in oral care practice with registered nurses and unregulated care providers. Through the questionnaires and feedback, it was clear that both disciplines did not have a clear understanding of what their role was in regards to oral care. Only 50 per cent of the registered nurses indicated that they were accountable for their own and that of the unregulated care providers' oral care practices. After the education intervention—and after the nurse educator had provided the nursing perspective and had addressed issues raised by the registered nurses—there was a positive outcome. All the registered nurses indicated (in the post questionnaires) that they felt accountable for their role. Table 7 was created and discussed in the first session to help clarify aspects of oral care each discipline was accountable for. The staff frequently referred to these responsibilities to ensure that the correct person was providing the care or that certain responsibilities were delegated to the unregulated care providers whenever necessary. Accountability was no longer an issue.

One of the factors that contributed to the success of the study was the positive change in the staff's approach to oral care. Opposed to working individually, they worked as a team, shared strategies and re-enforced best practices. The staff pointed out that their raised awareness after education sessions and support from the nurse educator, dental hygienist and manager had contributed to their success.

Some of the changes in practice were significant. For example,

- the registered nurse in charge of the evening shift established that oral care was delivered after dinner or before bedtime;
- mouth care was provided after the patient's tracheostomy was suctioned;
- patients were assisted with rinsing or cleaning their mouths, especially at night, after thickeners or apple sauce was administered with medication;
- the unregulated care providers said that they shared their effective strategies when providing care to patients with some challenging behaviours.

There was a marked improvement in the quality and consistency of oral care provided by both the nurses and unregulated care providers.

As brought to our attention through the evaluation forms, duration of the education sessions was a challenge, especially when staff numbers were less than ideal. If a nurse was absent, then each nurse had sixteen patients to care for instead of the usual twelve. Scheduling the education sessions was also very difficult since the participants worked rotating shifts; therefore, evening sessions were offered to accommodate their needs.

With the help of the Public Health CLC dental team, we were able to determine the effectiveness of the education initiative after a month of implementation. Table 6 compares the results of the following years: 2000, 2002, 2004 and 2006. There were many different variables that contributed to these results. In 2004, the number of patients with good oral care dropped to 50 per cent due to several factors: our patient population dramatically changed at the time; the needs of patients became more complex, and therefore, required more care. This also coincided with the SARS crisis in Toronto, where we were ordered by the Ministry of Health to transfer many of our patients who were functioning higher than others to long term care facilities or to assisted living centres to accommodate patients coming to us from acute care. The number in 2006 reflected the results of the oral hygiene education initiative. There was not only an increase in the level of staff satisfaction, but also in patient satisfaction. The Public Health CLC dental team, found that the patients were happier since their mouths were cleaner and healthier. These findings clearly reinforced the advantages of an education initiative intervention to achieve positive patient health outcomes.

The oral hygiene education initiative sparked an enthusiasm from other health professionals such as the speech-language pathologist. This showed that the awareness of the importance of oral health related to overall health was increasing and that collaboration was reinforced. During and after the study, it was not unusual to see nursing and dental personnel interacting for education sessions and strategy discussions. This enthusiasm should be fuelled.

CONCLUSIONS

One of the factors that contributed to the success of the study was the positive change in the staff's approach to oral care. They worked as a team, shared strategies and re-enforced best practices. The staff pointed out that their awareness was raised with the education sessions and with the researchers' support and knowledge. Some of the changes in practice were also significant, for example, the nurse in charge of the evening shift ensured that oral care was delivered after dinner or before bedtime; mouth care was provided after a patient's tracheostomy was suctioned; patients were assisted with rinsing or cleaning their mouths after medication was taken with thickeners or apple sauce, especially at night. The unregulated care providers said that they shared the strategies that were effective when providing care to patients with some challenging behaviours. Because the roles of the nurses and the unregulated care providers were redefined or clarified in regards to oral care, nurses' accountability was no longer an issue.

The research study was definitely a learning process. Along with successes, came challenges as well. One of the main limitations was having a small sample size. When the study participants took part in the education sessions, the staff who did not participate provided care to the patients with higher needs because the number of staff on the unit was not always ideal. Another challenge was

Table 6. Oral care audit results.

Patients with good oral hygiene; n=48 (Neuromuscular unit only)

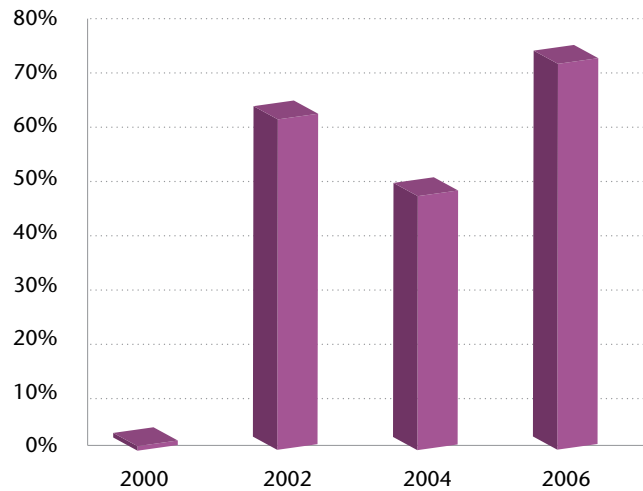


Table 7. Your role in oral care.

	Registered Nurse	Personal Service Provider
Assessment of the mouth	✓	
Observe mouth during oral care		✓
Oral care for patients	✓	✓
• Patients with oral pathology	✓	
• Trach patients	✓	
• Severe dysphagic patients	✓	
• Resistive patients	✓	✓
Suction toothbrush	✓	
0.12% Chlorhexidine rinse	✓	
Oral relief swabs	✓	✓
Oral balance mouth moisturizing gel	✓	✓

to change participants' perception about the research process. At first, they felt that the study would demand too much investment of time on their part, and they also felt that their performance was being evaluated. These points were clarified during staff meetings and through the use of recruitment letters; therefore, their perception changed. Scheduling education sessions was a challenge since the participants worked rotating shifts. Flexibility of time was considered to accommodate their needs. The duration of these education sessions was also a challenge especially on days when the staff numbers were less than ideal.

Implications for practice

A cascade of positive outcomes resulted from the education initiative. In terms of changes in practice, there was positive improvement in the quality and consistency of oral care provided by both disciplines. The knowledge transfer was evident at the bedside, thereby, meeting best nursing standards of practice. There was also an increase in the level of patient and staff satisfaction. Patients were gaining abilities through the knowledge transferred by the staff. These findings clearly reinforced the advantages of an education initiative intervention to achieve positive patient health outcomes. This also reinforced collaboration. During and after the study, it was not unusual to see nursing and dental personnel interacting with education sessions and discussing strategies.

Implications for future research

Research in the future could consider aspects such as:

1. Influence of education programs across the continuum of care in different areas of practice.
2. Involvement of nursing in other research projects in the context of unregulated care providers delivering most of the care.
3. Patient risk management perspective and the influence of better prepared nursing staff on patient safety.
4. Program of research in oral care for our patient population.

