SYSTEMATIC IMPLEMENTATION AND EVALUATION OF AN APP-BASED COMMUNITY PLATFORM FOR ASSESSING PAIN IN LONG-TERM CARE FACILITIES

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Vivian Tran, candidate for the degree of Master of Science in Clinical Psychology, has presented a thesis titled, *Systematic implementation and evaluation of an app-based community platform for assessing pain in long-term care facilities*, in an oral examination held on July 27, 2022. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

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Abstract

Pain is under-assessed and under-addressed among older adults living in long-term care (LTC) facilities. The Pain Assessment Checklist for Seniors with Limited Ability to Communicate-II (PACSLAC-II) is a validated assessment tool for health professionals to assess pain in residents with dementia. A tablet app, based on the PACSLAC-II, has been shown to have clinical utility. This study involved the systematic implementation and evaluation of a new community platform that works in conjunction with an updated PACSLAC-II app. The community platform is comprised of (a) a quality indicator (QI) feature, which allows health care professionals to view and share their unit QI scores (e.g., frequency of resident assessments) with other units; and (b) a resource community portal (CP) feature aimed at facilitating user interaction and continuing education. The objectives of this study were to (1) evaluate whether pain QIs (e.g., frequency and timeliness of pain management interventions) improved with the use of the app (and each feature) compared to the LTC unit’s regular pain assessment practices; (2) evaluate the impact of the use of the PACSLAC-II app and each of the new features on health care professionals’ self-reported stress and burnout levels, and; (3) obtain the perspectives of health care professionals on the app and its specific features through semi-structured interviews. Based on the job-demand resource model, it was anticipated that LTC units assigned to use the app and both features would see the most gains in QI scores, reduced staff stress, and staff satisfaction with the app. This would be followed by units that were assigned to the app with only one feature, and lastly by units that had access to the basic app with no additional features. For the purposes of hypothesis testing, a minimum of 25% improvement in QI scores was considered to reflect meaningful change. This study employed a mixed methods
multiple-baseline design across several LTC facilities. Eleven LTC facilities participated in this study and were randomly assigned to one of five conditions (App only, App + QI, App + CP, App + QI + CP, App + CP + QI). Complementing the unit data, 34 health care professionals completed self-report questionnaires and 32 participated in semi-structured interviews. QI data revealed improvements in QI scores compared to baseline regardless of experimental condition. Contrary to hypotheses, however, regression analyses showed that demographic data and utilization of the associated websites did not predict stress and burnout scores. Thematic analysis of staff interviews showed that a majority of participants expressed a preference for using the app as opposed to a paper version of the PACSLAC-II due to reasons such as the app’s ability to provide useful information (i.e., resident pain graphs), increased data security, as well as its user-friendly interface and increased convenience. The overall increase in QI scores observed in the implementation period suggests that the utilization of the PACSLAC-II may be effective and feasible in improving pain assessment practices in LTC facilities. At the same time, QI gains were not maintained during a follow up period, likely related to unusually high competing demands on staff due to the COVID-19 pandemic. Nonetheless, the results of this study strongly support benefits of using the app version of the PACSLAC-II, although use of the extra features were not shown to confer additional advantages to frontline staff. As pointed out by some participants, the QI feature might prove more useful for facility administrators monitoring overall facility performance than to frontline nursing staff.
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Dedication

This thesis is dedicated to my parents and grandmother. Without all of their sacrifices, I wouldn’t have all the opportunities that I have today. Cảm ơn Ba, for tirelessly working without complaint to support our family and for giving me the opportunities that you did not have. Cảm ơn Mẹ, for your words of encouragement and always checking up on me when I’m far from home. Cảm ơn Bà Ngoại, for loving me unconditionally. My love and appreciation for seniors comes from you and the amazing childhood you’ve given me.
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Systematic Implementation and Evaluation of an App-Based Community Platform for Assessing Pain in Long-Term Care Facilities

1.1 Pain in Long-Term Care Resident with Dementia

Pain is a complex and subjective experience that is influenced by a number of components such as biological, psychological, and social factors (Raja et al., 2020; Turk 1996). Due to its subjectivity, self-report is often considered the best practice approach as it respects each individual’s experience (Herr et al., 2019; Smith, 2005). Although all individuals deserve prompt recognition and treatment of pain (Herr et al., 2006), it is well documented that pain is under-assessed and under-addressed amongst seniors living in long-term care (LTC) facilities (Zwakhalen et al., 2009; Cohen-Mansfield, 2014; Miu & Chan, 2014, Fain et al., 2017), as it is estimated that 27-76% of residents in Canadian long-term care (LTC) facilities are affected by persistent pain (Gallant et al., 2020). Underrecognized and unaddressed pain is often linked to negative physical and mental health outcomes such as missed opportunities for early treatment, impairments in the overall quality of life, and requests for medical assistance in dying (Parmelee et al., 1991; Denny & Guido, 2012; Health Canada, 2020).

Pain is especially difficult to manage in residents with Alzheimer’s or other forms of dementia. Alzheimer’s disease is a progressive neurological disease and is the most common cause of dementia (National Institute on Aging, 2019). Dementia is a set of symptoms affecting cognitive functioning, specifically, it can cause disturbance in executive functioning, memory impairment, and limited ability to communicate (Public Health Agency of Canada, 2016). Aphasia is when an individual experiences difficulties with the expression (e.g., forming sentencing, naming objects) and the comprehension of written and spoken language. Language function is often greatly impaired in individuals
with severe dementia, as they may become mute or non-communicative. As a result, the decline in language abilities limits opportunities for residents with dementia to communicate their pain (e.g., through self-report) and receive appropriate assistance. Therefore, pain not only impacts quality of life but is also an ethical issue for individuals who require the most care (Hogan et al., 2016).

Pain is poorly managed due to a number of reasons such as the under-recognition of the problem (e.g., myths that pain is inevitable in old age and should be endured), lack of educational opportunities available to health care professionals on pain assessment in dementia, and reservations towards the provision of certain types of medication due to potential side effects such as risk of falls (Lynch, 2011; Martin et al., 2005; Thielke et al., 2012). Although clinical guidelines have been established to manage pain in LTC settings, systematic barriers and the high prevalence of residents with dementia make it difficult to apply the guidelines consistently (Boyle et al., 2013; Reid et al., 2015). One such example is the treatment of pain. It is well documented that seniors with dementia tend to receive considerably lower amounts of medication for their pain compared to seniors with no cognitive impairments (Horgas & Tsai, 1998; Morrison & Siu, 2000; Reynolds et al., 2008; Tan et al., 2015; Neumann-Podczaska et al., 2016). This could be due, in part, to the previously held belief that individuals with dementia may have reduced pain perception compared to seniors who are cognitively intact (Berthier et al., 1998). However, further research in this area found little support for this claim (Kunz et al., 2007). A recent review of the literature suggests a lack of evidence of the significant impact of dementia on pain threshold or tolerance (Gagliese et al., 2018). Instead, a more likely possibility is that pain is undertreated in this population largely because older adults with dementia frequently
underreport pain due to their limited ability to communicate. A recent meta-analysis of 31 studies on pain threshold and 9 studies on pain tolerance, has shown that although pain threshold shows small changes as a function of age in laboratory psychophysical studies, there are no substantial age-related changes in terms of pain tolerance (Lautenbacher et al., 2017). Moreover, there is no evidence that these changes in pain threshold have clinical significance (Hadjistavropoulos et al., 1998). In another systematic review conducted by Binnekade et al. (2017) on pain experience and dementia subtypes, the researchers found inconsistent findings in the literature for patients with Alzheimer’s Disease and their pain experience. Taken together, the evidence from experimental and clinical studies suggests that any changes to the sensory dimensions of pain are subtle (Gagliese et al., 2018). Therefore, although older adults, with or without dementia, may have a small increase in their pain threshold due to age-related changes, their pain tolerance has not changed and still needs to be appropriately addressed.

