Use of Technology in Canadian Occupational Therapists' practices with Older Adults: A Nationwide Survey

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Abbreviation list

CAOT	Canadian Association of Occupational Therapists
ICTs	Information and Communication Technologies
KT	Knowledge Translation
KTA	Knowledge to Action
OTs	Occupational Therapists
QoL	Quality of Life
WHO	World Health Organization

Abstract

Use of Technology in Canadian Occupational Therapists' practices with Older Adults: A Nationwide Survey

Introduction: In recent years, we have experienced increased population longevity due to successful advancements in the health care system. However, longevity also poses new challenges with respect to maintaining health and functional capacity through old age, especially in the current context of scarce human and financial medical resources[1]. The use of technology, such as information and communication technologies (ICTs), is an innovative way to support independence in later years so that older adults can age in place if they desire[2-3]. Technological products that cater specifically to the maintenance of independence, social participation, and the quality of life (QoL) needs of seniors[4], offer the potential to assist occupational therapists (OTs) in supporting home care services. However, to our knowledge, no study has investigated the current knowledge of such technology by Canadian OTs and which factors influence their use and recommendation of it in practice.

Objectives: The objective of this project is to describe the current state of knowledge on ICTs that Canadian OTs have and identify which factors are associated with its use and recommendation in practice.

Method: A Canada-wide online survey to investigate OT clinical practices specific to the use of ICTs was deployed. *Technology* was defined as: *products, instruments or systems used to improve the autonomy, security and well-being of people with disabilities. It includes technologies based on information and communications technology (ICT), as well as smart systems used to automate or facilitate tasks*. The survey included questions pertaining to

[1] United Nations, Department of Economic and Social Affairs, Population Division (2017). World Popula-tion Ageing 2017 - Highlights (ST/ESA/SER.A/397)

[2] Federation of Canadian Municipalities,, & Canadian Council on Social Development,. (2015). Seniors and housing: The challenge ahead: part II of Canada's aging population: the municipal role in Canada's demographic shift.

[3] Allard, G., Cloutier, A.-M., Laramée, P., Leblanc, G., Marier, D., & Paradis, C. (2011). 6 cibles pour faire face au vieillissement de la population – Association québécoise d'établissements de santé et de services sociaux (AQESSS). Montréal: Agence Médiapresse inc.

[4] Fozard, J.L., Rietsema, J., Bouma, H., & Graafmans, J.A.M. (2000). Gerontechnology: Creating ena-bling environments for the challenges and opportunities of aging. Educational Gerontology, 26(4), 331-344.

demographics, clinical practice characteristics, and technologies used. Provincial and territorial professional OT organizations were contacted to invite their members to complete the short survey, available in both English and French. Pilot testing of the survey was conducted prior to deployment for content validity. Descriptive statistics, chi-square analyses, and logistic regression analyses, were completed to describe clinical practices and identify which factors are associated with the usage of technology.

Results: There were 874 respondents to the survey and 681 full completions. Among those, 387 reported working with a *geriatric* or *geriatric and adult* clientele. Of those, 177 (45.7%) reported being familiar with technology but only 48 (12.4%) reported using it in practice. The majority of respondents were females working in the provinces of Quebec and British Columbia. The results show that the majority of OTs who are *familiar and users* of technology in practice are over the age of 45 and have over 10 years of clinical experience. The most reported used and recommended technology in practice addressed disability with communication (97.9%), followed by technologies addressing disabilities related to cognition (79.2%). More specifically, within those to support communication, the most common was text to speech applications (33%) for websites on computers, tablets, or smartphones. Within those for cognition, the most common was applications on tablets or smartphones for cognitive stimulation (48%). Finally, the univariate logistic regression showed that the odds of using technology in clinical practice increased if OTs were older (*35-45* age group (OR: 3.40) and *over 45* age group (OR: 5.23) as opposed to the *24-34* age group), had over 10 years of clinical experience (OR: 2.65), offered vocational rehabilitation client services (OR: 2.74), treated swallowing client conditions (OR: 6.25) or worked in a rehabilitation hospital or facility (OR: 2.74), as opposed to OTs that did not. On the other hand, the odds were lower for OTs offering assessment or orientation hospital services (OR: .28)), if they addressed dementia and related syndromes client conditions (OR: .035) or if they worked in a general hospital (OR: .34). In the multivariate logistic regression, only years of clinical experience remained positively associated with use of technology in clinical practice (OR: 2.43), and working in a general hospital, as well as treating dementia and related conditions, remained significantly negatively associated with usage of technology (OR: .378 and .415 respectively).

Conclusion: The results highlight that OTs lack knowledge on the current ICTs available for use in their practice with older adults. Moreover, familiarity with such technology is not enough to ensure its use. Personal and workplace environmental factors need to be accounted for when preparing recommendations for implementation of technology use in practice. Further research is needed to elucidate the facilitators and barriers faced with adoption of technology in practice.

Résumé

L’utilisation des technologies dans la pratique des ergothérapeutes canadiens avec des personnes âgées: un sondage national

Introduction: Au cours des dernières années, la longévité de la population a augmenté grâce aux progrès réalisés dans le système de soins de santé. Cependant, la longévité pose également de nouveaux défis en ce qui concerne le maintien de la capacité fonctionnelle et de la santé tout au long de la vieillesse, et ce, en particulier dans le contexte actuel où les ressources médicales humaines et financières sont limitées. L'utilisation des technologies, telles que les technologies de l'information et de la communication (TIC), constitue un moyen novateur de soutenir l'indépendance au cours des années à venir, de sorte que les personnes âgées puissent *vieillir chez soi*, si elles le désirent. Les produits technologiques destinés spécifiquement au maintien de l’indépendance, à la participation sociale, et aux besoins en qualité de vie des personnes âgées, offrent la possibilité d’aider les ergothérapeutes à soutenir les services de soins à domicile. Cependant, à notre connaissance, aucune étude n'a investigué les connaissances actuelles des ergothérapeutes canadiens sur ces technologies et les facteurs qui influencent leur utilisation et recommandation en pratique.

Objectifs: L'objectif de ce projet est de décrire l'état actuel des connaissances sur les TIC des ergothérapeutes canadiens et d'identifier les facteurs associés à leur utilisation et recommandation en pratique.

Méthode: Un sondage pancanadien visant à investiguer les pratiques cliniques spécifiques à l'utilisation des TIC des ergothérapeutes a été déployé en ligne. La technologie a été définie comme suit : *produits, instruments ou systèmes utilisés pour améliorer l'autonomie, la sécurité et le bien-être des personnes ayant un handicap. Ceux-ci incluent des technologies basées sur les technologies de l'information et de la communication (TIC), ainsi que des systèmes intelligents utilisés pour automatiser ou faciliter des tâches*. L’enquête comprenait des questions relatives à la démographie, les caractéristiques de la pratique clinique et des technologies utilisées. Les organisations professionnelles des ergothérapeutes de chacune des provinces et des territoires ont été contactées afin d’inviter leurs membres à remplir le bref sondage, disponible en anglais et en

français. Un test pilote du sondage a été mené avant le déploiement afin de vérifier la validité du contenu. Des statistiques descriptives, des analyses khi-carré et des analyses de régression logistique ont été réalisées pour décrire les pratiques cliniques et identifier les facteurs associés à l'utilisation de la technologie.

Résultats: Nous avons reçu 874 réponses au sondage et 681 étaient complètes. Parmi celles-ci, 387 des répondants ont rapporté travailler avec une clientèle *gériatrique* ou *gériatrique et adulte*. Parmi eux, 177 (45.7%) ont rapporté être familier avec la technologie, mais seulement 48 (12.4%) ont déclaré l'utiliser dans leur pratique. La majorité des répondants étaient des femmes travaillant dans les provinces du Québec et de la Colombie-Britannique. Les résultats montrent que la majorité des ergothérapeutes *utilisateurs de technologies* ont plus de 45 ans et plus de 10 ans d'expérience clinique. Les ergothérapeutes utilisateurs de technologie ont le plus souvent rapporté recommander des technologies pour aides à la communication (97.9%), suivie des technologies traitant des incapacités liées à la cognition (79.2%). Plus spécifiquement, parmi celles soutenant la communication, les plus courantes sont les applications de synthèse vocale pour ordinateurs, tablettes ou téléphones intelligents (33%). Les applications les plus courantes pour la cognition sont les applications sur tablettes ou téléphones intelligents pour la stimulation cognitive (48%). Enfin, la régression logistique univariée a montré que les probabilités d'utilisation de la technologie en pratique clinique augmentaient si les ergothérapeutes étaient plus âgés (groupe d'âge de *35-45 ans* (OR: 3.40); groupe d'âge *plus de 45 ans* (OR: 5.23) par comparaison au groupe d'âge de *24-34 ans*), avaient plus de 10 ans d'expérience clinique (OR: 2.65), offraient un service de réadaptation professionnelle (OR: 2.74), traitaient des problèmes de déglutition (OR: 6.25) et travaillaient dans un hôpital ou un établissement de réadaptation (OR: 2.74). Les probabilités étaient négativement associées si les ergothérapeutes offraient des services hospitaliers d'évaluation (OR: .28), s'ils traitaient une clientèle atteinte de démence (et syndromes associés) (OR: .035) et s'ils travaillaient dans un hôpital (OR: .34). Dans la régression logistique multivariée, seule le nombre d'années d'expérience clinique restait positivement associé à l'utilisation de la technologie en pratique (OR: 2.43) et le travail dans un hôpital général ainsi que le traitement de la démence (et syndromes associés) restaient négativement associés à l'utilisation de la technologie (OR: .378 et .415 respectivement).

Conclusion: Les résultats du sondage soulignent que les ergothérapeutes manquent de connaissances sur les TIC actuelles pouvant être utilisées dans leur pratique avec les personnes âgées. De plus, une connaissance de ces technologies ne suffit pas pour en garantir l'utilisation. Les facteurs environnementaux, personnels, et professionnels, doivent être pris en compte lors de la préparation des recommandations pour la mise en pratique de l'utilisation de la technologie. Des recherches supplémentaires sont nécessaires afin d’élucider les facilitateurs et les obstacles à l’adoption de la technologie dans la pratique.

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Preface

This manuscript-based thesis was written to fulfill the graduation requirements of a Master's in Rehabilitation Science at McGill University. It is written in accordance to the guidelines of the Faculty of Graduate and Postdoctoral Studies of McGill University. It contains a research manuscript and is organized as follows:

Chapter I presents a review of the existing literature relevant to aging of the population and the current research, development, and use of advanced technology in aging research.

Chapter II presents the rationale and objectives of the research project.

Chapter III consists of the manuscript titled *"Canadian occupational therapists' use of technology with older adults: a nationwide survey"*.

Chapter IV discusses the main findings of the study and implications to practice.

Chapter V provides concluding remarks and a summary about the main findings of the study including future research directions.

Contributions of authors

The research manuscript contained in this thesis is titled: “Canadian occupational therapists’ use of technology with older adults: a nationwide survey”. The research project was done under the supervision of Dr. Patricia da Cunha Belchior and co-supervisor Dr. Nathalie Bier. It was completed at the Centre de Recherche de l’Institut Universitaire de Gériatrie de Montréal.

This project was designed by the research team composed of Dr. Patricia da Cunha Belchior, Dr. Nathalie Bier, Dr. Louise Demers, Dr. Claudine Auger, Dr. Hélène Pigot, Dr. Dany Lussier-Desrochers, Dr. Martin Caouette and Mme Christine Ménard. My involvement in the project consisted in obtaining ethics approval, recruiting participants, completing the data collection and statistical analysis, including the logistic regression, as well as the preparation of the manuscript. The research team, with the addition of Dr. Mélanie Couture and Dr. Maxime Lussier, provided feedback on the interpretation of the manuscript results. Moreover, Dr. Maxime Lussier provided additional guidance for the statistical analysis.

The supervisory committee members, including Dr. Patricia da Cunha Belchior, Dr. Nathalie Bier and Dr. Isabelle Gélinas, reviewed this thesis and provided feedback.

CHAPTER I: INTRODUCTION

1.1 An aging world

The worlds' population is aging at unprecedented rates; there has been an increase of 48% in people aged 60 years or over from 2000 to 2015 and projections estimate a rise to 56% by 2030, totalling 1.4 billion individuals (United Nations, 2015). In 2017, 962 million individuals were aged 60 years or over globally, representing one in eight people, and the projections for 2030 remained unchanged (United Nations, 2017). While increased population longevity illustrates the successful medical advancements in the health care system, it also poses new challenges with respect to maintaining health and functional capacity through old age. In fact, this demographic shift is necessitating a redesign in the organization of the delivery of care and a review of policy reforms, across the world, to improve and effectively address the health demands for healthy aging (Osborn, Moulds, Squires, Doty, & Anderson, 2014; Araujo et al., 2017).

In framing a cohesive public-health response, first, the World Health Organization (WHO) (2015) defines *healthy aging* as "the process of developing and maintaining the functional ability that enables well-being in older age" (p.228). In that definition, *functional ability* reflects "the health-related attributes that enable people to be and to do what they have reason to value" while considering "the individual, their environments, and the interaction between them" (WHO, 2015). This new shift of focus on *functional ability* in healthy aging, as opposed to a *disease-free state*, emerges from the notion that "many individuals may have one or more health conditions that are well controlled and have little influence on their ability to function" (WHO, 2015). Indeed, functional independence is important to be able to live in the community (i.e. age in place) and avoid institutionalization (WHO, 2015; Luppa, Luck, Weyerer,

König, Brähler, & Riedel-Heller, 2010). Nonetheless, it is well established that aging seldom comes without any associated cognitive or functional decline hindering participation in daily activities and putting older adults at risk for institutionalization (Luppa et al., 2010; Marengoni et al., 2011; Colón-Emeric, Whitson, Pavon, & Hoenig, 2013; Murman, 2015). Gearing on supporting *functional ability* for independence in older age and avoidance of institutionalization is an important step towards addressing the current and anticipated health care delivery challenges.