Acknowledgements

The authors gratefully acknowledge:

- The participants (staff and patients) from the Neuromuscular Disease Unit of Bridgepoint Hospital.
- Nicole Allard, manager of this unit—for her support of the study.
- Dr. Linda Yetman, (former Director of Nursing Practice and Education of Bridgepoint Health) for all of her feedback, guidance and encouragement throughout this study.
- Pauline Carpenter, Grace Lee and Dragana Markovic for assisting the authors with the background work.
- Dr. Catriona Steele, Research Scientist from Toronto Rehab Institute, for her mentorship and guidance.
- Carol-Ann Yakiwchuk, past president of the CDHA. Her work in long term care with colleagues inspired the authors to explore ways to improve oral health for their patients at Bridgepoint Hospital.
- Bridgepoint Hospital for supporting the authors in their education and research.

Supplementary Information

This study used pre questionnaires for the registered nurses and for personal service providers to gather data for the oral health education initiative. The study participants also completed an evaluation after each education session. These tools are available online at: www.cdha.ca/onlinejournal/education_session.pdf or may be obtained from the corresponding author.

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Halitosis in the absence of oral causes: Recent research on the etiology of non oral origins of halitosis

Susan M. Badanjak, RDH, ADH

ABSTRACT

Objective: Halitosis is a common occurrence. Halitosis of non oral origin (extra oral) occurs in about 10% of cases, often going undetected, and possibly resulting in serious medical consequences. This review aims to identify and classify the etiologies of extra oral halitosis, describe assessment and differential diagnosis techniques and provide treatment and management strategies. It also highlights the importance of multidisciplinary treatment to reduce prevalence of this condition and to improve overall health. **Methods:** The search strategy was limited to articles published in English between 2008 and 2012. Searched databases included: MEDLINE, CINAHL and Scopus. MeSH subheadings and a combination of keywords were used in all three databases. To further verify references, Scopus was searched again, using exact search terms and time period for articles that had cited works published prior to 2008. This citational cross referencing method helped extract names of renowned authors on extra oral halitosis. The mined articles consisted principally of reviews and each was systematically evaluated for inclusion. **Results:** Halitosis impacts over 60% of individuals worldwide and may restrain social interaction and negatively impact self image. Volatile sulfur compounds are the malodorous source of both types of halitosis. Extra oral halitosis is blood borne and non blood borne, providing critical clues to the origins of cause. Treating extra oral halitosis necessitates locating the source, obtaining a differential diagnosis and eliminating the cause. **Conclusion:** Patients look to oral care providers for resolution. Diagnosis requires trained and calibrated breath assessors and/or gas chromatography. Remediation requires multidisciplinary collaboration; the etiology of extra oral halitosis is generally metabolic or systemic.

RÉSUMÉ

Objet : L'halitose est fréquente. L'halitose d'origine non buccale (extrabuccale) survient dans environ 10 % des cas; elle n'est souvent pas détectée et peut entraîner de graves conséquences médicale. Cette revue a pour objets d'identifier et classer les étiologies des halitoses extrabuccales, d'en décrire l'évaluation et les diverses techniques de diagnostic et de fournir des stratégies de traitement et de soins. Elle souligne aussi l'importance du traitement multidisciplinaire pour réduire la prévalence de cet état et améliorer la santé globale. **Méthodes :** La stratégie de recherche se limitait aux articles publiés en anglais entre 2008 et 2012. Les bases de données comprenaient : MEDLINE, CINAHL et Scopus. Les sous-titres MeSH et une combinaison de mots clés ont été utilisés dans les trois bases de données. Pour vérifier davantage les références, on a fouillé à nouveau dans Scopus les termes exacts et la période de recherche, utilisés dans les articles qui avaient cité des travaux effectués avant 2008. Cette méthode de comparaison des citations a aidé à repérer les noms des auteurs renommés sur l'halitose extrabuccale. Les extraits d'article provenaient principalement de revues et chacun a été évalué systématiquement pour inclusion. **Résultats :** L'halitose affecte plus de 60 % des personnes dans le monde entier et peut restreindre l'interaction sociale et avoir un impact négatif sur l'image de soi. Les composés volatiles sulfurés sont une source de mauvaise odeur pour les deux types d'halitose. L'halitose extrabuccale est de source sanguine ou autre, selon les indices d'origine de la cause. Pour la traiter, il faut en détecter la source, obtenir un diagnostic différent et en éliminer la cause. **Conclusion :** Les patients s'adressent aux personnes qui dispensent des soins buccaux pour résoudre leurs problèmes. Le diagnostic requiert des évaluatrices d'haleine formées et équilibrées et/ou une chromatographie en phase gazeuse. L'assainissement demande une collaboration multidisciplinaire; l'étiologie de l'halitose extrabuccale est généralement métabolique ou systémique.

Key words: halitosis, extra oral, blood borne, oral malodor, differential diagnosis, systemic disease, metabolic disease

INTRODUCTION

Halitosis or bad breath is a common condition that affects 50–65 percent of the world's population¹ and defined as an offensive odor emanating from the oral cavity, mouth air and breath. The emanation is socially distressing and embarrassing and impacts interpersonal relationships, leading to diminished self esteem, isolation and other sociopsychological effects.^{2,3} It is one of the chief complaints reported to oral healthcare providers.⁴ With the inception of a halitosis classification and treatment needs

system, oral healthcare providers are finally assuming a proactive and rightful role in managing what was once considered a cosmetic problem.⁴

Almost 90 percent of halitosis is intra oral in origin.⁵ However, more than 10 percent of oral malodor stems from extra oral etiology,¹ providing clues to an individual's overall health or lifestyle habits.³ In the absence of gingivitis, periodontitis, tongue coating or other oral pathologies and malfunctions, persistent halitosis may be indicative of systemic and metabolic conditions or diseases, genetic

THIS IS A PEER REVIEWED ARTICLE. Submitted 11 May 2012. Revised 24 Sept. 2012. Accepted 26 Sept. 2012.

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Table 1. Blood borne sources.

Hepatic system	Liver cirrhosis, hepatic diseases, hepatic failure
Renal system	Uremia, renal failure
Cardiovascular system	Leukemia or other hematological disease
Metabolic	Diabetes mellitus, diabetic ketoacidosis, acquired hypermethioninemia, non hereditary trimethylaminuria
Genetic	Trimethylaminuria (fish odor syndrome), cystinosis, dimethylglycinuria, hypermethioninemia
Medication	Disulfiram, dimethyl sulfoxide, cysteamine, amphetamines, antidepressants, antipsychotics, narcotics, analgesics, decongestants, antihistamines, diuretics, some antihypertensives, alpha-blockers, alpha 2-agonists, beta-blockers, muscle relaxants, other anticholinergics, anti-Parkinson's, anxiolytics, anorexians, solvent abuse, chemotherapy, chloral hydrate, nitrates, nitrites
Transient	Food (certain spices, garlic, onion), caffeine, alcohol, tobacco products

Table 2. Non blood borne sources.