Another challenge in the assessment and treatment of pain are the behavioural and psychological symptoms of dementia (BPSD) exhibited by residents with moderate to severe dementia. (Cerejeira et al., 2012; Cipher et al., 2006). BPSD exhibited by residents may include behaviours such as signs of agitation, verbal aggression, physical combativeness towards health care professionals or other residents as well as psychological symptoms such as delusions and hallucinations (Cerejeira et al., 2012; Capsi, 2013). BPSD is also known to increase as a function of pain severity (Cipher et al., 2006), as such BPSD due to unaddressed pain may be misinterpreted by health care professionals as a symptom of dementia rather than pain itself, leaving the pain untreated. Another possibility may be that the BPSD are treated with psychotropic, rather than analgesic medication (Balfour &
O’Rourke, 2003). Psychotropic medications may limit the mobility of these residents and have adverse effects including over-sedation, delirium, parkinsonism, and accelerated cognitive decline (Zaudig, 2000; Murphy et al., 2020). Psychotropic medications are also known to hasten death in frail older adults (Ballard et al., 2009; Johnell et al., 2016). Therefore, there is an increasing need for effective pain assessments and pain management strategies in this population.

1.2 Impact of Resident Pain on Health Care Professionals

Caregiver burden is the “physical, psychological, emotional and social stressors associated with the caregiver experience” (Kasuya et al., 2000 p. 119). It is associated with negative health outcomes such as depression and decreased quality of life (Schulz et al., 2006). Several studies have documented high stress and job burnout levels in both informal and formal caregivers of seniors with dementia (Ravenson et al., 2016; Costello et al., 2019). Behavioural disturbances are common in seniors with dementia who have under-addressed pain. These disturbances, which may include repeated vocalizations such as calling out for help, often contribute to distress and burnout in health care professionals (Hiyoshi-Taniguchi et al., 2018). Moreover, due to the potential difficulties in identifying pain in residents with severe dementia, health care professionals may experience uncertainty about the treatment needs of each resident (Martin et al., 2005). Together, the demands and uncertainty of caring for older adults with dementia may lead to burnout.

One way to predict potential burnout amongst health care professionals is through the Job Demands Resources (JD-R) model (Demerouti et al., 2001; Bakker & Demerouti, 2007). The model is built upon several premises. One being that work environments are characterized by job demands and job resources. Job demands are characterized by physical
or psychological features of a job that require an employee’s physical and/or psychological effort for extended periods of time (Baker & Demerouti, 2007). Examples of job demands include time and work pressure, feelings of uncertainty, emotional demands of clients, and role overload, all of which can result in physiological or psychological costs such as burnout. Job resources, on the other hand, are working conditions that provide resources for employees. Job resources refer to the aspects of the job that may either assist in achieving work goals, promote personal development, and/or may reduce job demands and their associated costs (Baker & Demerouti, 2007). Examples of job resources include training and development opportunities, supervisor and co-worker support, and performance feedback. According to the tenets of JD-R model, job resources can lessen the negative effects associated with job demands and have higher motivating potential when job demands are high. The JD-R model evaluates these job demands and job resources to predict how susceptible employees are to burnout. When job demands are high, but job resources are low, this may result in burnout (Bakker & Demerouti, 2007).

With regards to pain and dementia, job demands such as high stress environments, understaffing, time pressure, as well as resident factors, such as behavioural disturbances, negatively affect job satisfaction. Regular pain assessment and tools aimed to assist this process may be a job resource to address these demands. Pain assessments could potentially reduce burnout due to increases in health care professionals’ knowledge, feelings of control, and certainty (Edvardsson et al., 2009). In a study conducted by Fuchs-Lacelle et al. (2008), where a pain assessment protocol was implemented as an intervention, the results of the study indicated that regular pain assessment decreased pain in residents over time. In addition, decreased distress and burnout were also found in health care
professionals who utilized the pain assessment protocol (Fuchs-Lacelle et al., 2008). Therefore, regular pain assessment which can help to identify and treat pain may reduce the prevalence of behavioural disturbances in residents with dementia, thereby partially alleviating distress and burnout levels associated with these disturbances (Fuchs-Lacelle et al., 2008). As such, the observed benefits may serve as incentives for health care professionals to incorporate regular pain assessment in their professional practice and encourage work engagement in LTC settings (Fuchs-Lacelle et al., 2008). In the current study, the PACSLAC-II app and its associated features such as the community portal website, provided health care professionals with job resources such as training and knowledge about non-verbal pain behaviours, pain assessments, and best-practice recommendations. Through the use of the quality indicator website, they also received feedback about the progress of their pain assessment intervention. Together, the PACSLAC-II app and its associated features aimed to increase feelings of control and certainty, thereby decreasing stress and job burnout amongst participating health care professionals.

1.3 Benefits of Regular Pain Assessments

There are a number of other benefits that are associated with regular pain assessments in LTC. In one study, researchers found that implementation of a pain assessment protocol and an increased effort in communicating residents’ pain to physicians resulted in a number of benefits as identified by health care professionals involved in the study (Hadjistavropoulos et al., 2014). The health care professionals indicated that one benefit of the study protocol was the more careful evaluation of residents’ pain. For example, in some cases the use of a pain assessment tool helped the health care
professionals discriminate the presence of pain from other conditions, such as delirium or dementia. Moreover, regular pain assessment resulted in increased awareness and communication among team members regarding pain management. This led to improved problem solving for challenging pain situations and reassessment of current interventions being implemented for pain relief. Another benefit of the study was a greater precision of prescribing for older patients with dementia. A reduction of polypharmacy was observed as physicians would reassess the effectiveness of medication, leading to lower amounts of benzodiazepine medications that were prescribed, which can have serious side effects for older adults (Hadjistavropoulos, et al., 2014). And lastly, health care professionals noted a reduction in behavioural disturbances in residents with dementia once the identified pain was addressed by the health care professionals (Hadjistavropoulos, et al., 2014).

This reduction in behavioural disturbances has been found in other studies that implemented pain management protocols as well. In a large randomized control trial, residents with moderate to severe dementia who were experiencing pain were treated with a standardized stepwise treatment protocol using analgesic medication as recommended by the American Geriatric Society compared to care as usual (Husebo et al., 2011). The researchers found a significant reduction in aggressive behaviours, neuropsychiatric symptoms, and pain for residents in the treatment group compared to the control group (Husebo et al., 2011). The results of this study highlight the efficacy of pain treatment protocols in reducing not only behavioural disturbances but also the misappropriate use of psychotropic medications in residents living in LTC. In summary, regular pain assessments are beneficial for a number of reasons including: increased communication and assessments in the work environment, reduced behavioural disturbances in residents with
dementia, lower inappropriate prescription of psychotropic medication, and ultimately provision of appropriate pain management in an under-addressed population. Nonetheless, for these benefits to be observed, pain assessment practices must encompass a number of guidelines and considerations as discussed in the following section.

1.4 Pain Assessment Clinical Practice Guidelines

Key Clinical Guideline Recommendations

There are a number of guidelines established by influential organizations and other expert groups including the National Nursing Home Pain Collaborative (Herr et al., 2010), American Geriatrics Society (America Panel on Chronic Pain in Older Persons, 2002), and International Interdisciplinary Consensus Statement on Pain Assessment in Older Persons (Hadjistavropoulos et al., 2007). Common elements from many such guidelines were compiled by Hadjistavropoulos et al., (2014):

- Integrate the results of physical examinations, clinical history, test results etc.;
- Attempt self-report with all residents;
- Utilize validated standardized observational assessment tools;
- Gather collaborative informant reports;
- Pursue an individualized approach to assessment rather than cut-off scores;
- Assess pain before and after a pain management intervention;
- Recognize the limitations of screening tools.