1.2 Functional independence in later life

An individuals' functional independence level is established by the extent of their ability to perform basic activities of daily living (BADLs), the activities necessary to satisfy basic needs (e.g. personal hygiene and eating), and instrumental activities of daily living (IADLs), the more complex activities associated with successful functioning in the community (e.g. preparing meals, transportation and managing money or medication). The decline in these capacities through old age is dynamic, complex in nature, and its rate varies from one individual to another as it can slowly ensue as part of a *normal* aging trajectory or be accelerated subsequent to a health condition (WHO, 2015; Park & Lee, 2017).

Research shows that increased functional dependence results in poorer quality of life (QoL) and increased health care costs (WHO, 2015). In fact, relationships have been highlighted between functional dependence and an increased risk for morbidity as well as mortality (Millán-Calenti et al., 2010). Moreover, the presence of limitations is a risk factor for hospitalization (Chan et al., 2002; Greysen, Stijacic, Auerbach, & Covinsky, 2015; Na et al., 2017) which increases if insufficient care is received (Xu, Covinsky, Stallard, Thomas, & Sands, 2012). An

increasing severity in the limitations that an individual may experience in performing their daily activities is further associated with an increased risk for institutionalization (Luppa et al., 2010).

Similarly, the risk for institutionalization additionally increases in the absence of formal (e.g. homecare services) or informal (e.g. caregiver) support and assistance in meeting daily living needs (Luppa et al., 2010). The subsequent economic burden of functional disability on health care expenditures related to aging and hospitalization, health care utilization, and institutionalization, has been underlined in multiple studies (Fried, Bradley, Williams, & Tinetti, 2001; Chan et al., 2002; Taylor and Hoenig, 2006; Van, H. J., Van, O. H., Berger, De & Van, H. K., 2015). As such, finding means to manage and limit the functional losses through old age is also important from an economic perspective.

Additionally, functional losses can be a barrier to age in place. In fact, most older adults prefer to age in place, for as long as possible and even in the event of loss of autonomy (Eckert, Morgan, & Swamy, 2004; Wolff, Kasper, & Shore, 2008; WHO, 2015). In a study exploring the meaning of *aging in place*, older adults have expressed that they value remaining in their own homes as it provides them with a sense of attachment, of social connectedness in their community, a sense of security acquired from the familiarity of their surroundings (extending to both the individuals and the actual environment), and a sense of identity driven from retaining independence (Wiles, Leibing, Guberman, Reeve, & Allen, 2012). Moreover, provision and usage of home health services can delay admission to nursing homes (Chen & Berkowitz, 2012; Young, Kalamaras, Kelly, Hornick, & Yucel, 2015) and has been shown to be able to reduce health care expenditures (Marek, Stetzer, Adams, Popejoy, & Rantz, 2012). Considering the high costs associated with institutionalization (Fried et al., 2001; Chan et al., 2002; Taylor & Hoenig, 2006; Van et al, 2015) and the meaning, value, and sense of individuality that *aging in place*

holds for the older adults (Wiles et al., 2012), the preservation of functional capacities, for successful living in the community for as long as possible, becomes important from both an individual and societal perspective.

Research initiatives in the field of *technology and aging* have found to be promising in enabling *aging in place* and face the upcoming societal and economic pressures of the aging population in the current context of scarce human and financial medical resources.

1.3 Technology for independent living

Research in the field of *technology and aging* has been growing since the 1980s and continues to grow (Schulz, Wahl, Matthews, De, Beach, & Czaja, 2015). The interest arises from the coupling of an aging population with the fast pace of technological advancements and the rising interests of different sectors to tackle health care needs with the development of tools and services to maintain the independence of older adults, improve QoL, and decrease the associated healthcare costs (Schulz et al., 2015).

1.3.1 Technology terminology

The terminology in the field of technology is very diverse. First, in the context of research in *technology* intended for functional performance, the concept of *assistive technology* comes into play. *Assistive technology devices* are known as "any items, piece of equipment or product system whether acquired commercially off the shelf, modified, or customized that is used to increase, maintain or improve functional capabilities of individuals with disabilities", with respect to any functional capability and disability (Technology Related Assistance for Individuals with Disabilities, Act of 1988). These devices can range from non-technological devices, such as the use of a pencil grip to aid writing, to low-tech technologies, such as the use

of E-Tran boards for communication, to *smart* technologies, such as voice-operated recognition systems (Developmental Disability Association, 2018). There are also the *assistive technology services* which encompasses undertaking needs evaluation, selection of the appropriate devices, purchase of said devices, provision of support to the end-user and other individuals involved in the process of adapting to the device, as well as training of involved staff (Center on Technology and Disability [CTD]). As such, the term *assistive technologies* also serves as an umbrella term for various types of technologies considering the heterogeneity of conditions and purposes they address.

Along with *assistive technologies*, there are also *information and communication technologies* (ICTs) - the focus of this thesis. These advanced technologies allow for the acquisition, transfer, and processing of information through communication technological means. When ICTs are used in the context of health, they refer to eHealth technologies (WHO, 2012) and include higher technological tools supporting health care delivery such as management systems (e.g. electronic health records), communication systems (e.g. telemedicine), computerized decision support systems (e.g. systems that can be accessed through mobile phones to assist in clinical decision making), and information systems (e.g. use of Internet to access health-related sources of information) (Mair et al., 2009).

In the context of research in *technology in aging*, the field of gerontechnology emerges. Gerontechnology is a discipline that couples' gerontology, the study of aging, and technology, the development and distribution of technologically based products, environments, and services (Fozard, Rietsema, Bouma, & Graafmans, 2000). These technological products and services, derived from ICTs, are enhanced technical applications that consider the sensory, cognitive, physical functioning, and mobility, age-related challenges (Fozard et al., 2000). Their purpose is to compensate for (or delay) such losses experienced by the seniors as well as support (or

enhance) the maintenance of their independence, social participation, and QoL needs (Fozardet al., 2000). As such, these emerging technologies are designed to be applied in aspects of life related to housing, communication, mobility and transportation, health, work, recreation, and self-fulfillment (Fozard et al., 2000).

1.3.2 Significant technology targeted research initiatives to aid independent living

Research initiatives are being funded worldwide to further develop ICTs and provide support to assist healthy aging. For instance, from 2008 to 2013, over 1 billion EUR has been invested into research on aging well by the European Union, Member States and the industry in Europe (European Commission, 2014). This funding supported projects from the *7th Research Framework Programme*, the *Ambient Assisted Living Joint Programme* and those of the *Competitiveness and Innovation Programme* (European Commission, 2014). In 2014, the *Horizon 2020* framework program took over with 80 billion EUR in funding supporting projects from (but not limited to) the *Active and Assisted Living Programme* (formerly called the *Ambient Assisted Living Joint Programme*) and the *Knowledge and Innovation Community* (European Commission, 2014). All of these programs, within the European Commissions' action plan, have the aim of developing ICT solutions to improve older individuals' QoL and empower them to live independently in their desired environment.

In the United States, the National Institutes of Health (NIH) are leading a new initiative aimed at studying the use of in-home sensors and other technologies to systematically record, track, and detect changes in older adults' key health- and independence-related activities (e.g. sleep, mobility, body composition, and driving) (National Institute on Aging, 2017). This initiatives' goal is to ultimately enable and prolong older adults' independence through the use of unobtrusive technological tools. This $7 million dollar, 4-year long project titled *Collaborative*

Aging (in Place) Research Using Technology began in 2016 and will be integrated in over 200 homes across the United States.

In Canada, a pan-Canadian network called *Aging Gracefully across Environments using Technology to Support Wellness, Engagement and Long Life* (AGE-WELL) has been established through federal funding from the Network of Centers of Excellence (NCE) in 2015. The research initiative is funded until February 2020 and is dedicated to helping older Canadians maintain their independence, health, and QoL, through the development of technologies and services that increase safety and security, support independent living, and enhance social participation (AGE-WELL, 2018). The network brings together non-profit organizations, the government, the industry, end-users, caregivers, and academic partners, to drive innovative research organized in addressing three over-arching questions: 1) What are the needs of older adults and caregivers and how could technology be used to meet those needs?; 2) What technology-based systems and services should be used to enhance the health, well-being of older adults and support independent living?; and 3) How can innovation be fostered in the short and long-term to benefit older people, health care providers and Canadian Industry? (AGE-WELL, 2018b).

1.3.3 Technology research and aged-care issues

Working towards the public health goals of assisting older adults in longer independent living, various devices for aged care issues are being tested in interventions. In a narrative review of the research on technology for older adults' in-home use, Piau and colleagues (2014) identified that several publications addressed older adult or caregiver needs with social isolation, autonomy loss (functional decline), and cognitive disorders. To address these needs, research has investigated the use of video-phonic communication, affective orthotic devices or companion-type robots (for social isolation), various technologies for maintenance of independence (for

functional decline) as well as cognitive orthotics, wandering or tele-monitoring systems (for cognitive disorders). In a more recent systematic review of the literature, Khosravi and Ghapanchi (2016) identified that eight aged care problems are targeted and investigated by ICT researchers: (1) dependent living, (2) fall risk, (3) chronic disease, (4) dementia, (5) social isolation, (6) depression, (7) poor wellbeing, and (8) poor medication management. To overcome the above mentioned aged care difficulties, a combination of varying types of assistive technologies have been proposed, namely general ICTs, robotics, telemedicine, sensor technology, medication management applications, and video games (Khosravi & Ghapanchi, 2016). While not every device is successful in its intended purpose to aid functional performance, the potential benefits of ICTs for the QoL of older adults have been emphasized in many recent systematic reviews (Piau et al., 2014; Khosravi & Ghapanchi, 2016; De Sousa Leite et al., 2016; Liu, Stroulia, Nikolaidis, Miguel-Cruz, Rincon, 2016; Siegel & Dorner, 2017; Kim, Gollamudi, & Steinhubl, 2017).

1.3.4 Benefits of technology

Potential benefits of assistive technologies and ICTs have been found with regards to attending to older adults issues of loneliness and social isolation, mobility and falls, cognitive disorders, and assistance in other activities of daily living (e.g. medication management), through the use of a combination of means such as the internet, mobile phones, robots, monitoring sensors, smart homes, or telehealth services (Siegel & Dorner, 2017; Kim, Gollamudi, & Steinhubl, 2017; Khosravi, P., & Ghapanchi, A. H., 2016; De Sousa Leite, E. et al, 2016; Piau et al., 2014). Their potential benefit for decreased healthcare costs have also been illustrated

(Khosravi and Ghapanchi, 2016; Siegel and Dorner, 2017; Kim et al., 2017). Examples of the ways in which ICTs are beneficial for older adults and their caregivers are highlighted below, along with examples in which technologies benefit the heath care systems' associated costs.

Perceived benefits and clinical benefits for older adults (and caregivers)

Qualitative and quantitative research on ICTs for older adults demonstrate that their potential benefits can be perceived and/or of clinical relevance. For instance, Siegel and Dorner's (2017) systematic review exploring the influence and effect of ICTs on the QoL and subjective health of older adults concludes that technologies can provide feelings of empowerment to the older adults by allowing them to have control over their health problems, by compensating for functional disabilities, and increasing their safety. Similarly, in the scope of improving older adults fall management, studies in sensor technology for fall risks have demonstrated the feasibility of unobtrusively tracking in-home gait to detect walking anomalies suggestive of upcoming falls, thus improving the potential for clinical action (Gregory et al., 2017).

ICTs to address Loneliness and Social isolation

In attending to the feelings of loneliness and social isolation that older adults may experience, it appears that technology can work as a disabler of solitude. A recent systematic review of the quantitative and qualitative literature specifically investigating ICT interventions on reducing social isolation of seniors suggested that technology may be effective in alleviating older adults' social isolation by means of connection to the outside world, gaining social support, engaging in activities of interests, and boosting self-confidence (Chen & Schulz, 2016). For instance, Internet use allows building computer-based social networks which provided the seniors with connection to the outside world and social support (Nahm, Resnick, & Mills, 2003).

Similarly, nursing home older adults using videoconferencing chats with their family members reported improved social support, alleviated depressive symptoms and lower feelings of loneliness (Tsai, H. H., Tsai, Y.F., Wang, Chang, Chu, 2010).

ICTs to address Mobility and Falls

A review of the literature by Pietrzak, Cotea and Pullman (2014) on smart homes and computer-based monitoring technologies aimed at preventing and detecting falls in community-dwelling seniors elaborates that older adults experience a decreased fear of falls with the implementation of such technologies. The increased fall-related confidence and feelings of safety from using these technologies also minimized mobility restrictions (e.g. they feel safer to go outside of their home) (Pietrzak, Cotea, Pullman, 2014). As mentioned previously, sensor technology for fall risks has demonstrated promise in detection of changes in walking patterns predictive of falls (Gregory et al., 2017), but other technologies, such as mobile devices with accelerometers, are also successful for fall detection and classification (i.e. determining the type of fall that has occurred; e.g. forward, backward, sideways falls) (Albert, 2012; Lee & Carlisle, 2011). Wearable sensors (e.g. wristband sensor (Jung et al., 2015) or waistband sensors (Lee & Carlisle, 2011) can also be wirelessly connected to a mobile phone for fall surveillance, detection, and sending an alarm/notification to get help when a fall occurs.

ICTs to address Cognitive disorders

Technology can also aid older adults with cognitive impairments and their caregivers. This can be done by providing feelings of independence to older adults and reassurance of safety to caregivers. In a study exploring attitudes towards GPS technology, older adults report gaining more independence and caregivers reported that the tracking device provided them with *piece of mind* (Liu, Miguel Cruz, Ruptash, Barnard, & Juzwishin, 2017). Aside from the perceived benefits, ICTs can also help older adults compensate for their impairments by assisting in their

performance of daily activities. For instance, touchscreen videophones have the potential to ease making phone calls (i.e. to maintain social contact) (Boman, Lundberg, Starkhammar, & Nygård, 2014), and a computerized device using audio and/or audio-video prompts can help older adults with mild-to-moderate dementia complete handwashing independently and require fewer interactions with a caregiver (Mihailidis, Boger, Craig, & Hoey, 2008).