Nasopharyngeal	Sinusitis, antral malignancy, rhinitis, post-nasal drip, nasal foreign bodies or obstructions, nasal polyps, nasal malignancy, tonsillitis, tonsilloliths, post-tonsillectomy eschar, pharyngitis, pharyngeal ulceration, pharyngeal cancer, laryngitis
Respiratory	Respiratory tract infections, pulmonary abscess, tuberculosis, bronchitis, chronic obstructive pulmonary disease (COPD), bronchiectasis, lung cancer
Gastrointestinal	Pharyngo-esophageal diverticulum (Zenker's diverticulum), gastro-esophageal reflux disease, <i>Helicobacter pylori</i> infection, pyloric stenosis, hiatal hernia, digestive disorder, gastrointestinal inflammation, gastrointestinal disease, duodenal obstruction, erratic bowel movement, gastrointestinal malignancy

or psychological disorders, medication pharmacokinetics, transient factors or particular physiological processes.⁵⁻⁷ Extra oral halitosis is managed by treating the underlying cause and usually warrants medical intervention, based on the illness.^{7,8}

Objective

Both oral (intra oral) and non oral (extra oral) sources of mouth malodor have treatable or modifiable antecedents or both. The masking effect of oral diseases and poor oral hygiene can delay treatment of extra oral halitosis, which in some instances can be fatal. The aim of this paper is to identify and classify the etiologies of extra oral halitosis to sensitize oral healthcare providers

to their existence and to advise them that oral malodor may persist, despite elimination of intra oral halitosis causes. Proper assessment and differential diagnosis are vital, and as such, will also be described in this paper. Oral care specialists should glean that managing and treating extra oral halitosis requires a multidisciplinary approach, including the collaboration of the medical community.

METHODS

The search strategy for this paper was limited to articles published in English, between 2008 and 2012. Searched databases included MEDLINE, CINAHL and Scopus. The MEDLINE search terms consisted of the MeSH term "halitosis" used with the MeSH subheadings: "blood"; "chemically induced"; "classification"; "etiology"; "pathology"; "diagnosis"; "genetics"; "metabolism"; "pathophysiology". These concepts were searched separately and in combination with the key words "extra-oral", "extraoral", "extra oral" and subsequently—separately and in combination—with the keywords "blood-borne", "blood borne", "oral malodor" and "oral malodour" because no effective MeSH headings exist for them as they relate to the topic of extra oral halitosis. In addition, "oral malodor" and "oral malodour" were both searched as key words in conjunction with the "extra oral" and "blood borne" concepts to find articles that had not yet been indexed for MEDLINE. All of these terms were combined and searched for in CINAHL and Scopus also. To further verify references, Scopus was searched again, using exact text matching of keywords, for articles published between 2008 and 2012 that had cited works on the topic published prior to 2008. This citational cross referencing method helped extract names of renowned authors on the subject of halitosis and more importantly, on extra oral halitosis. The mined articles included few observational or retrospective studies or both, scant cross sectional studies, and a multitude of review articles. Publications selected for this communication, consisting of two subject searches and one citation search, were systematically evaluated for inclusion. As there was a paucity of randomized controlled trials, meta analyses and systematic reviews on this subject, the references principally comprised reviews.

DISCUSSION

Epidemiology

The presence of oral malodor, whether from intra or extra oral origins, is globally prevalent and seems to be indiscriminate with respect to demographics.^{4,6-8} Use of tobacco products, caffeine, alcohol and dietary habits play a transient role in the incidence of extra oral halitosis,¹ as do certain medications,⁹ unless pharmacological treatment is chronic.¹⁰ Halitosis is not a modern age phenomenon, but few reliable, objective, clinical studies on the subject are available.^{3,4,6-8} What is clear however, is that the use of objective and analytical methods of detection are accurate ways of differentiating between oral and non oral causes of bad breath and the subgroups of extra oral halitosis.¹⁰ Recently, dental and medical professionals' interest in halitosis has broadened, owing to increased awareness of its deleterious effects.^{1,3}

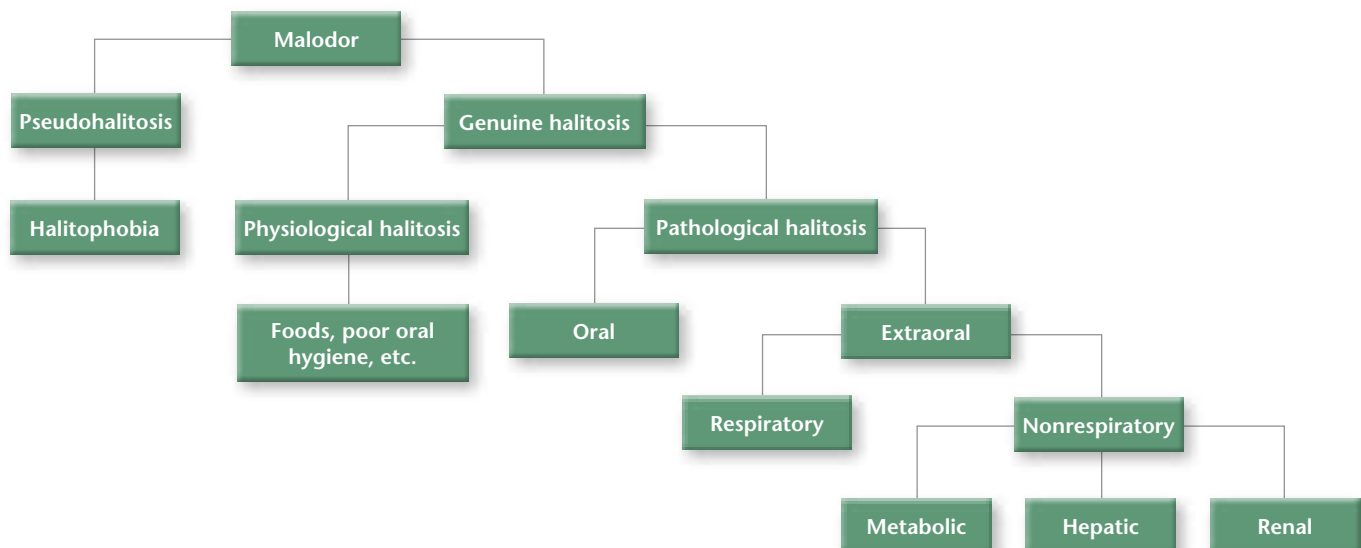
Etiology and pathogenesis

The classification of intra and extra oral halitosis is determined by the source of the odor.¹⁰ Malodors, caused by oral emissions of volatile organic compounds (VOCs), can be disease or disorder specific olfactive biomarkers or both.^{7,10} For example, the sweet, fruity, breath odor of diabetic ketoacidosis caused by the VOC acetone—an ammoniacal or fishy oral malodor due to the VOC ammonia—is common in renal insufficiency; those diseases which destroy pulmonary tissue produce sulfurous smelling VOCs that are emitted via alveolar air.^{7,11}

The oral cavity and, in particular, the dorsum of the tongue, are largely responsible for intra oral halitosis through the formation and degradation of oral biofilm and residual food debris that result in the production of VOCs, specifically volatile sulfur compounds (VSCs).¹⁰ Three main VSCs are produced: hydrogen sulfide (H₂S), methyl mercaptan (MM) and dimethyl sulfide (DMS).¹⁰ The human body metabolizes an immense variety of molecules that produce identical VSCs.^{7,10} Any derangement of this normal metabolic process by disease, genetics, diet, drugs or stress may produce extra oral halitosis.^{7,10} The causes of oral malodor are depicted in Figure 1.⁷

Tangerman and Winkel¹⁰ divided extra oral halitosis into blood borne and non blood borne categories and stressed the importance of clinically differentiating between the two. Blood borne extra oral halitosis occurs when VOCs—produced by degradation through the body's endogenous metabolic processes—enter the blood stream and travel to the lungs.¹⁰ It is in the alveoli of the lungs that a blood gas exchange occurs and the VOCs are fractioned and expelled through exhalation.¹⁰ Most individuals with extra oral halitosis are afflicted with the blood borne version and the most common VSC associated with it is DMS.¹⁰ Sources of blood borne extra oral halitosis are listed in Table 1.^{1,3–11}

Figure 1. Causes of oral malodor.