Medical History & Physical Examination. Effective pain assessment takes into account resident medical history, “pain history”, current pain problems, medical test findings, and physical examinations (Hadjistavropoulos et al., 2007). Other areas that should also be addressed for a thorough assessment include resident functional status,
emotional functioning, and contextual factors surrounding the pain (Hadjistavropoulos et al., 2007).

**Self-Report.** Self-report is often considered the “gold standard” approach in pain assessment practices (Herr et al., 2019; AGS Panel on Persistent Pain in Older Persons, 2002). It is highly recommended that resident self-report be attempted during all assessments, as reports are often valid in residents with mild to moderate dementia (Hadjistavropoulos et al., 2011). However, adjustments may be needed to accommodate for the sensory, physical, or cognitive limitations of these residents such as ensuring that hearing aides are functional or providing both written and oral instructions (Hadjistavropoulos et al., 2007).

**Observational Assessment Tool.** Cut-off scores are not recommended in observational pain assessments for older adults with dementia (Chan et al., 2014). This is because scores can be affected by a variety of factors. For example, longer observational periods will likely result in higher scores. Additionally, residents with limited mobility may have a limited expression of pain compared to residents with full mobility (Herr et al., 2019). Given that the duration of observation and situational variables could affect pain scores, it is important that assessments be conducted under consistent circumstances (Hadjistavropoulos, 2017). Therefore, an individualized approach to assessment is recommended, where clinicians would observe changes in resident pain scores over time and an unexpected rise in scores would be indicative of pain (Hadjistavropoulos et al., 2011). Obtaining scores before and after the administration of analgesics or other interventions would also assist clinicians to determine the presence of pain as well as the extent to which the intervention was effective in alleviating pain (Hadjistavropoulos, 2017;
However, caution is warranted in selecting analgesics for older adults with dementia due to elevated risks of side effects (Erdal et al., 2018). Health care professionals should also take into consideration that pain is more likely to be expressed during movement than at rest (Hadjistavropoulos et al., 2007; Herr et al., 2010). Lastly, conditions which are not related to pain (e.g., depression and delirium) could potentially mimic and be confused as signs of pain (Hadjistavropoulos et al., 2008). Therefore, pain assessment tools that have been designed to minimize overlap with these conditions, such as the PACSLAC-II, should be selected (Chan et al., 2014).

**Collaborative Informant Reports.** In LTC settings, care aides (Jansen et al., 2017) and family members (Ammaturo et al., 2017) are often the first to recognize changes in residents’ behaviours that are suggestive of pain. Therefore, the use of collaborative informants is vital to gather complete history information and to gain a better understanding of the resident’s pain outside the context of the clinical examination (Hadjistavropoulos, 2017). As conflicting reports of pain may be provided due to observer bias (Prkachin et al., 2007), it would be important for health care professionals to work with all concerned parties to make the best-informed treatment decision for their residents (Herr et al., 2019).

**Limitations of Pain Assessment Tools.** When health care providers use well-established observational pain assessment tools and are aware of the scope of these tools, they can produce reliable and valid assessments of assessing pain in residents with dementia. However, clinicians should not view observational pain assessments as definitive indicators of pain (Hadjistavropoulos, 2017). Rather, they are assessment tools meant to supplement other assessment approaches. Therefore, they may sometimes incorrectly suggest the presence of pain and at other times are unable to detect its presence.
As such, these tools should not be used as substitutes for a thorough assessment by qualified health professionals (Hadjistavropoulos, 2017).

**Feasibility of Clinical Guideline Recommendations**

Although these clinical guideline recommendations endorse thorough assessments, the extensiveness of each recommendation limits their application in LTC settings. This is due to the fiscal and resource realities that affect the day-to-day operation of nursing homes (Hadjistavropoulos et al., 2007). The consensus group acknowledges that, although adequate assessment is critical, many of their recommendations involve processes that may be too time-consuming in clinical settings (Hadjistavropoulos et al., 2007). As such, these guidelines may not be feasible for many facilities at least as far as routine day-to-day care is concerned (Hadjistavropoulos, et al. 2009). To address this problem, Hadjistavropoulos et al. (2009) gathered experts in public policy and in clinical pain assessment/management to develop clinical guidelines that are more feasible and take into account the existing resource realities of long-term care facilities. The clinical practice guidelines include:

1) “All residents should have pain assessed using a clinically appropriate and validated tool within 24 hours of admission and no less frequently than once a week”,

2) “Residents with findings of moderate or greater pain (and non self-reporting residents with findings with pain) should have a pain treatment plan documented and implemented within 24 hours”,

3) “Within 24 hours of implementation of the pain treatment plan, pain and side effects of treatment should be reassessed and managed to meet comfort goals”,

4) “Pain assessment processes and treatment outcomes should be a component of an ongoing quality improvement program”.
In a subsequent study, Hadjistavropoulos et al. (2011) surveyed the opinions of LTC stakeholders such as frontline staff and administrators about the aforementioned guidelines. The researchers found that their pain assessment and management guidelines were viewed as feasible and cost-effective by LTC stakeholders (Hadjistavropoulos, 2011). Therefore, it appears feasible to implement these clinical practice guidelines to improve the accuracy of pain assessments in LTC environments. More recently, implementation research has demonstrated that these guidelines can be implemented in LTC with minimal additional resources (Zahid et al., 2020; Hadjistavropoulos et al., 2016).

1.5 Pain Quality Indicators

One way of measuring the benefits of pain assessments is through the use of quality indicators. Quality indicators help to identify the presence of potentially poor care practices which may lead to negative resident outcomes. They also serve as a systematic and longitudinal record of the clinical profile of health care facilities in a standardized, relatively inexpensive, and regular manner (Karon & Zimmerman, 1996). One of the most readily used quality indicator systems in LTC settings is the Resident Assessment Instrument-Minimum Data Set 2.0 (RAI-MDS 2.0; Morris et al., 1997). The RAI-MDS 2.0 consists of a number of health quality indicators, such as falls, pressure sores, and antipsychotic use. Although the RAI-MDS is widely utilized, the exclusive use of the RAI-MDS 2.0 may not be sufficient to determine the quality indicators of pain. In most Canadian jurisdictions, RAI-MDS 2.0 assessments are required to be completed only once every three months. Therefore, pain experienced by LTC residents may be under-assessed and under-addressed between assessments. Moreover, the assessments are based on staff’s subjective opinions about pain and do not require the use of validated pain assessment tools
which are needed for residents with limited ability to communicate. Therefore, the inclusion of more specific pain quality indicators may be beneficial for LTC facilities to better understand the prevalence and incidence of pain in their respective facilities.

One set of pain quality indicators that has been developed based on a model of pain management in LTC involving the input of both pain and public policy experts (Hadjistavropoulos et al., 2009). These quality indicators were developed to be feasible and easy to document for LTC facilities that may have limited resources. Specifically, Hadjistavropoulos et al. (2009) proposed four quality indicators corresponding to each clinical policy guideline previously mentioned in Section 1.5. The quality indicators include:

1) “The percentage of residents with pain assessment documented in medical record within 24 hours of admission”,

2) “The percentage of residents with moderate or greater pain with a pain treatment plan documented,”

3) “The percentage of residents with moderate or greater pain with reassessment of pain and possible side effects of treatment within 24 hours of treatment implementation, and”,

4) “The documentation of a quality improvement program that incorporates the aforementioned three quality indicators and is aimed at improving pain outcomes for LTC residents,“

Recent studies have incorporated these quality indicators to measure the effectiveness of pain assessment protocols in LTC. In one study, Gallant et al. (2022) developed and evaluated an interactive online training program for LTC staff to facilitate
the implementation of a pain assessment protocol and included the quality indicators as one of their measures (Gallant et al., 2022). The researchers found dramatic increases in the frequency of pain assessment based on these indicators following a pain assessment implementation program in most participating facilities. In another study aimed at increasing the frequency of pain assessments in LTC through the introduction of a pain app, similar results were obtained (Zahid et al., 2020). Additionally, health care professionals expressed that there was no significant increase in workload levels with collecting quality indicator data. Therefore, these quality indicators are useful in the evaluation of programs designed to improve pain care in LTC and were incorporated in this current study as further discussed in sections 2.2 Materials and 2.5 Measures. Moreover, participating LTC facilities in this current study were able to compare their quality indicator scores to other participating facilities to assess their performance with regard to recommended pain assessment practices.