ICTs overall

In the aforementioned examples, technologies have been applied to specific aged care issues. However, it is important to note that technological tools are versatile and can be used/adapted to address multiple issues. Thus, a smart phone can serve to help track mobility in prevention of falls, but can also help social isolation and/or cognitive disorders. Similarly, robots have been designed to simultaneously address various aged care issues and research reveals they potentially enhance senior's well-being and decrease caregiver burden (Reza, Sima, Rajiv, & Mei-Tai, 2014). For instance, robots can be used in therapy, act as a companion, and aid with mobility, completing household tasks, monitoring health and safety (Broadbent, Stafford, & MacDonald, 2009; Khosravi & Ghapanchi, 2016).

Moreover, while the benefits of ICTs in aging are promising, it is important to acknowledge that these technologies are not a 'one-size-fits-all' solution and that negative results, as well as short-lived positive outcomes, have also been reported. For example, while individuals with mild dementia found the memory prompts of the COGKNOW day navigator helpful in supporting them, the effects did not translate to their independence or QoL, neither did it help their caregiver burden (Meiland et al., 2012). Alike, while videoconferencing chats improved feelings of social support, alleviated depressive symptoms, and lowered feelings of loneliness, these positive effects were not maintained at the 6-month or 12-month time points of the intervention (Tsai et al., 2010).

Cost benefits for the health care system

Aside from the potential benefits for the health well-being of older adults and promotion of healthy aging, technology also promises to improve the delivery of care to older adults and decrease the costs to the healthcare system. A systematic review on the health information technologies in geriatrics and gerontology reveals that five types of technologies are mainly used by health care: (1) telecare technology; (2) electronic health records; (3) decision support systems; (4) web-based packages for patients and/or family caregivers; and (5) assistive information technologies (Vedel, Akhlaghpour, Vaghefi, Bergman, & Lapointe, 2013). In 94% of included studies, these technologies translated into positive impacts on clinical processes by improving the quality of care, improving continuity of care and timely access to care, increasing the accuracy of records and decreasing clinical errors or adverse drug effects, as well as improving clinical assessments, detections, and monitoring (Vedel et al., 2013).

Further support is highlighted in a systematic review of systematic reviews and meta-analyses investigating the effectiveness and cost-effectiveness of eHealth interventions (including, but not limited to, technologies such as telemonitoring, web or mobile phone-based education, and mobile phone-assisted self-management programs) for patients with somatic diseases and in which personalized feedback was given from a health care professional (Elbert et al., 2014). The authors concluded that many of the articles show eHealth to be effective and cost-effective or at least promising (Elbert et al., 2014).

In the European Union's digital agenda report (2014), it is estimated that the introduction of ICT and telemedicine to the health care system has improved its efficiency by 20%. Furthermore, home care services costs can be diminished by up to 30% through telecare solutions; hospital days as well as nursing costs can be reduced by 26% and 10% respectively

through home telemonitoring of patients suffering from heart diseases; and e-prescriptions reduce costly drug dosage errors by 15% (Digital Agenda Report, 2014).

1.3.5 Technology availability on the market

Development of advanced technology for the aging population goes far beyond the realm of academic research. In fact, the business prospects of such innovations for seniors are recognized. Aside from the projects funded through research initiatives, start-ups working on homecare-based technologies have received over $200 million dollars in funding from venture capitalists by 2016 (Orlov, 2018). Moreover, opportunities to share ideas to further develop products, learn about new innovations redesigning care delivery, and connect with innovators, healthcare providers, business leaders, or market analysts, to name a few, are available through conferences alike the Connected Health conference, the Internet of Health USA conference, the Aging 2.0 conference, the Consumer Technology Association conference or the What's Next Boomer Business Summit.

Currently, a wide variety of advanced technology is available for purchase on the market. A market overview report from 2018 includes a list of technologies for communication and engagement (e.g. Amazon Echo), for home safety and security (e.g. TruSense sensor monitoring system), for health and wellness (e.g. Mymeds medication reminder app), for seniors learning and contribution (e.g. LiveTech which provides educational resources for seniors), for home care (e.g. Marvee, a voice operated check-in device), and for caregiving (e.g. GoGo Grandparent app to arrange transportation needs) (Orlov, 2018). Of note, some variances of these products are available at the doors of consumers at stores such as BestBuy. In fact, the American BestBuy offers a range of senior care products (e.g. *smart* medication pill dispensers) specifically under the tab *Technology Solutions Designed for Seniors*. In addition to the products, it also offers a

customizable assisted living senior service package using smart technology and promoting safety, independence, and connectedness, called *Assured Living*. Other (tele-)health monitoring devices and services are also offered by Honeywell for patients (e.g. the *Genesis Telemonitor*) and clinicians (e.g. the LifeStream clinical monitoring software) (Honeywell – Life Care Solutions) and by Philips (e.g. eCareCoordinator for clinicians or eCareCompanion for patients) (Philips – Home TeleHealth). As such, advanced technologies are becoming unavoidable with or without solid evidence of their impact on home care.

1.4 Factors influencing technology adoption and use

Notwithstanding the research developments and availability of ICTs on the market, the success of technology driven health initiatives relies on its successful acceptance and adoption by their intended end-user, whether it be the different health practitioners, the older adults themselves, or their caregivers. Technology going from adoption to use is multifactorial and different models have been proposed (Venkatesh, Thong, & Xu, 2016).

1.4.1 By older adults

The adoption of technology in daily life by older adults is increasing. Although proportions are still substantially lower in comparison to their younger counterparts, a recent Pew Research Center survey (2017) highlights the rising number of digitally connected American older adults (65 and older): 67% now report using the internet (as opposed to 12% in 2000), 51% use a home broadband (as opposed to none in 2000), 42% report owning a smartphone (as opposed to 11% in 2011), 34% use social media (as opposed to 2% in 2008), and 32% have a tablet (as opposed to 1% in 2010). Interestingly, the Deloitte's 2016 *Survey of US Health Care Consumers* exploring consumer expectations, preferences, and concerns around technologies, found that seniors and baby boomers are more likely than younger generations to

use sensor technologies such as location tracking devices (for caregivers), fall detection devices for caregivers or for self.

Moreover, as touched upon in the previous section, research highlights that older adults recognize the benefits of technologies. For instance, with respect to *home safety* devices and *health and wellness* technologies, survey data from the American Association of Retired Persons (AARP) (2008) suggests that older adults are aware these can support their independence and preference for *aging in place*, as well as provide their family members with peace of mind. Furthermore, in a study led by Mitzner and colleagues (2010), community-dwelling older adults reported positive attitudes towards using various types of technology (e.g. microwaves, computers (Internet), blood monitoring devices), in different domains of their lives (i.e. home, work, and health domains). Particularly, these positive attitudes are with regards to technologies ability to provide support to their daily activities, to make tasks less effortful mentally and physically (convenience), and to containing various useful features enabling different functions (Mitzner et al., 2010).

Research exploring enablers of ICT adoption amongst older adults identifies that multiple factors exist. Based on the *Unified Theory of Acceptance and Use of Technology 2* (UTAUT 2) model of technology acceptance, a systematic review was completed by Vassli and Farshchian (2018) on the available empirical qualitative data regarding the acceptance of health-related ICT among seniors living in the community. In concordance with the aforementioned survey reports, the review reiterates that older adults living in the community *want* to use health-related ICTs if it provides them social connectedness, a sense of safety and security, as well as allows them to maintain their well-being, their daily activities, and live independently. However, they have also

identified many barriers to adoption, namely issues surrounding concerns over privacy and lack of familiarity (Fischer, David, Crotty, Dierks, & Safran, 2014); ease of use (Hawley-Hague, Boulton, Hall, Pfeiffer, & Todd, 2014), reliability (Hawley-Hague et al., 2014); security, data presentation accuracy and costs of technology ownership (Memon, Wagner, Pedersen, Beevi, & Hansen, 2014); obtrusiveness and social stigma (Wagner, Basran, & Dal Bello-Haas, 2012) to name a few (see Vassli & Farshchian, 2018, for exhaustive review). These factors need to be accounted for and addressed when attempting to motivate an older adult to adopt and use technology.

1.4.2 By health care professionals

Approaches using ICT have demonstrated promising feasibility and effectiveness by certain health professionals, for various health conditions. For instance, a review by Johansson and Wild (2011) shows that tele-health has been successfully implemented by health professionals for patients requiring post-stroke rehabilitation care and high levels of satisfaction were reported by both health care providers and patients.

Despite demonstrations of feasibility and effectiveness of approaches using ICT by certain health professionals, the variation in adoption and use of technology in this group holds as true as it is amongst older adults. A systematic review on the factors which influence the adoption of ICTs by health care professionals in clinical settings presents that such research has been conducted with physicians, nurses, mixed clinical staff, and clinical as well as clerical staff (e.g. managers) and summarized findings concerning technologies including electronic medical/health patient records, information retrieval systems, personal digital assistants, clinical/hospital/nursing information systems, computerised decision support systems, computerized physician order entry, telemedicine and e-learning (Gagnon et al., 2012). It points

out that ICT implementation, in practice, is dependent on various factors, including technological factors (e.g. ICT specific), personal factors (e.g. perceived usefulness of the technology), and environmental factors (e.g. human environment (e.g. attitude of colleagues with respect to ICT) and organizational factors (e.g. time constraints) (Gagnon et al., 2012). Particularly, they identify that *system usefulness* (i.e. the perceived benefit of the technology) is the most common facilitator for the implementation of various types of ICTs, followed by the *ease of use* of said technology. On the other hand, barriers included issues regarding design (most common barrier across technologies), having technical concerns, lack of familiarity with ICTs, and time constraints (Gagnon et. al., 2012). The review concludes that "*ICT adoption is complex, multi-dimensional, and influenced by a variety of factors at individual and organisational levels*" (Gagnon et al., 2012, pp.9-1). Similarly, Vedel et al. (2013) found a barrier in the incompatibility of health information technologies in geriatrics and gerontology with the values, professional practices, and patient and/or practitioners needs. They report that only 62% of the studies identified in their systematic review are fitting with the practices, personal values and/or needs of practitioners and patients. Moreover, only 55% of the studies they identified considered that technologies were easy to use (Vedel et al., 2013). While technology use in the health care system may not be a natural practice for many professions, technology is not foreign to the field of occupational therapy (Smith, 2017).

1.5 Occupational therapy

Occupational therapy is a rehabilitation health care profession that focuses on addressing issues related to one's ability to accomplish tasks or participate in the activities that are important to them (World Federation of Occupational Therapists [WFOT], 2016). In other words, the practitioners' primary goal is to support the ability to engage in the occupations one wants to do,

needs to do, or is expected to do (WFOT, 2016). Given that occupational engagement can be supported or restricted by the individual, the occupation itself, or their environment, improved engagement is achieved by modifying one or a combination of these factors (WFOT, 2010). In fact, occupational therapists (OTs) are practitioners that have the training and knowledge not only of the physical limitations of a disability or injury, but also the psychosocial and environmental influences on the functioning of the individual (Canadian Association of Occupational Therapists [CAOT], 2016); they are rehabilitation specialists and experts in adapting environments. As such, they provide client-centered services to help individuals lead more productive lives by assessing their needs in the context of their specific abilities and environments, and planning interventions accordingly (CAOT, 2016). Additionally, the role of OTs scopes multiple spheres of the health care system. Indeed, they work with clienteles of all ages and in a variety of settings including homes and the community (e.g. community health centers), institutions (e.g. hospitals), the industry (e.g. corporations), and the government (e.g. as advisors in the areas of health promotions), as well as a variety of areas (e.g. general physical health, mental health, neurological health) (CAOT, 2016).

1.5.1 Occupational therapist and advanced technology use

As mentioned previously, OTs consider the environment of their client when designing an intervention. Through these environmental assessments, they can establish the appropriate interventions to reduce environmental barriers as well as effectively promote function and safe participation in daily activities- benefits which have been highlighted in a recent systematic review on the effect of home modification interventions on the participation of community-dwelling adults with different health conditions (Stark, Keglovits, Arbesman, & Lieberman, 2017). While these assessments are commonly done on-site, a recent scoping review of the

literature synthesizing technology use in occupational therapy home assessments complements the previous findings by highlighting that OTs use ICTs, such as telehealth, in conducting their home assessments and that this method could offer the potential to improve the efficiency of service delivery (Ninnis, Van Den Berg, Lannin, George, & Laver, 2018).

In addition to using technology to enhance their ability to conduct environmental assessments, OTs could also play a role as providers of technology as part of the intervention and care of their clients with different conditions (AOTA, 2015; CAOT, 2012). For instance, they use assistive devices such as cognitive orthoses, monitoring technologies, and smart home devices, in interventions for people with Alzheimer's disease or related dementias to address concerns of safety (Collins, 2018). Their involvement in an intervention making use of digital memory aids providing prompts to adults with brain injury supported patients in decreasing the amount of daily memory failures (Lannin, Carr, Allaous, Mackenzie, Falcon, & Tate, 2014). Moreover, computer-assistive technologies have also been used to help children with various disability to play activities for children and participate and perform in areas of education and communication (Chantry & Dunford, 2010).

In the context of working with older adults particularly, OTs roles fall in line with those of *technology in aging*: the purpose to compensate and provide support for the deficits associated with aging so as to maintain independence and continue participation in daily activities. As such, all things considered, OTs are important actors in the goal of improving older adults service care to aid aging in place and in decreasing the healthcare associated costs. With the rapid development of technologies, reshaping the way in which we engage in the world, in our activities, in the way we *function*, it becomes important to further consider these care professionals as users and facilitators to the use of technology in society. In an article on the

occupational therapy profession, Smith (2017) illustrates the history of technology use in OTs practices and elaborates a new foundational theory for occupational therapy practices in which he assigns technology a core component in therapy (as opposed to an adjunct component) for it is now unavoidably embedded in occupations of all kinds. He proposes that the use of technology in OTs practice should expand concomitantly to technological advances, in order to convey the best solutions to clients, to serve and assist individuals with disability in achieving optimal functional performance.