Reproduced from Scully C, Greenman J. Halitology (breath odour: aetiopathogenesis and management). *Oral Dis.* 2011;18(4):333–345. doi:10.1111/j.1601-0825.2011.01890.x⁷ with permission from John Wiley and Sons.

Table 3. Conditions which may affect levels of TMA and methionine.

Conditions in which TMA may be increased	Conditions associated with acquired hypermethioninemia
<ul style="list-style-type: none"> • Anxiety and stress • Menstruation • Deficient nicotine N-oxidation • Disorders of carnitine and choline intake • Hematological abnormalities • Hepatic disease • Noonan syndrome • Prader-Willi syndrome • Renal disease • Turner syndrome 	<ul style="list-style-type: none"> • Liver disease • Intake of large amounts of methionine • Premature birth or low birthweight or both

Adapted from Scully C, Greenman J. Halitology (breath odour: aetiopathogenesis and management). *Oral Dis.* 2011;18(4):333–345. doi:10.1111/j.1601-0825.2011.01890.x⁷ with permission from John Wiley and Sons.

According to Scully and Greenman,⁷ elevated levels of trimethylamine (TMA) and methionine—caused primarily by genetic disorders—may also be associated with the psychological, physiological, dietary habits or medical conditions listed in Table 3. These are still considered blood borne forms of extra oral halitosis.⁷ Non hereditary trimethylaminuria (TMAU) is due to an enzymatic disequilibrium while acquired hypermethioninemia is caused by a metabolic incapacity.⁷

An enzyme produced by the liver—flavin containing monooxygenase (FMO3)—is responsible for metabolizing, converting, neutralizing and detoxifying many compounds in the digestive process, including TMA.⁷ Trimethylamine,

Table 4. Visual summation of organoleptic differential diagnosis.







Intra oral	
Extra oral blood borne	 
Extra oral non blood borne (below throat)	 
Extra oral non blood borne (above throat)	

Table 5. Five categories of treatment needs (TN) for breath malodor.

TN-1*	Explanation of halitosis and instructions for oral hygiene (support and reinforcement of a patient's own self care for further improvement of his or her oral hygiene).
TN-2	Oral prophylaxis, professional, cleaning and treatment of oral diseases, especially periodontal disease.
TN-3	Referral to a physician or medical specialist.
TN-4	Explanation of examination data, further professional instruction, education and reassurance.
TN-5	Referral to a clinical psychologist, psychiatrist or other psychological specialist.
*TN-1 is applicable to all cases requiring TN-2 through TN-5	
Reproduced from Armstrong BL, Sensat ML, Stoltenberg JL. Halitosis: a review of current literature. <i>J Dent Hyg.</i> 2010;84(2):65–74 ⁵ with permission from the American Dental Hygienists' Association.	

found in the gut as a result of enterobacterial metabolism, has a strong, rotting fish odor.⁷ Colloquially known as fish malodor syndrome, individuals with this disorder emit a fishlike odor from their exhaled air and bodily fluids, including saliva.⁷ The variability in the levels of FMO3 influence TMA levels.

Anxiety and stress stimulate the sympathetic nervous system; blood levels of the hormones cortisol, epinephrine

and norepinephrine increase.¹² As a result, intestinal peristalsis and absorption, as well as saliva and oral mucous production, decrease; the liver increases glucose production in favor of FMO3 production.¹² The stress induced shift in homeostasis increases TMA and VSC levels.⁷

Sex hormones play a role in FMO3 regulation.¹³ Endogenous and exogenous hormonal fluctuation reduce the capacity of the FMO3 enzyme to convert TMA to a non odorous compound, trimethylamine N-oxide (TMAO).¹³ Menstruation¹³ and the genetic disorders of Noonan syndrome,¹⁴ Turner syndrome¹⁵ and Prader-Willi syndrome¹⁶ are influenced, either physiologically, pathologically or pharmacologically, by sex hormones. The vacillation of these hormones can cause TMAU.⁷

Nicotine, is metabolized by the liver, and FMO3 is responsible for nicotine N-oxidation formation; this readies nicotine for urinary excretion.^{7,13} Renal clearance of nicotine N-oxide is pH dependant.¹³ However, patients with nephropathies have fluid and electrolyte imbalances that alter blood pH and impair excretion of nicotine N-oxide.^{7,13} Renal function is further compromised, especially in renal failure, by limited amounts of FMO3; the enzyme has a role in drug and endogenous amine—nitrogenous compounds—metabolism and detoxification.¹³ Inadequate amounts of FMO3 cause an important accumulation of nitrogen waste products or uremia in the blood including TMA.¹⁷ In hepatic diseases, TMA accumulates in the intestinal tract as the damaged liver is no longer able to produce adequate amounts of FMO3.¹³ Insufficient amounts of FMO3 circulating in the blood due to anemia or other blood dyscrasias, result in TMAU.¹³

When large amounts of the TMA dietary precursors—carnitine and choline—are consumed, TMA production increases substantially.^{7,13} Due to the overload, the liver is unable to produce FMO3 in sufficient amounts and TMAU ensues.¹³

Acquired hypermethioninemia occurs when methionine, an amino acid, is not properly metabolized by the body due to hepatic disease; excessive dietary intake of methionine, or in premature or low birth weight babies or in both.¹⁸ In these babies, acquired hypermethioninemia is usually transient and resolves once the infant's digestive tract is fully developed.¹⁸ The breath, sweat and urine of individuals with hypermethioninemia have an odor resembling boiled cabbage.¹⁸

Non blood borne extra oral halitosis can originate from the nose, the upper and lower respiratory tracts, the gastrointestinal tract,^{19,20} or a combination of any of these, and is attributable to disease or disorders in these areas.^{1,5,7,10} Infection, inflammation, obstruction, benign and malignant neoplasms of the nasopharyngeal anatomy and the respiratory and gastrointestinal systems produce discharge or necrosis of tissues or both, resulting in the production of VSCs.^{1,5–7,10,11,19,20} Hydrogen sulfide (H₂S) and methyl mercaptan (MM) are correlated with non blood borne extra oral halitosis.^{1,5–7,10,11,19,20} The causes of extra oral non blood borne halitosis can be found in Table 2.^{1,3–11}

Assessment

There are five methods to assess halitosis: organoleptic measurements, sulfide monitoring, gas chromatography, microbial testing (cultures, smears, enzyme assays) and chemical test strips.^{3-5,10,11} The three most commonly used will be discussed in this paper—organoleptic measurements, sulfide monitoring and gas chromatography.