1.6 Behavioural Observational Pain Assessment in Older Adults with Dementia

Due to its subjective nature, pain is typically assessed through self-report. As a result, self-report should always be attempted with all residents with dementia as some individuals may be able to provide valid reports of pain (Hadjistavropoulos et al., 2014; Herr et al., 2019); however, self-report may not be feasible in residents with moderate to severe dementia as they may be unable to verbally communicate their pain to health care professionals (Proctor & Hirdes, 2001). As a result, pain assessments have relied on non-verbal pain expressions to determine incidences of pain in these vulnerable populations (Hadjistavropoulos et al., 2014; Herr et al., 2019).
The American Geriatric Society Panel on Persistent Pain in Older Persons (2002) has published pain assessment recommendations specifically for older adults with moderate to severe dementia based on strong evidence from previous studies in this field (American Geriatric Society Panel on Persistent Pain in Older Persons, 2002). Pain assessments are recommended when residents are both moving (i.e., walking, transfers) and at rest, so that health care professionals have the opportunity to observe pain behaviours that may be restricted to one or the other. Furthermore, the panel recommended the use of multidimensional pain instruments that evaluates pain in relation to other domains such as changes in activities or changes in normal functioning. Lastly, the panel identifies six domains categorizing pain cues that are commonly observed in older persons with cognitive impairment. These six domains include: 1) facial expressions, 2) verbalizations and vocalizations, 3) body movements, 4) changes in interpersonal interactions, 5) changes in activity patterns or routines, and 6) mental status changes (American Geriatric Society Panel on Persistent Pain in Older Persons, 2002).

Several behavioural observational scales have been developed in an attempt to address the challenges of pain assessment for residents with dementia. Unfortunately, most findings indicate that some of these observational scales do not have strong validity and reliability (Zwakhalen et al., 2006). However, several studies evaluating clinical utility, sensitivity, and psychometric qualities have found the Abbey Pain Scale (Abbey et al., 2004), DOLOPLUS-2 (Lefebvre-Chapiro, 2001), Pain Assessment in Advanced Dementia Scale (PAINAD; Warden et al., 2003), Pain Assessment Checklist for Seniors with Limited Ability to Communicate (PACSLAC; Fuchs-Lacelle & Hadjistavropoulos, 2004), and Pain Assessment Checklist for Seniors with Limited Ability to Communicate-II (PACSLAC-II;
Chan et al., 2014) to be among the most research-supported behavioural observational pain scales currently available for residents living with dementia (Paulson-Conger et al., 2011; Zwakhalen et al., 2006; Hadjistavropoulos, et al., 2014; Herr et al., 2019). All these tools have the strongest conceptual and psychometric support, and high clinical utility (Herr et al, 2019).

1.7 PACSLAC Scales

The present study utilized the PACSLAC-II scale (see Appendix A) as it is among the most validated tool of its kind and, unlike most other tools, comprehensively covers all of the aforementioned domains recommended by the American Geriatric Society Panel on Persistent Pain in Older Persons (Chan et al., 2014). This section will explore the PACSLAC scales and their psychometric properties in further detail.

The original PACSLAC scale (Fuchs-Lacelle & Hadjistavropoulos, 2004) consisted of 60 items divided into four subscales (facial expression, social/personality/mood, activity/ body movement, and other). The items are scored dichotomously with “1” indicating the presence of a pain behaviour and “0” as absent. The scores are then added with a higher score indicative of higher levels of pain (Lints-Martindale et al., 2007). It is recommended by the developers of the scale to only utilize the total score, rather than the individual subscales when drawing conclusions about a resident’s pain (Fuchs-Lacelle & Hadjistavropoulos, 2004). The use of specific cut-off scores is not recommended (Chan et al., 2014). Instead, the developers recommended that the tool be used in an individualized manner which consists of obtaining baseline scores for each resident and examining score fluctuations over time (Chan et al., 2014). Unexpected increases in the typical pattern of scores may be indicative of increased pain.
In accordance with current best practice guidelines, the PACSLAC and PACSLAC-II are meant to assist in the assessment of pain, rather than a definitive indicator of pain itself (Herr et al., 2019; Hadjistavropoulos et al., 2014). As a result, clear cut-off scores of *mild*, *moderate*, and *severe* pain are not clinically appropriate as they do not take individual and dementia-specific differences into account. Therefore, an idiographic approach, reliant on expert clinician judgement, is recommended where health care professionals utilize their clinical judgement to make a determination of pain severity, rather than cut-off scores (Herr et al., 2019; Hadjistavropoulos et al., 2014). This idiographic approach has worked well in previous studies utilizing the PACSLAC scales as demonstrated through measurable benefits for residents in LTC (Fuchs-Lacelle, et al., 2014; Hadjistavropoulos et al. 2016).

In relation to the quality indicators suggested by Hadjistavropoulos et al. (2009), for the purposes of this study, moderate to severe pain would be determined based on a clinically relevant increase in a resident’s PACSLAC score compared to their typical/baseline score, as well as the clinical judgement of a qualified health care professional who has completed a thorough assessment of the resident.

The PACSLAC has good content validity as well as high internal consistency \((\alpha = .92; \text{Fuchs-Lacelle} \& \text{Hadjistavropoulos}, 2004)\). Research completed to determine the validity of the PACSLAC scale and its individual items demonstrated its ability to discriminate between calm, painful, and nonpainful distress events among older adults (Fuchs-Lacelle \& Hadjistavropoulos, 2004). Specifically, pain events had the highest PACSLAC score, followed by nonpainful distress events, and lastly by calm events. Moreover, a study conducted Lints-Martindale and associates (2012) compared the psychometric properties of six observational pain assessment measures aimed at seniors
with dementia: Assessment of Discomfort in Dementia (ADD; Kovach et al., 2001), Checklist of Nonverbal Pain Indicators (CNPI; Feldt, 2000), Pain Assessment Checklist for Seniors with Limited Ability to Communicate (PACSLAC; Fuchs-Lacelle & Hadjistavropoulos, 2004), Pain Assessment for the Dementing Elderly Scale (PADE; Villanueva et al., 2003), Pain Assessment in Advanced Dementia Scale (PAINAD; Warden et al., 2003), and Non-Communicative Patients’ Pain Assessment Instrument (NOPPAIN, Snow et al., 2004). Although all six had adequate psychometric properties and were able to differentiate between painful and non-painful states, the PACSLAC outperformed all the other tools providing further support for its comprehensive coverage of AGS-recommended pain assessment domains (Lints-Martindale et al., 2012). In another study conducted by researchers not associated with the development of the PACSLAC scale, it was found that among the PACSLAC, DOLOPLUS-2, and PAINAD, the PACSLAC was rated as having the highest greater clinical utility (Zwakhalen et al., 2006). Outside of its ability to assist in the detection of pain, regular use of the PACSLAC has also demonstrated improvements in pain management practices in LTC facilities across multiple studies (Fuchs-Lacelle et al., 2008; Hadjistavropoulos, et al., 2014).

The PACSLAC scale was revised in 2014 based on feedback about the tool’s length, ambiguity of certain items, and items associated with other conditions not exclusive to pain such as depression and delirium (Hadjistavropoulos et al., 2008; Lints-Martindale et al., 2012). There were a number of changes in the new version of the scale. The PACSLAC-II is composed of six domains (facial expressions, verbalizations and vocalizations, body movements, changes in interpersonal interactions, changes in activity patterns or routines, and mental status changes) with 31 individual items, which is almost
half the items in the original PACSLAC scale (Chan et al., 2014). However, the PACSLAC-II still comprehensively covers all six domains of pain assessment in dementia as recommended by the AGS (Chan et al., 2014).