CHAPTER II: RATIONALE AND OBJECTIVES OF MANUSCRIPT

2.1 Rationale

Canada is not spared from the greying of the population. The 2016 census data highlights that the proportion of seniors aged 65 and over exceeds that of children under 15 years of age, for the first time in census history (apart from the Prairie provinces and the Territories), and now make up 16.9% of the population. This is representative of the largest increase for that age group in the past 70 years as well as a population rise of 2.1% since 2011 (Statistic Canada, 2016). Within this aging context, there has also been an increasing desire to *age in place* (AIP) expressed: in 2008, 85% of Canadians over 55 expressed the preference to AIP (Canadian Mortgage and Housing Corporation, 2008) and, in 2015, as many as 93% of seniors expressed this wish (Federation of Canadian municipalities, 2015). However, the Canadian healthcare system is not equipped to attend to this demographic shift (Canadian Medical Association, 2016). In fact, reports highlight that there are barriers faced by home care teams in meeting the needs of seniors facing loss of autonomy, or other aging related conditions (Allard et al., 2011; Federation of Canadian municipalities, 2015; Canadian Medical Association, 2016). The reports also highlight that home care resources are insufficient (Canadian Mortgage and Housing Corporation, 2015). The gap between what the older adults need and the support that is available to them often results in a quicker transition to long-term care facilities (Canadian Mortgage and Housing Corporation, 2015). As elaborated in the previous sections, the use of ICTs offers an innovative way to support older adult's independence and to help them remain at home, in their communities, if and when they desire to, and OTs can recommend technology to assist this desire. To date, to our knowledge, no study has investigated what the current state of Canadian

OTs knowledge of ICTs is, whether they are using it in practice and, if so, which are being used. Moreover, it is not known what factors influence their use of ICT.

2.2 Objectives

This project addresses a sub-component of a bigger project that aims to thoroughly describe the use of ICTs by Canadian OTs, across Canada, with older adults. This thesis is focused on the following two objectives:

1) Identify Canadian OTs knowledge of ICTs and which, if any, are currently being used and recommended in practice with older adults.
2) Identify which factors are associated with the use and recommendation of ICTs in clinical practice with older adults.

2.3 Conceptual framework

In order to explore if OTs were familiar with ICTs, or not, as well as to grasp a better understanding of their current practices with respect to the technology in aged care, including which factors were correlated to usage (as opposed to specifically studying the mechanisms of ICT acceptance), the study has been based on an integrated knowledge translation (KT) approach.

The Canadian Institutes of Health Research (2008) define KT as "*the exchange, synthesis and ethically-sound application of knowledge – within a complex system of interactions among researchers and users – to accelerate the capture of the benefits of research for Canadians through improved health, more effective services and products, and a strengthened health care system*" (para. 5). In other words, the KT strategy helps consolidate knowledge from research to be applied and implemented in real-life practices, to facilitate the use, integration, and

sustainability of evidence-based practice within the healthcare system. The theoretical approaches of KT have three goals: 1) To describe and/or guide the process of translating research into practice; 2) To understand and/or explain what influences implementation outcomes; 3) To evaluate the effectiveness of the implementation (Nielsen, 2015). To achieve each of these goals, different theoretical approaches can be applied (Nielsen, 2015).

This project is based on the Knowledge to Action (KTA) theoretical KT model, developed by Graham et al. (2006). This process model offers an approach "to describe and/or guide the process of translating research into practice" (Nielsen, 2015). As the name suggests, it consists of two major components, Knowledge and Action, which contain sub-divisions. The *knowledge creation* component includes: 1) knowledge inquiry, 2) knowledge synthesis, and 3) knowledge of tools. The *action cycle* component consists of 7 steps, namely 1) identifying the problem; 2) adapting knowledge to local context; 3) assessing barriers to knowledge use; 4) selecting, tailoring, implementing the interventions; 5) monitoring knowledge use; 6) evaluating outcomes; and 7) sustaining knowledge use, which considers the creation and sustainability of new knowledge that speaks to specific stakeholders in their particular settings. The process of moving *knowledge into action* using this framework is complex and dynamic: the phases from each step can occur sequentially and/or simultaneously and influence one another (Graham et al., 2006).

The focus of the project in this manuscript falls within the *action cycle* component. Specifically, it is on the "identifying the problem" phase, to further specify and define current OT practices in the area of *technology and aging*. This approach allows to highlight the state of OT practice, help identify the existence of gaps, potential ways to address them, and contribute

to the body of knowledge for the elaboration of initiatives to work towards assisting older adults' functional independence and *aging in place*, specifically in Canada.

CHAPTER III: MANUSCRIPT

Title: Canadian occupational therapists' use of technology with older adults: a nationwide survey

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3.1 Abstract

Background. Recent advances in Information and Communication Technologies (ICT) can aid older adults desiring to age in place. As rehabilitation specialists, occupational therapists (OTs) play a gateway role regarding recommendation of various ICT for homecare. However, no study has investigated current OTs practices concerning ICT for older adults in Canada. **Objectives.** To identify Canadian OTs knowledge and recommendation practices of ICT with older adults as well as factors associated with ICT use. **Methodology.** Online Canada-wide survey of 387 OTs. **Results.** Only 12.4% of respondents reported recommending ICT in practice. ICT supporting communication and cognition were the main types recommended. The multivariate logistic regression analyses showed that clinicians with more years of clinical experience were more likely to recommend ICT. Clinicians' services, work environments, and client diagnosis are also factors associated with ICT recommendation. **Implications.** Additional research is needed to understand how to overcome barriers to ICT use in OTs practice.

3.2 Manuscript

Introduction

The aging of the world's population is subjecting the social and healthcare systems to new challenges for the maintenance of health and functional capacity through old age (United Nations, 2015). However, within this demographic shift there is an emerging preference of older adults to *age in place*, that is, to remain living in the community, safely, independently, and comfortably, even in the event of loss of autonomy (Eckert et al., 2004; Wolff et al., 2008). To respond to the older adults aging preferences and address the resulting social and economic implications of the aging society, public health initiatives emphasize a focus on supporting functional independence and *aging in place* for as long as possible (WHO, 2015). In this strategy, the application of technology in aging seems promising.

The field of research in *technology and aging* for the development of tools and services to maintain independence in older age has been growing since the 1980s (Schulz et al., 2015). The emerging technological products, derived from technologies of information and communication (ICT), are enhanced technical applications that consider age-related sensory, cognitive, physical functioning, and mobility challenges (Fozard et al., 2000). As such, they are designed to support the age-related functional declines which tend to limit the ability to continue participation in various important aspects of daily life (e.g. communication, mobility and transportation, health) (Schulz et al., 2015).

Recent systematic reviews illustrate the potential benefits of adapted mobile phones, robots, monitoring sensors, smart homes and telehealth ICT for both decreased healthcare costs and increased senior QoL, particularly with regards to social isolation, cognitive disorders, mobility, falls, and assistance in other activities of daily living (e.g. medication management)

(Siegel & Dorner, 2017; Kim, Gollamudi, & Steinhubl, 2017; Khosravi, & Ghapanchi, 2016). However, reviews also state that the current research in ICT is too heterogenous, still at experimental stages, and that better quality studies are needed to establish the evidence for *aging in place* and improved QoL (Siegel & Dorner, 2017; Kim et al., 2017; Khosravi & Ghapanchi, 2016). Nonetheless, a multitude of ICT and services (e.g. robots, sensor monitoring systems, and telehealth services) are already on the market (Orlov, 2018). For instance, BestBuy specifically offers *Technology Solutions Designed for Seniors* and other companies (e.g. Honeywell and Philips) also offer (tele-)health monitoring devices and services for both clinicians and patients, thus making technology readily available to consumers.

Notwithstanding the research developments and availability of ICT on the market, the success of technology driven health initiatives relies on its successful acceptance and adoption by their intended end-user, whether it be the different health practitioners, the older adults themselves, or their caregivers. Research highlights that older adults recognize technologies benefits and are willing to use them if it provides social connectedness, a sense of security within their home, as well as allows them to maintain their well-being and live independently (Peek et al., 2014). With regards to the use and provision of technology in the healthcare system, the role of occupational therapists is very relevant (Canadian Association of Occupational Therapists [CAOT], 2012; American Occupational Therapy Association [AOTA], 2010). Indeed, in their practice as rehabilitation specialists aimed at helping individuals continue to lead productive and meaningful lives throughout the lifespan, occupational therapists could be at the forefront of ICT use. In the context of working with older adults, this translates into supporting functional deficits and *aging in place*, for as long as possible, if this is one's desire. Therefore, their role falls in line with the public health initiative proposed by the WHO (2015) and with the intended purposes of

the ICT developments for older adults. Moreover, they work in many different rehabilitation settings where technologies can be prescribed and taught.

Considering the growing role of ICT in healthcare and their potential benefits, it is important to understand how occupational therapists use ICT in their care practice. To our knowledge, no study has yet investigated the current state of knowledge of ICT among Canadian occupational therapists, whether they are using it in practice and, if so, what types are being recommended. It is also not known what factors influence their recommendation of ICT. Thus, we designed a Canada-wide study with the aim to investigate current Canadian occupational therapists' practices with respect to ICT with older adults by 1) describing their demographic and workplace clinical characteristics as well as familiarity with, and recommendation of, ICT in practice, and 2) identifying which factors influence ICT recommendation in practice.

Methods

Study Design

A Canada-wide, cross-sectional, online survey was conducted to investigate occupational therapists' practices with ICT. Ethics approval was obtained by the << removed for blinding >>.

Survey Design

Survey development: A rapid review (Sara, Kristin, Rob, Jeremy, & David, 2012) of ICT currently available in the market was conducted and the results were circulated among a team of experts in this area for content revisions (composed of a clinician occupational therapist and experts in technology and geriatrics). The questions exploring the practice profile of respondents were based on the CAOT classifications of occupational therapy practices. The survey was created in English and further translated into French. Prior to its deployment, both versions were

piloted tested with a group of five occupational therapists (working within our CIUSSS) for face validity, clarity of the questions, and survey length.

***Survey content*:** The survey was divided in multiple sections (see Supplemental Figure 1) and the following sections are addressed in this paper. The first section elicited information related to occupational therapists practice profile (i.e. primary province of employment, clientele group (e.g. geriatrics), areas of clinical practice (e.g. mental health), client services (e.g. home assistance/support), work environments (e.g. general hospital), and clientele diagnosis (e.g. dementia and related syndromes)). This led the second section focusing on familiarity with, and usage of, ICT in practice. The third section gathered information on the types of ICT used in practice (as described below). Finally, a series of questions on occupational therapists' demographic information (i.e. gender, age, number of years of clinical experience, highest education attained, and year of graduation) which concluded the survey was included. Apart from the demographic questions on age and number of years of clinical experience, all of the survey questions consisted in categorical, close-ended items including an open text box space to provide further information if deemed necessary by respondents. Based on occupational therapist familiarity with, and usage of, ICT in practice, they were prompted to complete different sections of the survey (See Supplemental Figure 1).

Definition of technology: In this project, technology was defined as products, instruments or systems used to improve the autonomy, security and well-being of people with disabilities, including technologies based on ICT, as well as smart systems used to automate or facilitate tasks. The technologies were categorized as per an adapted version of the Human Development Model conceptual framework (International Network on the Disability Creation Process, 2018) into those related to: 1) *Disability* (further divided into: technologies to support

cognition, to support communication, to improve knowledge on health status); 2) *Activity and Participation* (further divided into: transportation, general planning and management of daily activities, prevention of burns or water damage, prevention of falls, personal care or household activities, hobbies, medication management); and the 3) *Environment* (further divided into: smart environment and telehealth, caregiver support).

Recruitment

Clinician recruitment was completed via e-mail. Provincial and territorial professional occupational therapists' organizations were contacted to invite their licensed members to participate in the project. Organizations from 8 of the Canadian provinces agreed to participate (i.e. Society of Alberta Occupational Therapists (SAOT), College of Occupational Therapists of British Columbia (COTBC), Manitoba Society of Occupational Therapists (MSOT), New Brunswick Association of Occupational Therapists (NBAOT), College of Occupational Therapists of Nova Scotia (COTNS), College of Occupational Therapists of Ontario (COTO), Order of Occupational Therapists of Quebec (OEQ) and Saskatchewan Society of Occupational Therapists (SSOT). Members from the MSOT, NBAOT, COTNS, OEQ and SSOT were reached directly by their associations; members from the COTO were provided access to a posting on their association's website; members from the SAOT received an invitation from their association through an e-bulletin; finally, the COTBC provided a list of licensed members e-mails to be invited by a research assistant. Occupational therapists' whose correspondence information was publicly available on the CAOT website (and associated external sources) were also directly invited by a research assistant to participate. To be eligible, clinicians had to speak English or French and have been working with *geriatric* or *geriatric and adult* clients for the past 6 months. Clinicians were excluded if they had not completed the survey in its entirety.

Data Collection

The survey was deployed on the SimpleSurvey platform and its completion took approximately 10-15 minutes. Online consent was obtained from those who agreed to participate. The data collection period spanned four months. Two reminder e-mails to participate were sent two weeks apart to occupational therapists.

Data Analysis

Respondents were classified based on their knowledge and use of ICT in practice as 1) familiar users, 2) familiar non-users, and 3) not familiar. Descriptive statistics were completed to report on occupational therapists' demographic and practice profile characteristics (see Table 1 and 2) as well as to determine the prevalence of the different ICT used in practice (see Table 3). Age was categorized into three groups (between 24-34 years of age; 35-45 years of age; over 45 years of age) and years of clinical experience was dichotomized (10 years or less; over 10 years). Proportions were calculated for the categorical variables and means and standard deviations for the continuous ones.