Oral halitosis is ascertained organoleptically through orally and nasally exhaled breath.^{7,10} It is still considered to be the gold standard in halitosis testing, as the human nose has a tremendous capacity to smell the intensity of an odor and ascertain the degree of offensiveness.^{3-5,7,11} The organoleptic evaluation is performed by trained and calibrated breath assessors.^{3-5,11} The assessors independently rate the intensity on the Rosenberg scale (1 to 5) and the offensiveness on a hedonic scale (-2 to +2).³ Although considered to be a subjective approach of assessment, it has been shown to correlate with the findings of the other two objective methods of detection, sulfide monitoring and gas chromatography, but lacks specificity.³⁻⁵

The Halimeter® (Interscan Corporation, Chatsworth, CA, USA), a portable VSC detector capable of detecting H₂S, MM and DMS, is accurate at detecting the volume of VSCs and provides objective measurements in parts per billion.^{7,10} It is however, limited by its inability to differentiate between these compounds, and therefore incapable of detecting extra oral blood borne halitosis.¹⁰

Gas chromatography is the ideal assessment device as this highly specialized and precise piece of equipment not only detects H₂S, MM and DMS but also has the unique ability to differentiate between the three compounds.¹⁰ This distinction is vital for detecting blood borne extra oral halitosis as the primary VSC produced by blood borne halitosis is DMS.¹⁰ Tangerman and Winkel¹⁰ maintained that without a gas chromatograph, detection of extra oral blood borne halitosis was unlikely. This instrument provides diagnostic and prognostic value—it permits oral health professionals to provide or refer patients for appropriate treatment for their specific malodor.¹⁰ Gas chromatography also has limitations in that the unit is not portable, the test is time consuming to perform and requires a skilled operator, thereby, making it ill suited for routine dental use.³

A portable version of a gas chromatographer called OralChroma™ (FiS Inc. Itami-Shi, Hyogo, Japan) was developed having the same capabilities and accuracy of a standard chromatograph.^{6,7,10} Because it is used chairside, patients are able to view their chromatograph results via a monitor and receive a printed version of their chromatogram.^{6,10} This feature is advantageous because it serves as a motivational tool for patients and permits them to track their improvement.

Diagnosis and management

Management of extra oral halitosis is dependent on accurate diagnosis of the malodor.⁵⁻⁸ Performing a differential diagnosis ascertains the origin; the diagnosis should be confirmed organoleptically, and ideally, by using analytical techniques (VSC detectors).^{1,10} Individuals with intra oral halitosis present with bad breath from the

Table 6. Summary of treatment plan protocol.

- Establish the origin of the odor.
- Obtain a complete medical, dental, halitosis history.
- List all current medications.
- Evaluate dietary and personal habits.
- Perform an intra and extra oral examination.
- Analyze VSCs [intra and extra oral halitosis have different treatment protocols].
- Classify the treatment needs (TN).
- Refer to medical specialist, if halitosis is unresolved with oral hygiene measures.

Adapted from Armstrong BL, Sensat ML, Stoltenberg JL. Halitosis: a review of current literature. *J Dent Hyg.* 2010;84(2):65–74⁵ with permission from the American Dental Hygienists' Association.

Table 7. Causes of halitosis and corresponding number of patients.

Causes	Number of patients
Oral	359
Ear or nose or both; Nose or throat or both	11
Internal organ	3
Total	373

mouth, but not the nose.^{1,10} Those with blood borne extra oral halitosis will emanate rank odor from the mouth and the nose, as the presence of the malodorous volatiles are found in alveolar air.^{1,10} Patients with non blood borne extra oral halitosis will expel malodor from the mouth and nose, with the exception of patients whose source of odor is in the upper respiratory tract, more specifically, above the throat.^{1,10} These patients will emit bad odor from the nose exclusively.^{1,10} A visual summation of organoleptic differential diagnosis is provided in Table 4.^{1,4,10}

Treatment consists of identifying, eliminating or managing the causal predisposing and modifiable factors.⁵⁻⁸ Armstrong et al.⁵ discussed a classification and treatments needs (TN) system that identified TN-3 and TN-5 as criteria for referral to medical specialists, when treatment of halitosis was refractory, psychogenic in nature or beyond the scope of dentistry. This chart is shown in Table 5.⁵ A summary of a treatment plan protocol, adapted from Armstrong et al.⁵ is listed in Table 6.⁵

Although xerostomia is considered to be an intra oral source of halitosis, the medications listed in extra oral blood borne causes of halitosis, contribute to dry mouth.⁵ Xerostomia is also common in those with nasal and sinus issues, as a consequence of mouth breathing.⁵ This crossover of causes must be acknowledged and addressed. The same is true for tobacco products, as sources of intra oral malodor.⁵ Tobacco use is a risk factor for periodontal disease and oral cancer.²¹ It also contributes to non blood borne extra oral malodor, derived from tobacco induced malignancies of the throat, lung or esophagus and

diseases such as chronic obstructive pulmonary disease (COPD).^{1,3,6,7,9–11} Oral malodor is prevalent among the elderly, and should not be overlooked when assessing, treating and managing these individuals.²² Elevated levels of DMS in the elderly population have been correlated to systemic disease,^{22,23} respiratory and gastrointestinal conditions²³ and to medications.^{22,23}

RESULTS

It is difficult to comprehend why such a universal problem, with important sociopsychological, dental and medical consequences, has been given such little attention. There are limited data on the subject, the science behind these data is weak and, up until February 2012,²⁴ no standardized clinical research protocols existed for oral malodor. Few oral healthcare providers can accurately distinguish halitosis, especially blood borne extra oral halitosis, as this detection requires trained and calibrated breath judges or sophisticated equipment.

A study of 2000 consecutive patients, 25 of whom had visited a multidisciplinary university hospital breath clinic between 1995 and 2008 for oral malodor assessment and diagnosis, revealed a mere 5.3 percent were referred to the clinic by a dentist.²⁵ Ironically, 13 percent were referred by a general practitioner and 10.3 percent by an otorhinolaryngologist (ear, nose and throat specialist).²⁵ The remainder of the patients had participated willingly in the study, without referral.²⁵ Disturbingly, the majority of patients complained of unresolved malodor for a number of years, the average being seven.²⁵ Eighty of the patients had halitosis from extra oral origins.²⁵

Another university based halitosis clinic study evaluated and treated 451 patients over a seven year period.²⁶ Of the 451 patients, 375 had participated on their own accord and 284 had previously visited one or several dentists for their halitosis.²⁶ A total of 373 patients were diagnosed with halitosis; 14 patients had extra oral halitosis.²⁶ Table 7 identifies the causes of halitosis and the corresponding number of patients.²⁶ The duration of suffering was considerably longer for the majority of patients.²⁶ Among the 451 patients, 63 patients reported suffering for less than a year, 243 between 1 and 10 years, and 145 for more than 10 years.²⁶ The number of external referrals to the clinic increased every year.²⁶ Threefold number of referrals came from physicians compared to dentists; only 19 patients were referred by dentists, whereas 57 patients were referred by physicians.²⁶ Primary care physicians referred 18 patients to the halitosis clinic, while internists and gastroenterologists each referred 15 patients.²⁶ Otorhinolaryngologists and pulmonologists referred 8 and 1 respectively.²⁶ According to Zürcher and Filippi,²⁶ this suggests there is a greater awareness among physicians that the oral cavity is largely responsible for halitosis and that the initial consultation for oral malodor should be with a dental professional. Zürcher and Filippi²⁶ also observed that their dental colleagues preferred to refer patients with oral malodor to halitosis clinics. Considering that nine out of ten cases of halitosis have an oral cause, it stands to reason that oral health professionals be the quintessential diagnosticians of oral malodor.