The PACSLAC-II scale has satisfactory internal consistency ($\alpha = .82 - .92$), satisfactory interrater reliability ($\kappa = .63$), and strong convergent validity (Chan et al., 2014). In a study comparing the PACSLAC-II versus six other observational assessment tools, the PACSLAC-II accounted for more unique variance in discriminating painful states than all of the tools combined including the original PACSLAC (Chan et al., 2014). In addition, a recent study has also found that the PACSLAC-II can be used by laypeople to assess pain, further demonstrating its ability to be used by both formal and informal caregivers (Ammaturo et al., 2017). In summary, the PACSLAC-II is a validated observational assessment tool that has been shown to be more effective in its ability to detect pain in residents with dementia compared to other tools of its kind due to its inclusion of comprehensive behavioural domains. The present study aimed to evaluate a mHealth version of the PACSLAC-II.

1.8 mHealth

mHealth is defined as “medical and public health practices supported by mobile communication devices, such as mobile phones” (World Health Organization, 2011). In recent years, the number of mHealth apps has risen in popularity and is readily available for public use. In 2017 it is estimated that there are approximately 325,000 mHealth apps available on the market (Research2Guidance, 2017). The emergence of mHealth technology has brought about a number of potential benefits including ease of use, low cost, and flexibility (Ventola, 2014).
However, mHealth poses several novel challenges. Due to its rapid growth, processes are not in place to thoroughly evaluate and validate apps as they become available (Larson, 2018). This is most concerning as a large portion of apps do not involve health experts during their development (Cook et al., 2016). Any individual with computer programming skills can develop and distribute a health-related app, as long as their app meets the quality criteria of the app stores. Additionally, only a small proportion of mHealth apps are regulated by governing bodies such as the American Federal Drug Administration (Larson, 2018). Unlike medical devices, mobile health apps do not have to comply with labelling requirements or demonstrate evidence of scientific accuracy, safety, or effectiveness prior to coming to market (U.S. Food and Drug Administration, 2015).

App quality typically refers to the app user interface, performance, and stability of the software program, rather than the practical or clinical utility of the app itself (Google Play, 2015). As a result, the decision to recommend or implement an app by health care professionals can lead to serious consequences if the app’s content is inaccurate or if the app is invalid or even harmful (Boudreaux et al., 2014). For example, the use of a problematic app may lead to delayed diagnosis and treatment of a health condition. Furthermore, concerns about ethical issues, security, and privacy issues have also been brought forth (de la Vega & Miro, 2014). It is, therefore, important for researchers, practitioners, and policymakers to develop standardized evaluation criteria to ensure that apps are safe and impactful for patients (Boudreaux et al., 2014).

Chronic illnesses, such as chronic pain, seem to be a particular target area in the mHealth market. Currently, the literature on mHealth and pain is largely targeted toward patients living in the community. In a recent review that evaluated the effects of apps on
improvement in pain, researchers found pain management apps to be most beneficial for patients in outpatient settings (Thurnheer et al., 2018). Some reported benefits included an improvement of pain over time, the need for fewer pain medications, reduced anxiety, and increased quality of life (Thurnheer et al., 2018). There are a number of generalist apps also available for health professionals, other than pain, such as information management, medical education and training, clinical decision-making, patient monitoring, and health record maintenance (Ventola, 2014). However, even with the availability of these apps, health care professionals remain reluctant to adopt their use in clinical practice (Ozdalga et al., 2012). While there are some apps that are developed specifically for health care professionals, to the author’s knowledge, there are no apps that are made specifically for health care professionals working in LTC settings. Hence, there is a gap in the mHealth market as LTC often has a higher prevalence rate of pain than in the community (American Geriatric Society Panel on Persistent Pain in Older Persons, 2002).

1.9 PACSLAC-II App

Although it is best practice to check for pain regularly in seniors living in LTC, there are a number of barriers to using observational pain assessment tools such as the extra workload associated with utilizing an assessment tool. For example, the PACSLAC-II requires manual addition and graphing of the checklist scores. It is also the health care professional’s responsibility to keep track of the pain scores over time to identify pain-related patterns, which can greatly increase the amount of paperwork and charting that is required from nursing staff.

An app version of the PACSLAC-II has now been developed to facilitate assessment and allow for easy tracking of pain fluctuations over time (Stroulia &
Hadjistavropoulos, 2018). The PACSLAC-II app has been developed as an Android-based application due to the larger number of devices supported by the Android operating system (Stroulia & Hadjistavropoulos, 2018). Further, Android devices are typically more affordable than Apple devices which may be an important factor LTC facilities take into consideration. Finally, the Android system allows limited distribution of the app to qualified users, something that is not possible through the iOS system. Unlike many mHealth apps created specifically for pain (Portelli & Eldred, 2016), the PACSLAC-II app is based on a validated method, its targeted clinical population is seniors who are living in LTC environments rather than those who are living in the community and is specifically designed for use by health care professionals.

The PACSLAC-II app is able to perform a number of different functions to assist health care professionals in their pain assessment administrations. For example, the app can automatically calculate the scores for each assessment and graph the scores of multiple assessments over time for the same resident (Zahid et al., 2020). Finally, the app compiles all assessment administrations, the total score of each administration, and records each pain behaviour that was present to allow for easier documentation and record-keeping (Zahid et al., 2020). The goal of the initial evaluation of the app was to determine whether the use of the PACSLAC-II app will result in increases in pain assessment frequency, as well as its effects on staff stress and burnout levels, compared to the regular version of the PACSLAC-II. This evaluation was combined with a staff training and implementation program. The researchers found improvements in pain assessment frequency in both conditions (Zahid et al, 2020). However, the use of the PACSLAC-II app was associated with lower stress and burnout among care staff. Finally, staff also indicated an overall
preference for the PACSLAC-II app compared to the original PACSLAC-II (Zahid et al., 2020). The initial app that was developed was designed to be a literal interpretation of the paper PACSLAC-II (Zahid et al., 2020). Therefore, the inclusion of an interface design with additional features could potentially result in a more positive experience for users. In the current study, there was an increased focus on users’ experience in both the app and the resources found in the community platform such as a designated area for user discussion and access to pain assessment resources which is further discussed in Section 2.2 Materials.

1.10 Implementation Science

The current investigation relies heavily on the principles of implementation science and change management. Many interventions and assessment procedures are often unsuccessful in health care settings (Grimshaw et al., 2012). Implementation may fail due to barriers at multiple levels such as at: the patient level, the health care professional level, or the organizational level (Ferlie & Shortell, 2001).

One of the most prominent models in implementation science is the Consolidated Framework for Implementation Research (CFIR; Damschroder et al., 2009) is based on a review of 19 implementation models. The framework is composed of five domains: a) the intervention, b) the inner setting, c) the outer settings, d) the individuals, and e) the implementation process (Damschroder et al., 2009). The first domain relates to the characteristics of the intervention. Interventions have ‘core components’ and an ‘adaptable periphery’. Core commons are the essential elements of the intervention, while the adaptable periphery are components of the intervention that can be modified allowing the intervention to better fit with the needs of an organization (Damschroder et al., 2009). The
outer setting includes the contexts surrounding an organization such as economic and political contexts. The inner setting consists of the structural, political, and cultural contexts of an organization (Damschroder et al., 2009). The fourth domain relates to the individuals involved with the intervention (Damschroder et al., 2009). Lastly, the fifth domain is the implementation process. This process requires active change processes and may be comprised of a number of smaller sub-processes all with the common goal of effective implementation (Damschroder et al., 2009).

A previous study by Hadjistavropoulos et al. (2016) implemented a regular pain assessment program using the implementation science principles from the CFIR. The program included a pain assessment workshop for nursing staff and a ‘Pain Champion’ to assist with the implementation process. The researchers found that the regular pain assessment program successfully increased and regularized pain assessments during both the intervention period and at follow-up. Therefore, through the use of implementation science principles, regular pain assessments and pain management practices can be feasible and cost-effective in LTC environments.