Amongst respondents reporting being familiar with ICT, we further evaluated the potential association of occupational therapists' demographic and practice profile characteristics (i.e. age, years of clinical experience, education, work environments, areas of practice, client services, and client diagnosis) as explanatory variables for the recommendation of ICT in clinical practice outcome. Associations were initially assessed using χ^2 tests and, based on Hosmer & Lemeshow (2000), the variables with a p-values $\leq .25$ were retained and fitted for the following logistic regressions. Multi-collinearity between variables was verified through binary matrices. Univariate logistic regression was then performed to investigate the contribution of potential explanatory variables on the same outcome. Statistical significance was set at p-values $\leq .05$ for

the univariate logistic regressions. Finally, using the variables that showed statistical significance in the univariate logistic regression, a multivariate block-wise logistic regression with forward variable selection was run on to model the recommendation of ICT in clinical practice. The blocks were divided as: demographic variables; areas of practice; work environments; client services; client conditions. Given the statistical analyses, only variables selected by at least 10% of occupational therapists were considered and are shown in the tables.

Results

The survey was deployed in 2016 and 874 licensed clinicians accessed it. Of these, 681 fully completed it but 294 did not work with a *geriatric* or *geriatric and adult* clientele. Thus, a final sample of 387 (44.27%) occupational therapists was retained. The final sample included occupational therapists from 8 provinces with Quebec being the primary province of employment for half of the respondents. Most respondents were female, aged 39 years old, with a Bachelor's degree as their highest level of education attained and 14 years of clinical experience (Table 1). Practicing in the area of general physical health, working in a community service center, offering home assistance and support for client services, and seeing clients diagnosed with mild cognitive impairment, were the most reported practice profile characteristics (Table 2).

Familiarity with, and use of, ICT in current practice

Of the 387 respondents, 210 (54.3%) reported not knowing about ICT supporting occupational therapy practices (*non-familiar group*), 129 (33.3%) reported being familiar with them but not commonly using them in practice (*non-user group*), and 48 (12.4%) reported being familiar and using them in practice (*user group*).

Demographic and practice profile of ICT users, non-users, and non-familiars

On average, occupational therapists that are familiar with, and users of, ICT in clinical practice were 44 years old, had 19 years of clinical experience, and most of them held a bachelors' degree as their highest level of education (66.67%) (Table 1). In contrast, those who are familiar with ICT but not common users in practice are, on average, 6 years younger, have 6 years less of clinical experience, and more have a masters' degree as their highest degree of education (50%) (Table 1). The occupational therapists whom reported not being familiar with ICT are also, on average, 5.5 years younger than ICT users with 5.2 years less of clinical experience than those whom reported being familiar users (Table 1). However, the proportion of those having a bachelors' degree as their highest degree of education is alike the users group (63.81%) (Table 1).

With respect to the practice profile variables (Table 2), respondents most commonly reported working in the area of general physical health (over 50% across groups). Additionally, the most commonly reported client service across respondents consisted in offering home-assistance and support services (over 40% across groups). However, *users* most commonly reported working in a rehabilitation hospital or facility (33.3%), whereas most *non-users* reported working in a community health center (34.1%) and most *non-familiar* occupational therapists reported working in the general hospital (29.5%). Finally, most *users* and *non-familiar* occupational therapists reported addressing mild cognitive impairment client conditions (83.3% and 84.3% respectively), whereas *non-users* most commonly reported addressing dementia and its related syndromes (83.7%).

Types of ICT recommended in practice

Amongst *users* (n=48), the highest proportion of respondents indicated recommending technologies pertaining to *disability* in practice: 97.9% (n=47) reported using ICT to support communication, 79.2% (n=38) to support cognition, and 64.6% (n=31) to support knowledge on health status (Table 3). Particularly, the most reported tool was the use of websites to enable clients to obtain information on their disease or condition (e.g. Stroke Engine and associations or organization such as the Alzheimer's Society website) (Table 4).

Regarding ICT pertaining to *activity and participation*, the highest proportion of respondents reported recommending technology to assist the transportation needs of their patients 64.6% (n=31) (e.g. mats/bed strips with movement detectors or GPS localization application) (Table 3). The two most reported tools concerned alternatives to restraints using various interfaces to facilitate mobility (e.g. sensitive pads, belts with buckles, alarms, mats or bed strips with movement detectors) and the use of a personal emergency response system involving a pendant or bracelet (including a monthly subscription to a central) for the detection and prevention of falls (Table 4).

Finally, for ICT pertaining to the *environment*, the majority of respondents reported recommending smart environments and telehealth technology (52.1% (n=25)). In that category, only 45.8% (n=22) reported using tools to facilitate the role of caregivers (Table 3). The most commonly recommended smart environment technology consisted of an alarm connected to a phone line in order to enable individuals to get help in case of emergency and the most commonly caregiver tool consisted of referral to websites specifically dedicated to caregivers (Table 4).

Factors predicting the recommendation of ICT

The univariate logistic regression revealed that multiple factors were significantly associated with the recommendation of ICT in practice and help discriminate between *familiar users* and *non-users* (Table 5). Among the demographic variables, age and years of clinical experience were associated: the odds of recommending ICT in practice increased for older occupational therapists as opposed to the younger ones (35-45 age group (OR: 3.40) and over 45 age group (OR: 5.23)) as well as those with over 10 years of clinical experience in comparison to those with 10 years of experience or less (OR: 2.65). As part of the practice profile variables, concerning client services, offering vocational rehabilitation services was associated with an increased odd of use (OR: 2.74) while providing orientation and assessment hospital services was associated with a decreased odd of use (OR: .28). As for work environments, working in a rehabilitation hospital or facility increased the odds of using technology in practice (OR: 2.30) while working in the general hospital decreased the odds (OR: .34). Finally, treating client conditions related to eating disorders (swallowing) were significantly associated with an increased odd of using technology (OR: 6.25) while treating dementia and related syndromes had decreased odds (OR: .035). No association were found between areas of practice and technology use.

The multivariate bloc logistic regression (Table 6) with forward variable selection analysis revealed that the variables of years of clinical experience, addressing client conditions of dementia and related syndromes and working in a general hospital work environment remained statistically significant when modeled to explore which of the independently associated variables remained associated to the outcome of interest, i.e. the recommendation of ICT. In this model, the odds of recommending ICT in clinical practice increased with more years of clinical experience (OR: 2.43) and decreased when addressing client conditions with dementia

(OR: .415) or working in a general hospital (OR: .378). This model explained 13.7% (Nagelkerke R^2) of the variance in usage of ICT and correctly classified 75.1% of the cases. Client services, other client conditions, and other work environments, were no longer statistically significant.

Discussion

This project investigated current Canadian occupational therapists' practices with respect to ICT use with older adults in 9 Canadian provinces and territories. More specifically, first a descriptive analysis of occupational therapists' demographic and workplace clinical characteristics as well as familiarity with, and use of, ICT in practice was done. Second, factors which influence occupational therapists' recommendation of ICT in practice were identified.

Demographic and practice profile of ICT users, non-users, and non-familiars

The final sample includes women practitioners, aged 39 years old on average, with a Bachelor's degree as their highest level of education attained, and 14 years of clinical experience. They are particularly from Quebec and British Columbia, working primarily in community centers, in general physical health, and providing home assistance and support services. This demographic and practice profile information is representative of the average Canadian occupational therapist population (Canadian Institute on Health Information, 2016).

Familiarity with and use of ICT in practice

One of the main findings from this study is that more than half of the clinicians surveyed reported not being familiar with ICT supporting occupational therapy practices with older adults. This lack of knowledge is intriguing given that occupational therapists play an active and primary role in promoting well-being and improving the QoL of their patients by adapting, educating, and informing them of the best devices available to maintain participation in their

daily activities. Moreover, overall, only 12.4% reported recommending them in practice. This highlights an important gap in occupational therapists' knowledge and practices with ICT. While previous research has explored the presence of gerontological content in Canadian occupational therapy university programs (Klein, 2002), further research is needed to explore the adequate update of its content to reflect new research. Moreover, occupational therapists may be facing other barriers which limits their recommendation of ICT in practice. It is important to understand the barriers that can impact underutilisation of ICT. Research in the adoption of ICT in health professional practices has shown that issues exist with respect to costs, ease of use, and the lack of trust in the technology or technical skills (Kapadia, Ariani, Li, & Ray, 2015). Therefore, the low rate of recommendations could arise because clinicians may not consider options of ICT in their day to day practice. Another potential explanation could be ageist attitudes that remain in practice at the personal, professional, and organizational level (Klein & Liu, 2010); e.g. that an older adult is less interested in ICT or cannot use it. Further exploration of these factors is needed.

Type of ICT recommended in practice

ICT pertaining to *disability* were the most recommended. In fact, occupational therapists most commonly reported using ICT to improve communication, followed by those to improve cognition and, finally, those to improve performance in personal care or household activities. This is consistent with ICT that have been researched for usability and acceptability by older adults with mild cognitive impairment (MCI) or dementia (Holthe, Halvorsrud, Karterud, Hoel, & Lund, 2018) and representative of the daily activity needs that may be addressed in a client population of older adults presenting MCI (Jekel et al., 2015) - the most commonly reported clientele condition of users. Additionally, the most used ICT device falls under the category of *improving knowledge on health status*, which is consistent with the most reported area of practice

being general physical health, and consisted in the recommendation to use websites to enable clients' acquisition of information on their disease or condition (e.g. Stroke Engine, associations, or organizations websites – e.g. Alzheimer's Society website).

The findings from our survey are in line with previous research suggesting that seniors' familiarity with technology is a factor for its acceptance and adoption (Peek et al., 2014; Peek et al. 2017). In fact, most of the communication and cognition technological tools listed by occupational therapists involved applications on a computer, smartphone or tablet – digital devices that the majority of Canadians now generally own and that the elderly population have shown to be increasingly more willing and comfortable to use (Statistic Canada, 2017). Considering that there is only partial funding available for communication devices and little to no funding for devices addressing cognition (Schreiber et al. 2017), this highlights a need to revisit current technological devices funding opportunities.

Surprisingly, less than half of the *users* reported using tools to facilitate the role of the caregivers. The necessity to concomitantly support them in supporting their loved ones needs to be further addressed in occupational therapy practice considering, on the one hand, the physical and psychological toll that they experience in their role, further reflected through the fact that they are willing to pay for technologies to support caregiving (Schulz et al., 2016), and, on the other hand, their key influence on technology acceptance and adoption by the impaired individual (Peek et al., 2017).

Factors predicting the recommendation of ICT

In the univariate analysis, having more years of clinical experience and being older increased the odds of ICT recommendation in occupational therapy practice. This suggests that recommendation of technology might be learned in practice and acquired through time, especially given that higher education was not associated with increased odds of using

technology. Given that merely 27% of the occupational therapists that are familiar with ICT recommended it in practice bears the question of whether the Canadian school curricula provides students with the necessary tools and knowledge about *which* and *how* technologies could be employed in practice. For instance, in the United States, an account of assistive technology education trends in the entry-level occupational therapy curricula of 1994-1995 showed increases in the content of assistive technology education as opposed to 1989 (Kanny & Anson, 1998). In Australia, recommendations to improve the Australian occupational therapy school curricula have been made following research on Generation Y - OT graduate students highlighted a lack of technological skills relevant to their practice and confidence to use specialized softwares, specialized devices or assistive technology (Hills et al., 2016). This further highlights the importance to explore the adequate update of Canadian occupational therapy university programs' content to reflect new research and to determine the aptitudes of Canadian graduates to ensure that they have the necessary skills and confidence in providing ICT with this clientele.

Interestingly, occupational therapists working with clients that have dementia or related syndromes were less prone to recommend ICT in practice, although these individuals and their caregivers might benefit from its use (Bier et al., 2018; Gitlin, Winter, & Dennis, 2010). It is wondered if this emerges from a belief that older adults with dementia and their caregivers cannot benefit from new technologies or if it is that most occupational therapists are not aware of the technologies suitable for this clientele. As mentioned previously, there is little to no funding available for cognitive devices in Canada (Schreiber et al. 2017). For instance, the *Programme ministériel des aides techniques à la communication,* a program that provides technical aids in Quebec, does not include coverage of technical aids for people with Alzheimer's disease. This lack of access to funding could also be a factor influencing this result. Finally, working in a rehabilitation hospital or facility also increased the likelihood of using technology in practice

whereas working in a general hospital and providing assessment or orientation services in the hospital was associated with a decrease. This is consistent with the realities of the profession and inherent nature of the work environment: patients seen in the general hospital are quickly assessed whereas rehabilitation hospitals or facilities leave more room for technology use as they are environments where rehabilitative interventions are emphasized, where occupational therapists can spend time with the patient and have the ability to devise intervention plans.

Finally, although the multivariate logistic regression exploration classified appropriately 75% of the cases, it only explains 13.7% of the variance in ICT recommendation by occupational therapists in practice. Thus, more work towards a better understanding of the factors involved in ICT usage by Canadian occupational therapists is required.

Limitations

The results of the survey need to be taken with caution. First, it is important to note that most respondents were occupational therapists from the provinces of Quebec and British Columbia. Thus, generalisability cannot be made across Canada. Moreover, the survey was self-reported and the occupational therapists who volunteered may have had an interest in the topic, consequently being different from non-respondents. Finally, due to the different regulations and methods in reaching members of each provincial licensing board (i.e. some sent the invitation as part of a listserv, some included the survey invitation link on their website), there may have been discrepancies across provinces in the exposure of occupational therapists to the survey invitation.

Conclusion

This project is the first to provide insight on the current state of technology use among Canadian occupational therapists working with older adults. It highlights that technology for older adults is not well integrated in their practices and suggests there is a need to develop educational programs to inform clinicians about the available technologies, their potential

benefits to clients, and *how* to use them in practice. In fact, familiarity with technology alone is not sufficient to drive its use in practice and there is a need to bridge the gap between the current growth of technological devices and the provision of recommendations for the homecare of seniors. As such, to gain a deeper understanding of the situation and elucidate reasons behind occupational therapists' attitudes towards technology use and recommendation with older adults, future steps should be taken to address the barriers and facilitators they face in practice.