Left untreated, halitosis has deleterious sociopsychological effects.^{2,26} Sufferers are marred psychologically and become socially withdrawn.^{2,26} Halitosis has a serious impact on quality of life (QOL), as shown by Kizhner et al.²⁷ Their validated twenty item Halitosis Associated Life-quality Test (HALT) questionnaire is a tool that assesses the impact of oral malodor on QOL.²⁷ According to Kizhner et al.²⁷ there are many afflicted and dismissed patients. Assessing and managing oral malodor requires a collaborative approach between the dental and medical disciplines. Without this multidisciplinary approach, people will endure the burden of bad breath needlessly.

Billions of dollars are spent on masking oral malodor with chewing gum, mints, mouthwashes, toothpastes, sprays and breath strips.^{4,6,7} Zürcher and Filippi²⁶ reported that almost 96 percent of participants in their retrospective study had tried to auto treat their halitosis by masking the odor with gum, candy and mouthwash. Do oral healthcare providers themselves unintentionally perpetuate the masking effect? If halitosis persists, after mechanical dental intervention by the dental team and after the patient's home care cooperation, the postliminary approach is a chemical one.³ Are dental professionals contributing to the disguising of a grave, basal, medical condition by prescribing and recommending antimicrobial mouthrinses, saliva substitutes and xylitol containing mints and gum? Consider also that intra oral sources of halitosis, such as periodontal disease, are themselves capable of veiling extra oral halitosis. Diligent and thorough assessment of oral malodor before undertaking any management of the same, ensures the oral health specialist appropriately treats halitosis cases.

CONCLUSIONS

One out of ten patients troubled by halitosis has extra oral halitosis and suffers unnecessarily. Bad breath is the most common complaint reported to dental professionals. Screening for and assessment of halitosis by dental hygienists, is not only practical but imperative in helping patients maintain overall health. As oral specialists, dental hygienists play an important role in detection, management and resolution of bad breath, considering that most cases of oral malodor are intra oral in origin. Breath analysis is a valuable diagnostic tool and gas chromatography detection of VSCs is the ideal standard of care for all halitosis sufferers, as it detects all three VSCs: H₂S, MM and DMS. Methyl mercaptan (MM) appears to be the main culprit of intra oral halitosis, whereas patients with extra oral halitosis present with elevated levels of DMS, often indicating an underlying medical disorder. Managing halitosis requires a multidisciplinary approach; it must be thoroughly investigated by oral healthcare providers initially and by medical specialists subsequently, in the absence of a definitive oral cause or diagnosis. Extra oral halitosis is generally metabolic or systemic in origin and management or elimination of the cause is usually justified and in some cases obligatory. Halitosis in the absence of oral causes exemplifies the oral systemic link.

Acknowledgement

I would like to acknowledge the assistance received from Sarah McCord, MLIS, AHIP, Head of Reference and Instructional Services, Associate Professor, Library and Learning Resources, Massachusetts College of Pharmacy and Health Sciences.

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Decoding qualitative research for Dental Hygiene

Zul Kanji, BSc, DipDH, MSc, RDH

ABSTRACT

The concept of evidence based practice is one that is now well known and applied frequently in oral healthcare. Research in the science based professions has predominantly employed quantitative methods, fuelled by this drive towards evidence based practice in recent decades. Although now used with increasing frequency in dental hygiene, relatively few studies are conducted using qualitative methods. Consequently, familiarity with qualitative research, including its purpose, various approaches and appraisal is limited. This paper therefore attempts to “decode” the qualitative research process and aims to strengthen the readership’s understanding of qualitative methodology by providing an introductory description and analysis of its purpose, approaches, and strategies for rigour while contextualizing its value in dental hygiene.

RÉSUMÉ

La notion de la pratique fondée sur des données probantes est aujourd’hui fort bien connue et s’applique fréquemment aux soins de santé buccodentaire. La recherche scientifique fondée sur les professions a surtout utilisé des méthodes quantitatives, avivée par cet élan vers l’exercice fondé sur les données probantes des dernières décennies. Bien qu’elles soient maintenant utilisées plus fréquemment, relativement peu d’études ont recours aux méthodes qualitatives. En conséquence, la familiarité avec la recherche qualitative, y compris son objet, ses diverses approches et son évaluation, est limitée. Cet article tente donc de « décoder » le processus de recherche qualitative et ses buts, visant à renforcer la compréhension par le lectorat de la méthodologie qualitative en lui fournissant une introduction descriptive et une analyse de son objectif, de ses approches et de ses stratégies de rigueur tout, en contextualisant sa valeur en hygiène dentaire.

Key words: dental hygiene, qualitative research, epistemology, grounded theory, phenomenology, ethnography, case studies, purposeful sampling, rigour in qualitative research

INTRODUCTION

As self regulated health professionals, dental hygienists have an obligation to be able to critically appraise and apply the research they read. Most of this research employs quantitative methods. Randomized controlled trials and questionnaire based surveys are the most common research approaches used.^{1,2} As a result, the foundational education that many dental hygienists receive focuses on understanding the key concepts of quantitative methodology. However, knowledge produced from qualitative research can play a significant role in a practice that is evidence based. Yet, many are challenged to understand its scientific value. Qualitative research may seem “unscientific” or like common sense, but behind its use lies years of education and practice, rules of evidence, guidelines of approach, and strategies for rigour. Qualitative research begins with a clearly defined question of investigation, identifies the appropriate approach to gather data, and employs a multifaceted strategy to analyze and to interpret the findings. The purpose of this paper is to “decode” or deconstruct the qualitative research process and to contextualize its value in evidence based dental hygiene practice.

The purpose of qualitative research

Qualitative research offers a unique insight into people’s experiences and perspectives, providing a comprehensive understanding of their beliefs, attitudes, and behaviours. This approach allows for explorative, descriptive, and interpretative methods in studying human social events with a focus on interactions.^{3,4} The qualitative research question explores in great depth the “what,” “how,” and “why” of social experiences and phenomena rather than investigating “how much” that typically enables generalizations. Quantitative researchers aim to create results that can be analyzed for statistical significance and generalizability to a larger population, whereas qualitative researchers attempt to understand the social aspects and context of an event or interaction.³ One research methodology is not “better” or more valuable than the other; rather, each method attempts to answer a completely different set of questions. The qualitative approach can therefore help health professionals better appreciate why people behave the way they do, which can be useful when individualizing client care or population interventions.^{3,4}

THIS IS A PEER REVIEWED ARTICLE. Submitted 18 July 2012. Revised 24 Sept. 2012. Accepted 26 Sept. 2012.