In the current study, various measures were taken to encourage the uptake of the intervention. This includes facility administrators and researchers working collaboratively with health care professionals in the implementation process, establishing Pain Champions to help encourage and monitor the implementation, and incorporating unique implementation features for each participating unit (e.g., a few staff members conducting many pain assessments vs. more staff conducting a few assessments each), based on the inner and outer settings of each unit.
1.11 mHealth Adoption by Health Care Professionals

Understanding the adoption behaviour of users is critical for mHealth developers and researchers. Technology adoption is often defined as ‘the first use or acceptance of a new technology or product’ (Khasawneh, 2008). It is the process that enables potential users to successfully adopt and use technology. Although mHealth has the potential to improve the quality of services provided in health care organizations, adoption and diffusion remain low (Maiga & Namagembe, 2014). Health care often falls behind other organizations in the use and adoption of new IT systems (Esmailzadeh et al., 2012). The acceptance of mHealth solutions by health care professionals is a key enabler for improving the market and facilitates user adoption through their recommendations (PWC Report, 2012). However, health care professionals are also responsible for slowing down the adoption of new technology due to a number of barriers (Maiga & Namagembe, 2014). Some barriers include health care policy, the technical literacy of health care professionals, and the privacy, confidentiality and security concerns for personal health information of patients (Zanifa et al., 2010; Yarbrough, 2007; Paul & McDaniel, 2004).

Therefore, it is important to understand the factors that would enable health care professionals to adopt mHealth technology. One prominent theory is the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh and associates (2003), which has been validated in multiple studies (Aggelidis & Chatzoglou, 2007; Kijsanayotin et al., 2009). UTAUT proposes eight determinants of behavioural intention and technology use in organizational contexts (Venkatesh et al., 2003). These determinants consist of four predictors (performance expectancy, effort expectancy, social influence, and facilitating conditions) and four moderators (age, gender, experience, and
voluntariness). Based on the data from four organization, Venkatesh and colleagues (2003) found that the UTAUT explained 70% of the variance in users’ intentions to adopt technology outperforming previous models accounting between 17-53% of the variance (Venkatesh et al., 2003).

In one study using the UTAUT to predict and explain health care professionals’ acceptance and adoption of mHealth in environments with limited resources, the researchers found that adoption of mHealth technology tools is simplified if they are easy to learn and use, assist in the timely competition of complex tasks, are flexible to interact with, and do not require that users take too much time off from regular work tasks (Maiga & Namagembe, 2014). The study also revealed that a majority of health care professionals were worried about the use of new mHealth technology due to privacy and security concerns, too much pressure to use mHealth, anxiety created when using mHealth, and distrust for the reliability and functionality of the new technology. The authors also found that users were more likely to adopt mHealth technology given monetary benefits, training on the use of mHealth technology, as well as praise and recognition for work completed (Maiga & Namagembe, 2014). A recent systematic review which reviewed 33 studies looking at mHealth adoption by health care professionals found similar results. Factors influencing the adoption of mHealth technology include: perceived usefulness, ease of use, design, cost, time, privacy and security issues, and familiarity with the technology (Gagnon et al., 2016). Therefore, future researchers and mHealth app developers should take these findings into consideration when developing a mHealth app to ensure that the technology is adopted and maintained by health care professionals.
In the current study, a number of factors were taken into consideration to assist in the adoption of the app. Features that health care professionals found to be most useful in the previous version of the app (Zahid et al., 2020) were implemented in the updated version to increase the user-friendliness of the app. Ease of use, privacy and security issues were also taken into consideration. With regards to performance expectancy, during the training phase of the study, the researchers explained to the health professionals the potential benefits of utilizing the app and its features (e.g., improved pain care), and the potential improvement in the quality of their pain assessment and management practices. With regards to effort expectancy, initial training was provided and offered on an ongoing basis by the researchers and the Pain Champion to ensure ease of use for the participating health care professionals. For the social influence factor, the promotion and support for the app and its associated features by the researchers, Pain Champion, and facility administrators were ongoing throughout the study. And lastly, for the facilitating condition factor, health care professionals were provided with appropriate resources necessary to utilize the app, technical administrative support, and support from the researchers and Pain Champion regarding any other potential areas of concern. Although these considerations have been put in place, it is possible that other factors may affect technology adoption in this study. Therefore, individual semi-structured interviews (Section 2.5 Procedure; Appendix B) were conducted with health care professionals to discuss perceived usefulness, perceived ease of use, and any other potential barriers or recommendations that may influence the adoption of the app and its associated websites in future LTC settings.
1.12 mHealth Communities and Electronic Communities of Practice (eCoPs)

Another component that may also contribute to a user’s adoption of mHealth is the opportunity to be a part of an app’s community. As commonly described in the literature, a sense of community is obtained through four elements: membership, influence, integration and fulfillment of needs, and emotional connection (McMillan & Chavis, 1986). Professional communities in health care, often known as communities of practice (CoP), once bound to specific workplaces, have changed in recent years due to the increasingly virtual nature of the health-care workplace forming the development of electronic communities of practice (eCoPs) (Hooker et al., 2012). Today, communities are linked less by location and more by common interests and goals (Li, 2009). This flexibility not only offers the CoP the ability to collaborate on shared problems and work interests but allows the results of those collaborations to extend beyond one single workplace (Hooker et al., 2012).

A culture of sharing information is essential in mHealth communities. Scanfeld and associates (2010) examined messages sent publicly on Twitter and demonstrated the potential effectiveness of this medium for the dissemination of information (Scanfeld et al., 2010). The sharing and seeking of information is one of the most common reasons health care professionals seek out eCoPs (Spallek et al., 2008). As such, eCoPs need appropriate infrastructure to allow for both direct and indirect information sharing (e.g., uploading documents or sharing links). It is also recommended for eCoPs to provide opportunities for members to communicate such as through the use of message boards and forums to encourage group discussions as the success of eCoPs relies on users being productive contributors to their eCoPs (McCartney et al., 2012).
It is therefore important for researchers to understand the motivations and characteristics of mHealth community members in order to develop communities that are successful in achieving health-related outcomes or other goals that the community hopes to achieve. Unfortunately, in the realm of mHealth and pain, there are very few apps that offer a platform for social support (Lalloo et al., 2015). As this social support and community may potentially achieve positive health-related outcomes in their specific target populations (i.e., improved quality indicators), the current study explored the introduction of a mHealth community through our resource community portal website. This study, to the best of our knowledge, was the first to examine the effects of an app-based community platform on health care professionals working in a LTC environment. Individual semi-structured interviews (Section 2.5 Procedure; Appendix B) explored the perceived usefulness of the resource community portal, reported participation in the mHealth community, the website’s strengths and weaknesses, how the information available online was translated or utilized on the unit, and whether or not a sense of community was perceived by the users of the feature.

1.13 Purpose

This study involved the systematic implementation and evaluation of a new community platform on the PACSLAC-II app and is an extension of Zahid and associates’ (2020) study which evaluated the clinical feasibility of an earlier basic version of the PACSLAC-II app. The community platform is comprised of two features: a quality indicator website that will allow health care professionals to share their quality indicator scores with other facilities and compare individual resident scores with a norm; and, a resource community portal aimed at facilitating user interaction, the sharing of knowledge,
and continuing education. This study, to the best of the author’s knowledge, was the first to examine the effects of an app-based community platform on health care professionals working in a LTC environment.

The first objective of this study was to evaluate whether quality indicators of pain improve with the use of the updated PACSLAC-II app (and the role of each of its community platform websites) compared to the LTC unit’s regular pain assessment practices. The second objective was to evaluate the impact of the use of the PACSLAC-II app and its associated websites on health care professionals’ stress and burnout levels through self-report measures. Lastly, the third objective was to gain further understanding of health care professionals’ experiences and perspectives on the use of the app and its associated websites through semi-structured individual interviews.