Key message

Occupational therapists lack familiarity with information and communication technologies that can support everyday occupations in later life. With the increase of technological devices development, educational strategies should be put in place to foster the awareness and knowledge of occupational therapists concerning these new devices as potential interventions to be used in their current practice.

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TABLES

TABLE 1: ***Clinicians' demographic variables*** *(n=387)*

Variables	Full sample (N=387)	Familiar		Non-familiar (n=210)
		Users (n=48)	Non-users (n=129)	
Age, n (%)				
Over 45	115(29.7)	22(45.8)	31(24.0)	62(29.5)
35-45	125(10.5)	18(37.5)	39(30.2)	68(32.4)
24-34	147(38.0)	8(16.7)	59(45.7)	80(38.1)
Mean ± SD	39.9 ± 10.5	44.4 ± (10.3)	38.1 ± (10.5)	38.9 ± (10.2)
Gender, n (%)				
Female	352(91.0)	41(85.4)	117(90.7)	194(92.4)
Male	35(9.0)	7(14.6)	12(9.3)	16(7.6)
Education, n (%)				
Bachelors	230(59.4)	32(66.7)	64(49.6)	134(63.8)
Masters & higher	157(40.6)	16(33.3)	65(50.4)	76(36.2)
Years of clinical experience, n (%)				
Over 10 years	230(59.4)	36(75.0)	68(52.7)	126(60.0)
10 years or less	157(40.6)	12(25.0)	61(47.2)	84(40.0)
Mean ± SD	14.7 ± 10.2	19 ± (10.13)	12.8 ± (10.13)	13.8 ± (10.04)
Province of primary employment*, n (%)				
Quebec	197(50.9)	24(50)	58(45)	115(54.8)
British Columbia	109(28.2)	13(27.1)	41(31.8)	55(26.2)
Nova Scotia	33(8.5)	5(10.4)	13(10.1)	15(7.1)
Manitoba	19(4.9)	2(4.2)	8(6.2)	9(4.3)
Saskatchewan	18(4.7)	1(2.1)	5(3.9)	12(5.7)
Ontario	6(1.6)	2(4.2)	3(2.3)	1(0.5)
Alberta	2(0.5)	1(2.1)	1(0.8)	0(0)
New Brunswick	2(0.5)	0(0)	0(0)	2(1)
Northwestern Territories	1(0.3)	0(0)	0(0)	1(0.5)

*There were no respondents from Newfoundland, Nunavut, Prince Edward Island and Yukon Territories

TABLE 2: ***Clinicians' practice profile characteristics (n=387)***

Variables	Full sample (N=387)	Familiar		Not familiar (n=210)
		Users (n=48)	Non-users (n=129)	
Work environment, n (%)				
Rehabilitation hospital/facility	72(18.6)	16 (33.3)	23(17.8)	33(15.7)
Community health centre	118(30.5)	16 (33.3)	44(34.1)	58(27.6)
Residential care facility	73(18.9)	8 (16.7)	30(23.3)	35(16.7)
General hospital	106(27.4)	6 (12.5)	38(29.5)	62(29.5)
Assisted living residence	22(5.7)	-	-	-
Solo professional practice/clinic	21(5.4)	5 (10.4)	-	-
Mental health hospital/facility	18(4.7)	-	-	-
Visiting agency/business	7(1.8)	-	-	-
Group professional practice/clinic	14(3.6)	-	-	-
Post-secondary educational institution	4(1)	-	-	-
School or school board	0(0)	-	-	-
Association/Government/Para-Governmental	7(1.8)	-	-	-
Industry, manufacturing and commercial	1(0.3)	-	-	-
Areas of practice, n (%)				
General physical health	260(67.2)	26(54.2)	88(68.2)	146(69.5)
Neurological/Neuromuscular	212(54.8)	25(52.1)	73(56.6)	114(54.3)
Musculoskeletal system	203(52.5)	22(45.8)	67(51.9)	114(54.3)
Palliative/End of life care	133(34.4)	15(31.3)	51(39.5)	67(31.9)
Mental health	93(24)	13(27.1)	30(23.3)	50(23.8)
Cardiovascular and respiratory system	96(24.8)	11(22.9)	32(24.8)	53(25.2)
Health promotion and wellness	51(13.2)	5(10.4)	18(14.0)	28(13.3)
Client service management	32(8.3)	5(10.4)	13(10.1)	-
Vocational rehabilitation	36(9.3)	-	-	-
Medical/Legal client service management	10(2.6)	-	-	-
Digestive/Metabolic/Endocrine system	29(7.5)	-	13(10.1)	-
Teaching	21(5.4)	-	-	-
Service administration	15(3.9)	-	-	-
Research	7(1.8)	-	-	-

Client services, n (%)				
Home assistance/support	164(42.4)	21(43.8)	53(41.1)	90(42.9)
Rehabilitation – Social integration	79(20.4)	18(37.5)	32(24.8)	29(13.8)
Long-term care	98(25.3)	13(27.1)	38(29.5)	47(22.4)
Assessment/Orientation (clinics/specialized services)	78(20.2)	12(25.0)	29(22.5)	37(17.6)
Screening/Assessment	101(26.1)	10(20.8)	36(27.9)	55(26.2)
Rehabilitation – Vocational	46(11.9)	9(18.8)	-	27(12.9)
Palliative care	85(22)	8(16.7)	32(24.8)	45(21.4)
Information/Promoting health in the community	44(11.4)	8(16.7)	15(11.6)	21(10)
Rehabilitation – School integration	9(2.3)	5(10.4)	-	-
Suicide, disease, accidents, social issues prevention in the community	19(4.9)	5(10.4)	-	-
Assessment/Orientation (hospital services)	98(25.3)	-	31(24.0)	63(30)
Assessment/Orientation (emergency)	11(2.8)	-	-	-
Legal services	8(2.1)	-	-	-
Psychotherapy	4(1)	-	-	-
Client diagnosis, n (%)				
Mild Cognitive Impairment	323(83.5)	40(83.3)	106(82.2)	177(84.3)
Progressive neurological disorder	297(76.7)	37(77.1)	103(79.8)	157(74.8)
Disorders related to aging	288(74.4)	32(66.7)	95(73.6)	161(76.7)
Musculoskeletal and amputation disorders	272(70.3)	32(66.7)	93(72.1)	147(70)
Arthritis and rheumatology	263(68)	32(66.7)	91(70.5)	140(66.7)
Dementia and related syndromes	310(80.1)	31(64.6)	108(83.7)	171(81.4)
Chronic pain	242(62.5)	29(60.4)	87(67.4)	126(60)
Traumatic brain injuries	183(47.3)	26(54.2)	61(47.3)	96(45.7)
Cancer	200(51.7)	25(52.1)	71(55.0)	104(49.5)
Visual impairment	211(54.5)	24(50.0)	80(62.0)	107(51)
Intellectual disability	141(36.4)	23(47.9)	51(39.5)	67(31.9)
Hearing impairment	193(49.9)	21(43.8)	75(58.1)	97(46.2)
Cardio-respiratory disorders	169(43.7)	21(43.8)	61(47.3)	87(41.4)
Speech and language impairment	141(36.4)	21(43.8)	58(45.0)	62(29.5)
Alcoholism and other drug dependencies	119(30.7)	20(41.7)	39(30.2)	60(28.6)

Mood disorders	144(37.2)	18(37.5)	55(42.6)	71(33.8)
Myelopathies	103(26.6)	17(35.4)	37(28.7)	49(23.3)
Affective disorders	112(28.9)	17(35.4)	36(27.9)	59(28.1)
Personality disorders	118(30.5)	15(31.3)	41(31.8)	62(29.5)
Genetic disorders	85(22)	13(27.1)	27(20.9)	45(21.4)
Swallowing disorders	146(37.7)	12(25.0)	53(41.1)	81(38.6)
Encephalopathy	93(24)	12(25.0)	30(23.3)	51(24.3)
Developmental delays	54(14)	10(20.8)	17(13.2)	27(12.9)
Psychotic disorders	66(17.1)	8(16.7)	23(17.8)	35(16.7)
Eating disorders (e.g. anorexia, bulimia)	23(5.9)	8(16.7)	-	-
Severe behavioural disorder	46(11.9)	7(14.6)	15(11.6)	24(11.4)
Pervasive developmental disorders	20(5.2)	6(12.5)	-	-
HIV	28(7.2)	-	-	-
Burns	15(3.9)	-	-	-

TABLE 3: ***Percentage of occupational therapists that report recommending at least one type of Information and Communication technology in practice*** **(n=48)**

Technologies	Users n(%)
Disability	
To support communication	47(97.9)
To support cognition	38(79.2)
To improve knowledge on health status	31(64.6)
Activities and participation	
To facilitate transportation	31(64.6)
To improve performance in personal care or household activities	30(62.5)
To improve or facilitate hobbies	29(60.4)
To detect/prevent falls	27(56.3)
To improve or facilitate medication management	25(52.1)
To improve general planning and management of daily activities	11(22.9)
To prevent burns or water damage	11(22.9)
Environment	
Smart environment and telehealth	25(52.1)
To facilitate the role of the caregiver	22(45.8)

TABLE 4: ***Percent of specific Information and Communication technologies recommended by familiar users OTs (n=48)***

Technologies	Users n(%)
Disability	
To support communication	
Text to speech application for websites on computers, tablets or smartphones	17 (35)
Video calls through Internet	16 (33)
Communication via social media	14 (29)
Adapted smartphones	10 (21)
Communication notebook on tablets or smartphones	9 (19)
Telephone with voice control commands	8 (17)
Telephone with pictures	6 (13)
Visual dictionary (with images) on tablets or smartphones	4 (8)
To support cognition	
Applications for cognitive stimulation, on tablets or smartphones	23 (48)
“Calendar” application on tablets or smartphones	22 (46)
“Reminders” application on tablets or smartphones	22 (46)
Electronic timer	18 (38)
“Timer” application on tablets or smartphones	17 (35)
“Notes” application on tablets or smartphones	15 (31)
“Picture” application on tablets or smartphones	15 (31)
Automated voice recording memos	14 (29)
Serious video games	9 (19)
Digital photo frame	4 (8)
To improve knowledge on health status	
Websites that enable clients to obtain information on their disease or condition	25 (52)
Applications/devices to track physical activity	11 (23)
Discussion forum on the web	10 (21)
Application/devices to record psychological symptoms	5 (10)
Application/devices to record different physiological parameters	4 (8)
Applications/devices to screen for biological parameters	3 (6)
Websites enabling online intervention with automated assistance (non-human interaction) dedicated to clients	3 (6)

Activity and participation	
To facilitate transport	
Alternatives to restraints (e.g. sensitive pads, alarms, mats or bed strips with movement detectors – using interfaces)	23 (48)
GPS localization application	8 (17)
Monthly subscription to GPS tracking services linked to an online application	4 (8)
Application to remotely pay for parking	3 (6)
To improve performance in personal care or household activities	
Online grocery shopping services	21 (44)
Timer for cooking (e.g. Safecook™)	14 (29)
Recipe websites	13 (27)
Application to create grocery lists on tablets or smartphones	9 (19)
Programmable coffeemaker	7 (15)
Iron with automatic shutoff feature	7 (15)
Robot vacuum	6 (13)
Budget planning/follow-up application on tablets or smartphones	4 (8)
Sleep cycle monitoring application on tablets or smartphones	4 (8)
Application providing diverse recipes and assisting with the planning and organization of meals, on tablets or smartphones	3 (6)
To improve or facilitate hobbies	
Various games on computers, tablets or smartphones	22 (46)
Simplified universal remote control	11 (23)
To improve detection/prevention of falls	
Personal emergency response system involving the use of a pendant or bracelet (with monthly subscription to a central)	23 (48)
Motion-activated nightlight	12 (25)
Infrared motion detector or artificial vision to signal/detect falls, with monthly subscription to a central	9 (19)
To improve or facilitate medication management	
Medication reminder application on tablets or smartphones	21 (44)
Electronic pill dispenser	15 (31)
Application to create medication lists on tablets or smartphones	3 (6)

To improve general planning and management of daily activities	
Applications illustrating the different steps of a task, combining visual and verbal indications	7 (15)
Applications, such as Logbook, to keep record of accomplished activities	5 (10)
To prevent burns or water damage	
Water temperature with light indicators	4 (8)
Automatic control system for hot water	3 (6)
Water damage/flood detector with alarm signalling	3 (6)
Environment	
Smart environments and telehealth	
Alarm device connected to a phone line, enabling individuals to get help in case of an emergency	18 (38)
Control of household appliances and home settings by home automation	9 (19)
Video surveillance systems	6 (13)
Remote control of household appliances and home settings via tablet or smartphone application	5 (10)
Telecare systems	4 (8)
To facilitate the role of the caregiver	
Website with information specifically dedicated to the caregiver	13 (27)
Devices to facilitate monitoring by the caregiver	11 (23)
Videoconference with the caregiver	4 (8)
Websites enabling online interventions with automated assistance (non-human interaction) dedicated to caregivers	4 (8)
Discussion forums	4 (8)

TABLE 5: ***Factors associated to the recommendation of Information and Communication technology in clinical practice (n=177)***

Factors	Univariate analysis		Multivariate analysis	
	Odds ratio (p-value)	Confidence interval	Odds ratio (p-value)	Confidence interval
Age group				
24-34 *(ref)*				
35-45	3.40(.009)	1.38-9.01		
Over 45	5.23(<.001)	2.16-13.81		
Years of clinical experience				
10 years or less *(ref)*				
Over 10 years	2.65(.009)	1.263-5.547	2.43(.021)	1.141-5.212
Client services				
Assessment or orientation (hospital services)	.28(.026)	.08-.78		
Vocational rehabilitation	2.74(.041)	1.02-7.30		
Client conditions				
Dementia and related syndromes	.035(.007)	.16-.76	.415(.027)	.191-.904
Swallowing	6.25(.004)	1.86-24.44	-	-
Work environments				
General hospital	.34(.024)	.12-.81	.378(.047)	.145-.989
Rehabilitation hospital or facility	2.300.029)	1.07-4.87	-	-

CHAPTER IV: DISCUSSION AND IMPLICATIONS FOR PRACTICE

With the aging of the population and limited healthcare resources, technology offers promising help to support the functional performance of older adults and their desire to *age in place*. While the success of technology for homecare is dependent on different players and multiple factors, this thesis focused on the role of OTs as enablers of function and participation in meaningful activities of their clients through the recommendation of ICT in their practice. Particularly, findings relate to the current knowledge and use (or lack thereof) of different ICTs by Canadian OTs working with an older population, across various settings and areas of practice.