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Qualitative approaches and Methods of data collection

Epistemology

Central to qualitative research is epistemology. Epistemology can be defined as the knowledge a researcher uses to approach the research, as influenced by personal values and world view. Various research approaches and methods of data collection used in qualitative research differ from quantitative research because of a fundamental difference in research perspective. Quantitative research attempts to remove all bias from collection and interpretation of data, while qualitative research acknowledges that bias is inherent and declares it upfront. The researcher reveals personal beliefs and values that may influence the research and its findings, through a description of the underlying epistemology. Epistemologies underpin all qualitative methodologies.^{1,5} While methodology refers to the study of methods and various approaches of collecting data, epistemology deals with the philosophical questions of what can be known, who can know it, and through what lens or perspective the researchers approach the investigation.^{1,5,6} Exploring epistemology in detail is beyond the scope and intent of this paper; however, one can simply interpret epistemology to be the “science of knowing” and methodology as the “science of finding out.”⁶ Refer to Table 1 for a definition of epistemology and other common terminologies used in qualitative research.

Once qualitative researchers identify with their epistemological approach and research question, they then choose an appropriate approach to frame the design of their project. As with any study, the design of a research project is based on a clear idea of the question under investigation. That is, the research question informs the research design. Described below are four common approaches used in qualitative research: grounded theory, phenomenology, ethnography, and case studies. Data collection methods commonly used with these approaches involve direct participant engagement or observation or both. While quantitative research aims to summarize data findings through statistics that can be quantified and generalized, qualitative research generally documents these findings through descriptive text. These methods are described and also contextualized within dental hygiene.

Grounded theory

Grounded theory, emerging from Glaser and Strauss in the late 1960s, has become one of the more popular qualitative approaches.^{5,7} This approach refers to theory that is inductively developed during a study. Inductive research involves an exploratory method of drawing conclusions based on observations.⁵ The original theory developed is “grounded” in the actual data collected, in contrast to theory that is developed conceptually and then simply tested against empirical data. Studies using grounded theory typically involve interviews or focus groups with a moderately sized sample of carefully selected participants.^{5,7} Researchers are encouraged to use a constant comparative method of data analysis that involves a rigorous examination of the interview data, coding of transcripts, and thematic development which

emphasizes patterns and contrasts across participants.⁵⁻⁸ Within a dental hygiene context, grounded theory has been used to study adolescents’ perceptions of oral health and influencing factors.⁹ Factors which were theorized to influence adolescents’ perceptions included personal value, socioeconomic status, social support, and peer behaviours.⁹ This grounded theory resulted in greater insight into the development of health promotion strategies.⁹ More recently, grounded theory has been used to examine the relationship between perceived oral health, body image, and social interactions among institutionalized elders.¹⁰

Phenomenology

Phenomenology explores the lived experience of a specific phenomenon as well as the results or outcomes of those experiences.^{11,12} Study participants are individuals who share a common life experience. Examples may include being an oral cancer survivor, being edentulous, or living with dental phobias. Researchers must acknowledge their biases about the research and make those biases explicit to readers. In addition, they need to set aside their preconceptions about what is real. This practice, known as bracketing, is central to phenomenology and is essential for minimizing researcher bias.⁵ Typically, phenomenologists collect data through intensive in depth interviews where they seek to understand the lived experience of the phenomenon under investigation. Data analysis involves extensive coding of interview transcripts in search of quotes and statements that are emblematic in meaning. The resulting data are then clustered into emerging themes which form the architecture of the findings. Phenomenology has been used to better understand the motivating influences, learning experiences, and practice outcomes of dental hygienists who practised with a diploma and then returned to university to complete their dental hygiene baccalaureate degree.^{13,14} This research provided insight into the meaning and value of advancing one’s education in dental hygiene from self reported lived experiences.

Ethnography

The objective of ethnography is to explore cultural phenomena that reflect the knowledge and systems of a cultural group. Pioneered in the field of anthropology, ethnographical data collection methods intend to capture the social meanings and ordinary activities of people in naturally occurring settings.⁵ The goal is to collect data in such a way that does not interrupt the participants nor impose bias on the data. Thus, the trademark approach of ethnography involves participant observation.^{5,15} Ethnographical studies involve long periods of time engaging in intense and ongoing observation, taking field notes, and interviewing key informants and are iterative; researchers continuously need to revisit their participants and data.^{5,8,15} An example would be a 2008 ethnographic study that examined, through observation and interviews, why Latino children experienced a higher prevalence of caries than did children of any other ethnic group in the United States of America.¹⁶

Case studies

Case study analysis draws on the ability of the qualitative researcher to extract great depth and meaning in context. This approach involves an intense analysis of an individual case (one person, a group, or an event) or multiple cases stressing developmental or causal factors in relation to a specific context.^{5,14} Case studies create a system that is an integrated whole bounded by time and place, known as a bounded system.⁸ This approach may employ a number of data collection strategies, including multiple interviews, observation, and document analyses. For example, a case may include a dental hygienist, a dentist, an assistant, and a client to examine their relative roles in oral hygiene care. Another case study may explore the social impact of experiencing a full mouth reconstruction or wearing full mouth orthodontic brackets for the first time. These cases are limited to the context of the dental work and the time during which the case is studied.

Other qualitative approaches

The risk of focusing on only four qualitative approaches in this paper lies in conveying a false message of being limited to these frameworks described above. Qualitative researchers may use other approaches, such as a narrative approach or action research, if that approach aligns more appropriately with their research question. Whereas narrative researchers elicit storytelling or discourse analyses, action researchers dedicate their efforts towards commitment to social change and community empowerment.⁵ Researchers may also mix qualitative approaches (fusion or hybrid approach) to achieve the most suitable combination for their needs.⁵ For example, a researcher may wish to explore the lived experience of a specific phenomenon (phenomenology) of one client in a specific context in great depth (case study), and may thus use a hybrid phenomenological case study approach. When implemented with experience and discipline, mixing approaches and techniques can bring a new synergy and can serve as complimentary leading to enriching perspectives.

Sampling

The researchers' decision regarding how to sample is driven by the study's research question and goals. As qualitative researchers seek to describe and analyze people's experiences and social interactions in great depth, they generally employ **purposeful sampling**—a deliberate process of selecting participants based on their ability to provide the needed information.^{5,7,15} This technique should not be confused with **convenience sampling** which involves selecting participants based solely on their availability.^{5,8} Padgett,⁵ Maxwell,⁷ and Creswell¹⁵ describe various types of purposeful sampling techniques, including:

- **Maximum variation sampling:** attempts to capture the heterogeneity or differences across the sample population in order to generalize the findings within the population being studied (known as "internal generalizability").

Table 1. Definitions of common terminology in qualitative research.