Based on the job demands-resources (JD-R) model, the PACSLAC-II app and its associated websites presumably act as job resources for the health care professionals participating in the study and work to offset the job demands associated with working in LTC as well as the difficulty of assessing residents with dementia who are unable to communicate. Therefore, it was anticipated that LTC units that are randomly assigned to the app and both websites (the quality indicators website and community portal websites) will see the most positive gains such as increased quality indicator scores, reduced staff stress, and positive staff satisfaction with the app as they will have the most job resources (e.g., social support, access to educational material, relative performance feedback etc.). For the purposes of hypothesis testing, a minimum of 25% improvement in quality indicator scores was deemed to reflect meaningful change. This will be followed by units who are randomly assigned to the app and only one feature (quality indicator or community
portal feature), and lastly by units who only have access to the PACSLAC-II app with no additional features. For the units that received only one of the additional websites, it is expected that units that are assigned to the quality indicator website will have better outcomes compared to units that are assigned to the community portal website. This is because the quality indicator website is a more passive resource that health care professionals will have readily available, allowing them to evaluate the progress of their pain assessment intervention. The community portal website, on the other hand, is a more proactive resource aimed at providing health care professionals with educational material that they can apply in the future. Additionally, the community portal feature relies on the active participation of the health care professionals. However, due to their fast-paced work environment, health care professionals may not have enough time to actively participate to gain the most out of this resource.

2.0 Methods

2.1 Participating LTC Units and Health Care Professionals

This study utilized a concurrent triangulation mixed methods approach (Creswell et al., 2003) and a multiple-baseline-between-LTC units design (Hersen & Barlow, 1976). Eleven LTC units were recruited in this study with each unit acting as an independent case series. The number of units was established to ensure a counterbalanced design and to maintain a minimum of two units for each of the five conditions. All 11 units were located in one of two mid-sized metropolitan cities in Saskatchewan. Prior to recruiting LTC units, measures were taken to ensure that there was minimal or no overlap of staff, such as staff working in multiple units. This was to limit potential cross-contamination between units.
that were assigned to different features. If overlaps occurred, staff were asked to only complete pain assessments in their designated unit.

The research team approached LTC units that had expressed an interest in implementing improved assessment practices using the PACSLAC-II irrespective of this study as a means of ensuring engagement. A Pain Champion was also appointed by each unit as recommended in the literature (Kaasalainen et al., 2016). The Pain Champion was a resident care coordinator or manager with an interest in pain assessment and pain management practices as identified by the Director of Care at each LTC unit (Hadjistavropoulos et al., 2016). Previous research has also shown that having a designated Pain Champion in LTC significantly reduces residents’ pain compared to care as usual (Kaasalainen et al., 2016). The Pain Champion helped to oversee the implementation protocol and support the use of the PACSLAC-II app and associated websites throughout the study.

Nurses and care aides working in participating units were not obligated to provide feedback. However, individuals who were interested in sharing their experience underwent a consent process and was asked to provide demographic information, self-report measures, and participate in an individual interview.

2.2 Materials

*Updated Tablet App Version of the PACSLAC-II*

Similar to the previous version of the PACSLAC-II, the updated version of the PACSLAC-II was developed for Android devices. The Android operating system allowed the researchers to distribute the app to participating LTC facilities without having the app publicly available on an app store. Two Android computer tablets were provided to each
LTC unit. The tablets had Android Version 10.0 to optimally run the PACSLAC-II app. The PACSLAC-II app was downloaded onto the tablets by the researchers for the facilities’ convenience before they were dropped off at each facility. Drop-off procedures were in place to reduce in-person contact due to the ongoing health concerns regarding COVID-19. No security passwords or PINs were placed on the tablets by the researchers, however, Pain Champions in individual facilities were able to place a password on their tablets and share the password with their staff if they wanted additional security.

For the purpose of this study, participating units were asked to not input resident names and demographic information (i.e., age, gender) into the app to protect residents’ confidentiality. Units were instead asked to keep a master list of the residents on their unit and assigned either a code or resident number as appropriate. Pain Champions were encouraged to register all the residents on their units before the intervention period so that all of the residents on their units were formatted similarly for staff to easily identify residents (i.e., 201VT, 202RR, 203JD etc.). However, all users had the ability to register new residents as needed. The only resident information available on the app would be residents’ assigned code for the study and their pain assessment data (i.e., assessment date, PACSLAC-II score, and specific pain behaviour). The use of private servers, encryption through https, and firewall protection were established to ensure that all of the data collected from the app was securely stored.

**App Walkthrough.** To log into the app, users first needed to log in using their unit’s credentials. Each participating unit had separate credentials that were created with the consultation of their respective Pain Champion to ensure that the health care professionals in their unit are able to easily remember the credentials throughout the study.
After users logged in using their unit’s credentials they were able to create their staff profile which included a personal username and password that they used to log-in to the app. Hence, there are two levels of credential verification on the app before users are able to access any resident information.

Once a participant logged onto the app using their individual staff profile, they were able to select the resident they wished to review or assess. When the participant assessed a resident for pain, they were asked to indicate whether or not the resident has been newly admitted. Once an admission date has been inputted, the app no longer queried this information. Participants were also asked to enter which resident activity they were observing (i.e., sitting, walking, transferring) and the PACSLAC-II items that were present by selecting individual checkboxes. When this was completed, the app then prompted the participant to ask a nurse whether or not the resident was experiencing moderate to severe pain, as a qualified health professional is needed to interpret the results. Although there are no specific cut-off scores for the PACSLAC-II, classifying pain as mild, moderate, or severe is a conventional way to communicate residents’ pain. Therefore, a nurse had to use clinical judgement to make this determination. If moderate to severe pain was suspected, during the next assessment, the app queried whether the resident had a treatment plan for pain at the time. The app automatically calculated the time difference between these two assessments to determine whether or not a resident was reassessed within 24 hours of pain detection.

Another important feature of the app is its graphs and reports. The app automatically stored the checklist scores for each assessment and graphed the scores of multiple assessments over time for the same resident. Additionally, the app compiled all
resident assessment administrations including which pain behaviours items were observed, creating a comprehensive assessment history for each resident (Zahid et al., 2020). Finally, to ease the integration of the PACSLAC-II app reports with current record-keeping practices, an option to email the pain graph and residents’ assessment history was available so that the information could be easily printed and added to residents’ charts (Zahid et al., 2020).

**App Modifications.** A number of modifications were made to the first PACSLAC-II app. Unlike the previous version of the app, which was designed to be a simple adaptation of the paper PACSLAC-II (Zahid et al., 2020), this app was modified to enhance users’ experiences with an updated interface. Other changes were made so that health care professionals were able to review the context surrounding each assessment. For example, a new addition to the checklist portion of the app is ‘Observed Activity’. During each assessment, health care professionals were asked to specify which resident activity they are observing (e.g., sitting, walking, transferring). Having this contextual information is beneficial as scores between different activities are not comparable. For example, a resident may experience little pain while sitting, but experience moderate pain while walking. Hence, this modification allows for better comparisons for each resident according to the observed activity.

Another contextual feature that was added to the checklist is the length of the assessment. On the checklist, health care professionals can specify the duration of their observation period if the time that was automatically calculated by the app was incorrect. Typically, after an assessment has been completed, a message popped up asking a nurse to determine whether the resident was in moderate to severe pain. A diagnosis of moderate to
severe pain is made based on the resident’s current PACSLAC-II assessment and the nurses’ clinical judgement, the resident’s previous PACSLAC-II scores, and the nurses’ evaluation of the resident. However, due to the busy environment in LTC settings, the initial evaluator may not find an available nurse right away to complete this section. Hence, health care professionals can modify this field if needed. Having this information readily available is beneficial because the longer the observation period, the higher the likelihood that the assessment will have a higher score. Hence, providing the health care professionals with the context surrounding these assessments allows for more accurate interpretations.