Using the KTA framework in synthesizing the information gathered from the cross-national survey allowed the researchers to identify and explore gaps in Canadian OTs practices in *technology and aging* as well as highlight future directions for research and recommendations for practice. This project addresses the "identifying the problem" phase of the action cycle, the first step in leading to the implementation or the application of knowledge, to close the knowledge-to-practice gap. Gaps in awareness, as well as barriers at various levels, have been identified.

4.1 Gaps in OTs awareness and knowledge of ICTs

First, there is indication that Canadian OTs lack familiarity with ICTs. This result is intriguing and warrants further exploration considering OTs expertise and active role in promoting well-being and improved QoL with the use of technological devices (CAOT, 2012a). This knowledge gap highlights limitations in the potential of OTs to facilitate the occupational performance of their older adult clientele through ICTs. In the United States, an account of assistive technology education trends in the entry-level occupational therapy curricula of 1994-1995 showed increases in the content of assistive technology education as opposed to 1989 (Kanny, E., & Anson, D., 1998). To our knowledge, no other study has further explored these

trends. While previous research has explored the presence of gerontological content in Canadian occupational therapy university programs (Klein, 2002), further research is needed to explore the adequate update of its content to reflect new research related to technology. Indeed, with the rapid development of technologies, it is important for practitioners to keep up-to-date with the applications of technology in their area of practice. Piau et al. (2014) highlight that technology definitions vary extensively across publications and Schulz et al. (2015) further supports the fragmentation in definitions. As such, as suggested by the CAOT (2012a), efforts and initiatives should be placed towards educating OTs on ICTs and providing continuing professional education as well as practice resources to support the professional development of OTs. Similarly, Smith (2017) poses that occupational therapy education will require more knowledge in occupational science and technology. These would be the initial steps towards improving ICTs implementation in practice and improving OTs role in older adults' service care for *aging in place* as well as decreasing the healthcare associated costs.

4.2 Barriers at the health care system, practice, practitioner & older adult level

As depicted in Miller's (1990) pyramid, reaching changes in clinical practice for better patient outcomes goes beyond instilling knowledge in practitioners. In fact, the results of the current study indicate that being familiar with ICTs is not enough to ensure that OTs will recommend it to their older adult clients. The low rate of ICT recommendation amongst *familiar* OTs suggests that there are barriers beyond knowledge that they may face in their recommendation of ICTs. This finding is consistent with other research projects on the adoption and implementation of technology in health professional settings and practices. The research efforts to understand and predict use of technology in different health care practices through models of technology acceptance has shown that implementation is complex, multifactorial, and

regroups an assortment of environmental, organizational, and personal factors needed to be accounted for (Venkatesh, Thong, & Xu, 2016; Vassli & Farshchian, 2018). Additionally, implementation of practice change in response to research results requires an understanding of the context in which change is warranted and is practitioner, site, and patient specific (Burke et Giltin, 2012). A literature review on the implementation of electronic health records followed by an *action-research* project in two Quebec hospitals has identified five factors influencing its integration, namely 1) technological risk (e.g. the lack of access to technology), 2) human risk (e.g. resistance to change), 3) usability risk (e.g. a perceived lack of usefulness of the technology and difficulties in using it), 4) managerial risk (e.g. human and financial resources), and 5) strategic/political risk (e.g. inter-agency conflicts) (Sicotte, Paré, Moreault, & Paccioni, 2006). Possibly, Canadian OTs face similar barriers in the implementation of ICT in practice.

Particularly in health professional practices in aged care, Kapadia et al. (2015) identify barriers surrounding costs, ease of use, and the lack of trust in the technology or technical skills in research on the adoption of ICTs. Therefore, OTs may be limited in their capacity to recommend ICT or may simply not consider options of ICTs in their day to day practice despite being familiar with the new, developing, and existing technologies. Our results show that OTs with a clientele with dementia or related syndromes were less likely to recommend ICT in practice. However, technology might benefit these individuals in their everyday lives and their caregivers in managing symptoms of the disease (Bier et al., 2018; Gitlin, Winter, & Dennis, 2010; Kim et al., 2017). It is wondered if this emerges from a belief that older adults with dementia and their caregivers cannot benefit from such technologies or if it is that most OTs are not aware of the technologies suitable for this clientele. Additionally, in Canada, access to technology and their cost coverage varies from one province to another, the government-funded

programs will not cover the full cost of equipment or its repair/maintenance, and the most commonly funded and serviced devices concern mobility or sensory limitations (Schreiber et al., 2017). Considering that there is little to no funding for devices addressing cognition (Schreiber et al., 2017), the unavailability of subsidized costs could also act as a barrier to OTs ICT recommendation in practice and highlights a need to revisit current technological devices funding opportunities.

Additionally, our results are consistent with previous research showing that factors such as *ICT compatibility (or lack of)* with the work process/tasks and *time constraints* (or *heavy workload*) act as healthcare professionals' barriers to ICT adoption (Gagnon et al., 2012). In fact, OTs working in a rehabilitation hospital or facility were more likely to recommend ICT in practice whereas those working in a general hospital and providing assessment or orientation services in the hospital were less likely. This is representative of the realities of the profession and inherent nature of the work environment wherein patients seen in the general hospital are assessed quicker than in rehabilitation hospitals or facilities, where more room for technology use is available (as they are environments in which rehabilitative interventions are emphasized), and where OTs have more ability and liberty to devise intervention plans as well as spend time with their patients.These results further show that recommendation of ICT in practice is setting specific.

Besides the organizational and practice barriers that OTs may face, considering the existing stigma surrounding older adults and a lack of technological skills (e.g. older adults are less interested into ICTs or cannot use them), ageist attitudes remaining in the practice at the personal, professional, and organizational levels (Klein & Liu, 2010) could further explain OTs low rate of ICT recommendation to older adults. The impact (*or role*) of stigma surrounding

older adults' conditions is a reality with various layers that warrant further exploration with respect to technology considering the increasing development of technological tools to aid *aging in place*. Fraser et al. (2016) highlight that the age-related stereotypes perpetuated in the media with respect to older adults and assistive technology devices are not without consequences for the older adults; a better understanding of this social construct and how it shapes the perspectives of OTs would be useful for the effective adoption and use of ICT. (pp.58-59).

Finally, aside from the factors associated with clinicians, their practice, and organizational environments, the older adults themselves could play an active role as a barrier or enabler in OTs recommendation of ICT. Indeed, although older adults have become more accepting of technology, their adoption of it is also complex and multifactorial (Chen & Chan, 2011) and there are remaining barriers to overcome such as concerns regarding privacy, costs, lack of training, ease of use and suitability for daily use, the lack of trust and functionality perceptions, the perceptions of "no need", stigma, and fears of dependence (Yusif, Soar, & Hafeez-Baig, 2016). Thus, the unwillingness and unreceptiveness of older adult clients to use ICTs, or difficulty to appropriately address older adults' concerns, could dissuade OTs from recommending them.

Taken as a whole, further research investigating the barriers faced by Canadian OTs *familiar but non-users of ICT* in practice is needed to better understand the situation as well as identify and elaborate ways for an optimal integration of ICT for homecare. Identifying what are the *specific* barriers in adoption of ICT in practice informs the knowledge translation initiative methods to use for the successful uptake of knowledge in practice. In other words, it allows to tailor the knowledge to the specific setting and the particular individual for whom it is intended.

4.3 Avenues to address the knowledge gap emerging from the survey

The survey findings indicate that recommendation and usage of ICT might be learned in practice and acquired through time. Given that higher education was not associated with an increased likelihood of using ICT and that merely 27% of the *familiar with ICT* OTs used it in practice bears the question of whether the Canadian school curricula provides students with the requisite tools and knowledge about *which* and *how* technologies could be used in practice. In Australia, recommendations to integrate the topic of assistive technology, among others, to the Australian OT school curricula have been made following research conducted on Generation Y – OT undergraduates' skills and confidence in the use of technologies relevant to contemporary practice highlighting that they face a lack in technological skills relevant to their practice and in confidence to use specialized softwares, specialized devices, or assistive technology (Hills et al. 2016). In Poland, recommendations to complement the curricula of academic and continuous education OT programs with a module on technology use, including robotics, were made following research investigating OT students' perceptions of the role of robots in the care for older people living in the community (Tobis, Cylkowska-Nowak, Wieczorowska-Tobis, Pawlaczyk, & Suwalska, 2017). In Canada, as mentioned previously, Klein's (2002) research highlighted an increased amount of gerontological content taught by faculty members with gerontological training. However, it also highlighted existing inconsistencies in the amount of instruction and availability of field work experiences provided to occupational therapy students. Research to determine the current aptitudes of Canadian OT graduates to ensure that they have the necessary knowledge, skills, and confidence, in recommending ICTs in their practice with older adults is needed.

Increasing knowledge and familiarity with ICTs is an avenue to help bridge the knowledge gap previously presented. Peek et al. (2014 and 2017) illustrate that older adults' familiarity with technology is a factor positively influencing acceptance and adoption of technology for *aging in place*. In a systematic review on the factors influencing the adoption of ICT by different healthcare professionals, Gagnon et al. (2012) illustrate this to be true for healthcare professionals as well. The results from our survey rejoin these findings as the majority of recommended ICT devices involved applications on a computer, smartphone, or tablet – all devices that are now generally owned by the majority of Canadians and which older adults have shown to be increasingly more at ease with and willing to use (Statistic Canada, 2017). Finally, gaining a better understanding of the barriers and facilitators of ICT implementation from *familiar users* OTs could further highlight ways to overcome underutilization of ICT in practice.

CHAPTER V: CONCLUSION AND FUTURE WORK

This project focused on the current state of ICT recommendation by OTs working with older adults across Canada. This project is the first to provide insight on this topic and the findings highlight that use of ICT for older adults is not well integrated in the practices of OTs. In fact, the findings suggest there is a need to research, revisit, and update the Canadian OT school curricula accordingly, as well as to establish continuing educational programs to inform professionals about the currently available technologies, their potential benefits to clients, and *how* to integrate and use them in practice. There is a need to go beyond providing knowledge of available tools, although *familiarity* with technology is regarded as an enabler of technology usage, as familiarity alone is not sufficient to drive adoption in practice. Nonetheless, it is important to acknowledge that this potentially stems from the fact that technology adoption and use in the healthcare system is multifactorial and that different stakeholders are at play. Keeping

this in mind, to grasp a better understanding of the current situation and elucidate reasons behind OTs attitudes towards technology use and recommendation with older adults, future steps should be taken to detail the barriers and facilitators they face in practice. To complement the survey findings, and as a continuation of this research project, individual interviews have been conducted with OTs from various work environments and of different familiarity level with the technology, across Canada. The data is being analysed. With the increasing developments of technological tools and the role that OTs play in the healthcare system, it is expected that the practice of OTs will evolve alongside these important developments, ultimately, bridging the gap between the current growth of technological devices and the provision of recommendations for the homecare of the older adults.

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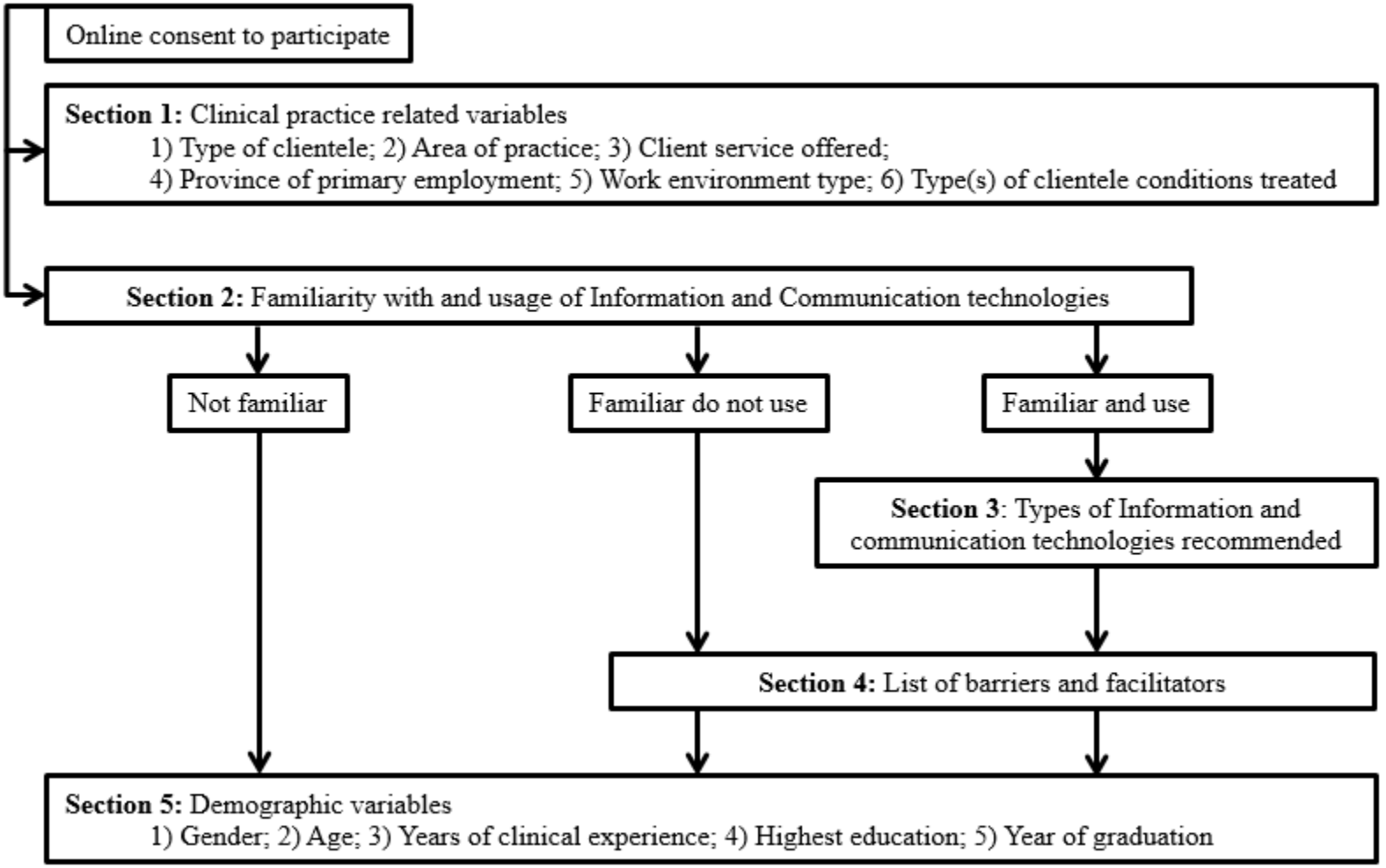
APPENDIX