Terminology	Definition
Epistemology	Theories of knowledge interpretation and ways of knowing which underpin how research proceeds.
Grounded theory	Theory that is inductively developed during a study and is grounded in the findings of the study.
Phenomenology	Investigating the lived experiences and outcomes of a specific phenomenon.
Ethnography	A systematic description of a cultural group's beliefs and perspectives.
Case study analysis	Extracting great depth in context of an individual case.
Coding	Systematic analysis of transcripts in search of patterns and contrasts leading to thematic development.
Bracketing	Acknowledging and sidelining preconceptions before engaging in research.
Purposeful sampling	Selecting research participants based on their ability to provide the needed information.
Rigour	Strategies used to reduce the potential for bias and enhance the trustworthiness of the research findings.
Data saturation	The point at which no new information or themes emerge.
Triangulation	Collecting information using a variety of sources and methods [at least three].
Member checking	Soliciting feedback from research participants to verify the accuracy and/or interpretation of the researchers' findings.
Negative case analysis	Actively searching for disconfirming evidence and discrepant findings.

- **Homogenous sampling:** attempts to accomplish the opposite of maximum variation sampling by choosing participants who share a common characteristic central to the investigation. An example would be Faust's study which explored the lived experience of being a male dental hygienist in a female dominated profession.¹⁷
- **Critical case sampling:** selects cases that are the extreme of a situation, such as a dental intervention that aggravated rather than relieved a condition.
- **Snowball sampling:** selects isolated or hidden populations whose members may be difficult to find or to cooperate, such as gang members or drug users or human trafficking victims, commonly explored in social work research.
- **Theoretical sampling:** occurs when inductively derived concepts in a study are used to guide the selection of additional participants.

Random sampling is a rarely used selection strategy in qualitative research since researchers are interested in understanding specific contexts and phenomena. This range of purposeful sampling techniques may seem foreign or “unscientific” to researchers who are familiar with randomization principles that aim to generalize externally in quantitative methods. Another “unscientific” concept may be the smaller sample sizes that are often sought in qualitative research. However, sample size considerations in qualitative research focus on flexibility and depth rather than on breadth and external generalizability.^{5,7,15} The phrase that quantitative research is “a mile wide and an inch deep” and qualitative research is “an inch wide and a mile deep” holds true when sampling.⁵ Due to the fundamental focus with depth over breadth, qualitative researchers sample not to maximize breadth or reach but to become saturated with information about a specific topic. Data saturation is a key concept to recognize when appraising qualitative research and is one of many strategies used for scientific rigour.

Validity threats

A key distinction in qualitative research is that the researchers themselves are the tools used in the gathering and analyzing of the data, rather than statistical tests and computer software programs commonly used to analyze the results in quantitative studies. Using human beings as the investigative tool means that qualitative researchers need to ensure they maintain certain strategies of ethics and rigour to ensure their study remains credible and that the results are trustworthy. A key concept for trustworthiness is the validity threat: circumstances that can lead researchers to inaccurate conclusions.⁷ Threats to validity in qualitative research fall under three broad headings: reactivity, researcher bias, and respondent bias.^{5,7}

- **Reactivity** refers to the potential distorting effects of the researcher's presence on the participants' behaviours and statements. Quantitative research uses distance and controlled conditions to protect against biases; however, the intensity and closeness involved with qualitative research makes participant reactivity a constant concern.
- **Researcher bias** emerges when observations and interpretations are altered by preconceptions of the researcher.
- **Respondent bias** may occur when participants are not completely truthful. Participants may withhold information to protect their privacy or to avoid embarrassment. Conversely, participants may try and be helpful by offering information that they believe the researcher wants to hear rather than what actually occurred.

To minimize these threats to trustworthiness, qualitative researchers implement various strategies within their methods to enhance the scientific rigour of their study.

Strategies for rigour

Rigour refers to vigilance about methods—strategies

used to increase the trustworthiness of the research findings. Several strategies for rigour should be used within a study to reduce the potential for bias or misinterpretation and thus increase the trustworthiness of the conclusions. Familiarity with these strategies will enable the reader to appraise qualitative research more comfortably and critically. Strategies for rigour include, but are not limited to, the following:

- **Pilot testing:** Researchers need to anticipate how particular questions actually work in practice, that is, how participants may understand and interpret them. Thus, researchers may pilot test their interview protocol or focus group questions with a small cohort of people who meet the study's inclusion criteria to determine if the questions work as intended before the larger primary study begins. Qualitative research is iterative and reflexive, meaning that researchers commonly revisit and modify their design, particularly if their pilot test does not measure what was originally intended.
- **Data saturation:** Saturation of data refers to the point at which no new additional information is being generated. Saturation refers to completeness. The alternative to saturation—a predetermined endpoint or number of participants—is a poor fit for qualitative research.⁵ Using a predetermined endpoint for data collection increases the risk of missing information that may have emerged if more data was gathered. When conducting interviews for example, researchers continue to interview participants until no new data or themes emerge rather than predetermining a set sample size.
- **Triangulation:** Researchers may collect information from three or more sources and methods (e.g., interviews, observations, archival records) that can provide a more comprehensive description and analysis of events. When data collected from multiple methods converge, one has greater confidence that the results are valid.^{5,7}
- **Member checking:** Also known as “respondent validation,” researchers may seek verification of their findings by soliciting feedback from their study participants. Member checking can be an important step in guarding against researcher bias, by ruling out the possibility of misinterpreting the meaning of what study participants say.^{7,18} For example, researchers may provide their participants with a copy of the interview transcript or interpretative summary so the participants can verify that they have been accurately represented.¹⁸
- **Negative case analysis:** Acknowledging a human cognitive bias towards looking for confirming data that may fit with a researcher's beliefs, negative case analysis involves actively searching for disconfirming evidence and may include consulting with participants on discrepant findings.^{5,7} Negative case analysis enhances fairness by giving attention to differing viewpoints and minimizing favouritism or biased interpretations.

This section has highlighted a few key strategies

that qualitative researchers may employ to ensure their methods and results are trustworthy. Moreover, researchers should provide detailed and transparent accounts of these strategies for rigour used throughout the methods in their publications so readers can follow and critically appraise the validity of the findings. Scholarly peer review will serve as the final gatekeeper in determining rigour and trustworthiness. Peer review provides evidence that the study has been externally and impartially judged. Publishing the study then complements the satisfaction of having an answer to a well defined question. Publication is an important process for the dissemination of knowledge alongside translation into an evidence based practice.

CONCLUSION

The purpose of this paper was to provide an introductory description and analysis of the qualitative research process, while also contextualizing its role in dental hygiene through using examples of relevant studies. "Decoding" this process and examining its purpose, various approaches to research design, data collection methods, sampling techniques, and strategies for rigour aimed to strengthen the readership's ability to read, to appraise, and to apply qualitative research more critically. Qualitative research certainly has its role within the dental and social sciences; it need not be considered as less valuable to its more traditional counterpart. The best evidence on social dynamics and factors which influence why clients behave the way they do, regardless of clinical interventions employed, is most often found within qualitative studies.³ Qualitative research explores people's experiences and perspectives in great depth. The richness of this approach addresses the "what", "how" and "why" of behaviours and interactions. The capacity for qualitative research to explore and to analyze provides ample opportunity to satisfy formally driven curiosity and to contribute to evidence based dental hygiene practice.

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