Supplemental Figure 1: Survey content and flow

Survey: "*Understanding current Canadian occupational therapists' practices with gerontechnology"*

SECTION 1
Preliminary information

1. **Please check the age group(s) that apply to your clientele:** (check all applicable answers)
   - ☐ Pediatric (0-18 years old)
   - ☐ Adult (18-64 years old)
   - ☐ Geriatric (65 years and older)

2. **Area(s) of practice**
   - ☐ Mental health
   - ☐ Service administration
   - ☐ Client service management
   - ☐ Medical/Legal client service management
   - ☐ Teaching
   - ☐ Research
   - ☐ Neurological/Neuromuscular
   - ☐ Musculoskeletal system
   - ☐ Cardiovascular and respiratory system
   - ☐ Digestive/Metabolic/Endocrine system
   - ☐ General physical health
   - ☐ Vocational rehabilitation
   - ☐ Palliative/End of life care
   - ☐ Health promotion and wellness
   - ☐ Other. Please specify: _____

3. **Client services**
   - ☐ Home assistance/support
   - ☐ Long-term care
   - ☐ Assessment/Orientation (hospital services)
   - ☐ Assessment/Orientation (clinics/specialized services)
   - ☐ Assessment/Orientation (emergency)
   - ☐ Rehabilitation – Vocational
   - ☐ Rehabilitation – Social integration
   - ☐ Rehabilitation – School integration
   - ☐ Palliative care
   - ☐ Legal expertise
   - ☐ Screening/Assessment
   - ☐ Psychotherapy (with permit)
   - ☐ Information/Promoting health in the community
   - ☐ Suicide, disease, accidents, social issues prevention in the community
   - ☐ Other: Please specify:_____

4. **Province of primary employment:**
   - ☐ Alberta
   - ☐ British Columbia
   - ☐ Manitoba
   - ☐ New Brunswick
   - ☐ Newfoundland
   - ☐ Nova Scotia
   - ☐ Northwest Territories
   - ☐ Nunavut
   - ☐ Ontario
   - ☐ Prince Edward Island
   - ☐ Quebec
   - ☐ Saskatchewan
   - ☐ Yukon Territories

5. **Work environment**
   - ☐ General hospital
   - ☐ Rehabilitation hospital/facility
   - ☐ Mental health hospital/facility
   - ☐ Residential care facility
   - ☐ Assisted living residence
   - ☐ Community health centre
   - ☐ Visiting agency/business
   - ☐ Group professional practice/clinic
   - ☐ Solo professional practice/clinic
   - ☐ Post-secondary educational institution
   - ☐ School or School board
   - ☐ Association/Government/Para-Governmental
   - ☐ Industry, Manufacturing and Commercial
   - ☐ Other – Specify: _____

SECTION 2
Knowledge about new technologies

Definition: In this survey, **new technology** refers to products, instruments or systems used to improve the autonomy, security and well-being of people with disabilities. It includes technologies based on information and communications technology (ICT), as well as smart systems used to automate or facilitate tasks.

1. Are you familiar with new technologies supporting occupational therapy practice?
   - ☐ Yes, and I use them in my current practice
   - ☐ Yes, but I do not commonly use them in my practice
   - ☐ No, not at all
   - ☐ I don't know

Inventory of new technologies

For each category listed below, place a checkmark next to all technologies that you have previously recommended to your clients.

Category: Disabilities

a) Technologies to support cognition:

- ☐ "Calendar" application on tablets or smartphones
- ☐ "Notes" application on tablets or smartphones
- ☐ "Picture" application on tablets or smartphones
- ☐ "Reminders" application on tablets or smartphones
- ☐ Automated voice recording memos (e.g. system with pre-programmed messages)
- ☐ Electronic timer
- ☐ "Timer" application on tablets or smartphones
- ☐ Digital photo frame
- ☐ Applications for cognitive stimulation, on tablets or smartphones (e.g. crossword puzzles)
- ☐ Serious video games (i.e. games aimed at improving cognition)
- ☐ Other – Specify: _____

Comments: _____

b) Technologies to support communication:

- ☐ Digitalized telephone directory directly connected to the phone line
- ☐ Telephone with pictures
- ☐ Telephone with voice control commands
- ☐ Video calls through Internet (e.g. Skype, Facetime, Hangout)
- ☐ Communication via social media (e.g. Facebook, Twitter, Instagram)
- ☐ Applications to learn a second language on tablets or smartphones

☐ Communication notebook on tablets or smartphones (e.g. application with pictures to support naming of objects)
☐ Visual dictionary (with images) on tablets or smartphones
☐ Text to speech application for websites on computers, tablets or smartphones
☐ Object recognition application on tablets or smartphones
☐ Adapted smartphones (e.g. fewer or bigger buttons, fewer functions)
☐ Other – Specify: _____
Comments: _____

c) Technologies to improve knowledge on health status:

☐ Applications/devices to screen for biological parameters (e.g. glucose detector, blood pressure monitor, smart clothes)
☐ Application/devices to record different physiological parameters (e.g. blood pressure measures, glucose levels)
☐ Application/devices to record psychological symptoms (e.g. hallucinations, anxiety, mood)
☐ Applications/devices to track physical activity (e.g. pedometers)
☐ Applications/devices for the management of skin conditions
☐ Websites that enable clients to obtain information on their disease or particular condition (e.g. Stroke Engine, associations or organizations websites – e.g. Alzheimer's Society website)
☐ Websites enabling online interventions with automated assistance (non-human interaction) dedicated to clients
☐ Websites enabling online interventions provided by clinicians (human interaction) and dedicated to clients
☐ Discussion forums on the web
☐ Other–Specify: _____
Comments: _____

Category: Activities and participation

a) Technologies to facilitate transportation

☐ GPS localization application for tablets or smartphones
☐ Application to remotely pay for parking, for tablets or smartphones
☐ Monthly subscription to GPS tracking services linked to an online application (computers, tablets or smartphone)
☐ Smart accessories for motorized wheelchairs (e.g. device providing parking assistance for wheelchairs)
☐ Devices assisting driving (e.g. blind spot information systems, parking assistance systems)

☐ Alternatives to restraints with various interfaces (e.g. sensitive pads, belts with buckles, alarms, mats or bed strips with movement detectors)
☐ Other – Specify: _____
Comments: _____

b) Technologies to improve general planning and management of daily activities:
☐ Applications illustrating the different steps of a task, combining visual and verbal indications on tablets or smartphones
☐ Applications, such as Logbook, to keep record of accomplished activities on tablets or smartphones
☐ Other – Specify: _____
Comments: _____

c) Technologies to prevent burns or water damage:
☐ Faucets with light indicator
☐ Water temperature with light indicators
☐ Automatic control system for hot water
☐ Water damage/flood detector with alarm signalling
☐ Other – Specify: _____
Comments: _____

d) Detection/prevention of falls
☐ Personal emergency response system involving the use of a pendant or bracelet (including monthly subscription to a central)
☐ Infrared motion detector or artificial vision to signal/detect falls, with monthly subscription to a central
☐ Motion-activated nightlight
☐ Other – Specify: _____
Comments: _____

e) Technologies to improve performance in personal care or household activities
☐ Application providing visual recommendations for dressing according to the weather, on tablets or smartphones
☐ Sleep cycle monitoring application on tablets or smartphones
☐ Timer for cooking (e.g. Safecook™)
☐ Induction stove
☐ Programmable coffeemaker
☐ Application allowing the control smart household appliances remotely (e.g. coffeemaker, dishwasher), on tablets or smartphones

☐ Application providing diverse recipes and assisting with the planning and organization of meals, on tablets or smartphones
☐ Online grocery shopping services
☐ Smart fridge that displays a list of current ingredients and notifies the user in case of missing items
☐ Application to create grocery lists on tablets or smartphones
☐ Recipe websites
☐ Iron with automatic shutoff feature
☐ Robot vacuum
☐ Budget planning/follow-up application on tablets or smartphones
☐ Application for remote activities with to-be-accomplished recall system using light signals via tablets or smartphones
☐ Other – Specify: _____
Comments: _____

f) Technologies to improve or facilitate hobbies

☐ Simplified universal remote control
☐ Various games on computers, tablets or smartphones
☐ Other – Specify: _____
Comments: _____

g) Technologies to improve or facilitate medication management

☐ Electronic pill dispenser
☐ Medication reminder application on tablets or smartphones
☐ Application to create medication lists on tablets or smartphones
☐ Other – Specify: _____
Comments: _____

Category: Environment

a) Smart environments and telehealth

☐ Control of household appliances and home settings by home automation (e.g. household temperature, lighting, electrical outlets, locks)
☐ Remote control of household appliances and home settings via tablet or smartphone application (e.g. household temperature, lighting, electrical outlets, locks)
☐ Alarm device connected to a phone line, enabling individuals to get help in case of an emergency
☐ Video surveillance systems
☐ Telecare systems
☐ Other – Specify: _____
Comments: _____

b) Technologies to facilitate the role of the caregiver

☐ Devices to facilitate monitoring by the caregiver (e.g. video cameras linked to a tablet or smartphone application, door contact/infra-red sensors)

☐ Videoconference with the caregiver

☐ Website with information specifically dedicated to the caregiver

☐ Websites enabling online interventions with automated assistance (non-human interaction) dedicated to caregivers

☐ Websites enabling online interventions provided by clinicians (human interaction) and dedicated to caregivers

☐ Discussion forums

☐ Other – Specify: _____

Comments: _____

Other: Identify any other technology that you use and that is not listed in the categories above:

SECTION 3
Facilitators and barriers

Please indicate the facilitators and most important barriers linked to your use and knowledge of the new technologies presented in this survey.

Facilitators (check the most important ones)

1. **Facilitators**

In general, the factors that facilitate the use of advanced technologies in my practice are (check the main factors):

☐ The availability of the technology, i.e. it can be easily acquired from the industry
☐ The reliability of the technology
☐ The ease of operation of the technology
☐ Past successful achievements with said technology
☐ The usefulness of said technology with respect to the needs observed in my practice
☐ The accessibility of said technology in my practice, i.e. the possibility to acquire it via my department or supply system
☐ Reasonable purchasing, use, and maintenance costs of said technology
☐ Availability of necessary support (technical, administrative, financial) in my workplace
☐ Encouragement from my superiors to use new technologies (moral and financial support)
☐ Other – Specify: _____
Comments: _____

2. **Barriers**

In general, the factors that limit the use of advanced technologies in my practice are (check the main factors):

☐ The complexity of said technology
☐ The lack of availability of said technology
☐ The lack of knowledge and training related to the use of said technologies
☐ The lack of reliability of said technology
☐ Bad experiences with said technology
☐ The lack of usefulness of such technologies in the context of my current practice
☐ The lack of accessibility of said technology in my area of practice
☐ The need to change my current practice to integrate the use of said technologies
☐ High purchasing, use and maintenance costs for administrators in my workplace
☐ The lack of support (technical, administrative, financial) at my workplace
☐ The use of said technologies generates greater responsibilities
☐ The use of said technologies increases the workload

☐ The lack of sufficient and necessary administrative support to undertake the new responsibilities (learning how to use the new technologies)
☐ The lack of relevant information in my workplace concerning said technologies
☐ Other – Specify: _____
Comments: _____

Demographics

6. Check all conditions that apply to your clientele:

☐ Progressive neurological disorder
☐ Alcoholism and other drug dependencies
☐ Arthritis and rheumatology
☐ Burns
☐ Cancer
☐ Speech and language impairment
☐ Intellectual disability
☐ Visual impairment
☐ Hearing impairment
☐ Dementia and related syndromes
☐ Mild Cognitive Impairment
☐ Chronic pain
☐ Encephalopathy
☐ HIV
☐ Genetic disorders
☐ Myelopathies
☐ Neonatology
☐ Developmental delays
☐ Traumatic brain injuries
☐ Affective disorders
☐ Eating disorders (e.g. anorexia, bulimia)
☐ Cardio-respiratory disorders
☐ Swallowing disorders
☐ Personality disorders
☐ Mood disorders
☐ Musculoskeletal and amputation disorders
☐ Pervasive developmental disorders
☐ Severe behavioural disorder
☐ Disorders related to aging
☐ Psychotic disorders
☐ Other:

7. How many years of experience do you have in clinical practice?

Number of years: (if less than a year, use decimals. For example, write "0.5" for 6 months of experience).

8. **Indicate your highest level of education (completed):**
   - ☐ Bachelors
   - ☐ Masters
   - ☐ Doctorate

   Graduation year:

9. **Indicate your sex:**
   - ☐ Male
   - ☐ Female

10. **How old are you?**

    Age (years):

Are you willing to be contacted to participate in a focus group or an individual interview aiming to deepen our understanding of your practice with technology?

- ☐ YES
- ☐ NO

Thank you for your participation in this survey!