Changes were also made to the security of the app. In the previous version of the PACSLAC-II app, there was only one level of user verification which is the health care professionals’ personal login information. In the updated version of the app, a second level of user verification was added because LTC units from multiple LTC facilities would be participating in the study. In the updated app, each unit had their own login information and once health care professionals logged into their unit, they were able to register for a personal staff profile on the app. Upon completion of registration, health care professionals were able to select their name from the drop-down function and enter their personal password to access the app. As an extra security measure, no email addresses are asked from the health care professional when they are registering. Rather, in the case where a user forgets their password, the assigned technical administrator for that facility had access to all of the health care professionals’ login information and can assist the user. These extra security measures were to ensure that confidentiality was met and that health care professionals were not able to access information from other participating facilities.
App-based community platform.

The novel aspect of this study was the introduction of the app-based community platform in conjunction with the PACSLAC-II app. The platform aimed to increase health care professionals’ knowledge of pain, decrease the frequency of pain in LTC, and increase user interaction. The app-based community platform is composed of two main features: a quality indicator feature and a community portal feature. Since the features were presented in a counterbalanced order for participating units, the researchers had the ability to turn the features on and off at each phase of the study.

Feature 1: Quality Indicator Website. This feature was developed in collaboration with Dr. Eleni Stroulia from the University of Alberta. Each of the following quality indicators were provided with an individual score of up to 100%, rather than a total quality indicator score combining all four score. The quality indicators in this feature (see Table 1) are based on the findings by Hadjistavropoulos and associates (2009) and were successfully utilized by Zahid and associates (2020) in the previous PACSLAC-II app study.

Table 1

Pain quality indicators

<table>
<thead>
<tr>
<th>Pain Quality Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Percentage of new residents who were assessed for pain with the PACSLAC-II app within 24 hours of admission</td>
</tr>
<tr>
<td>2. Percentage of current residents assessed with the PACSLAC-II app a minimum of once per week</td>
</tr>
<tr>
<td>3. For residents with PACSLAC-II app findings of moderate-to-severe pain, percentage of residents with a documented treatment plan within 24 hours of pain identification</td>
</tr>
<tr>
<td>4. Percentage of residents reassessed with a standardized pain assessment tool within 24 hours of treatment implementation</td>
</tr>
</tbody>
</table>
These quality indicators were collected automatically by the app. However, units were asked to collect and report these quality indicators as part of the study procedure. This quality indicator feature was accessed through a separate website via a link on the app so that the quality indicators themselves could not be viewed on the app. Health care professionals assigned to the quality indicator website were able to create their own account to utilize the website and gained access to the website as the study progressed. Access to the website was controlled by the researchers to ensure that health care professionals in the app-only condition did not have access to these quality indicators. The website also provided more specific information for each resident and their corresponding assessments such as: the total PACSLAC-II score, the PACSLAC-II items that were present during the assessment, the observed activity, pain severity, assessment duration, and whether or not the resident was newly admitted.

The quality indicators were provided to health professionals on a real-time basis, unlike the three-month delay that is typical of how quality indicators are normally presented to LTC facilities. Pain Champions were asked to regularly update whether or not residents are still on the unit or have been discharged to ensure that the quality indicator calculations were accurate for each facility. The quality indicators were presented to health care professionals in multiple ways through graphs, visuals, and interactive maps. Health care professionals were able to see their facility’s quality indicators scores compared to other individual facilities’ scores in their city and province. Facilities were labelled as Facility A, Facility B etc. on the quality indicator website to protect confidentiality. Units were also able to see changes in their quality indicator scores over time as well.
Feature 2: Community Portal Website. This feature was also created in collaboration with Dr. Eleni Stroulia from the University of Alberta. The community portal feature was created with the goal of encouraging a culture of sharing information as it is an important factor in the success of a mHealth community. Continuing education materials were available to the health care professionals through a separate website outside of the app. When health care professionals opened the app, they had access to a link to where the continuing education resources were located. This again was to ensure that health care professionals in the app-only condition did not have access to these resources. Health care professionals were asked to create individual accounts to access the website and access authorization was monitored by the researchers. Resources included educational videos, links to relevant literature, best practice recommendations, and user toolkits. All health care professionals had the ability to upload resources that they would like to share with other users. Users were also able to comment and discuss on individual resources. In addition, this feature also had a forum section to facilitate discussions outside of the individual resources themselves. Health care professionals could easily create new forums to ask each other questions or search through previous forums to help address any questions they may have about pain assessment. Pain Champions in the facility were asked, as part of their role, to encourage the use of the community portal website and help to promote discussion of the resources in their physical community as well. Activity on the website was monitored to determine which groups of health care professionals based on their professions were more likely to seek resources, the amount of discussion on forums, and which resources were the most useful to health care professionals.
2.3 Training

**Pain Champion Training**

Training was provided to Pain Champions on their role and responsibilities to assist in the adoption of the study including: scheduling training sessions, distributing surveys and consent forms, setting up the app (i.e., entering in residents), providing on-floor training, sharing community platform content if applicable, and reporting of quality indicator data weekly to the researchers. Pain Champions were also trained on how to use the PACSLAC-II app and the community platform prior to the health care professionals on their unit, so that they were able to provide in-person support if needed when the researchers conducted training sessions over Zoom.

**PACSLAC-II and App Training**

Training was provided to health care professionals on each unit, on how to conduct pain assessments using the PACSLAC-II, guidelines on interpreting pain utilizing the resident’s pain graph, as well as assessment considerations (i.e., observed behaviour, length of assessment) and its impact on PACSLAC-II scores. The training was conducted either via Zoom or in-person if permitted based on the COVID-19 context at the time. Training took approximately 30 minutes to complete. Pain Champions were asked to provide additional support on the floor as needed.

**Community Platform Training**

The research team also provided training specifically for each community feature. Training took place in person or via Zoom due to COVID-19 protocols at the time. During the training process, the researchers also explained to the health professionals the purpose of each feature and its potential benefits. A user manual was shared with all LTC units...
detailing how to use all of the features on each website. Training for each feature took approximately 20 minutes to complete. A copy of the PowerPoint training slides with audio recordings was also provided for staff members as a refresher or for those who were unable to participate when the sessions were held.

2.4 Procedure

During the baseline period, LTC units were asked to collect the same quality indicator data according to their current pain management practices. The baseline period varied across the units and was dependent on which condition they were assigned to. Once a unit’s baseline period was complete, health care professionals who were interested in sharing their experience underwent a consent process and were asked to complete a demographic information sheet, the Nursing Stress Scale, and Maslach Burnout Inventory. Participating units were asked as part of the study to follow the study protocol which is based on the four quality indicators (see Table 1). The units were asked to record their quality indicator scores and their current number of residents weekly on the provided spreadsheet and send a copy to the researchers during the study period. This allowed the researchers to compare the accuracy of the app and quality indicator feature in calculating each facility’s quality indicators. Based on previous studies, participating units have high compliance in completing this task (Zahid et al., 2020; Hadjistavropoulos et al., 2016). As part of the Pain Champions’ role, they also supported their unit in completing the weekly quality indicator sheets.

Training was provided through a small group format via Zoom or in-person as described in Section 2.3 Training. The training material was the same regardless of the training modality. Health care professionals were provided with resources to support them
throughout the study period such as technical administrative support, and support from the researchers and Pain Champion. To encourage the adoption of the pain intervention protocol and utilization of the app, additional training was provided to Pain Champions so that they can assist health care professionals as issues arise. Pain Champions were also asked to work collaboratively with health care professionals to encourage and monitor the implementation process.

There were five phases in this study with each phase lasting three weeks in duration: a baseline period, up to three intervention periods depending on which condition a unit was assigned to, and a follow-up period. The first intervention involved the introduction of the PACSLAC-II app to the participating units. The second intervention was the quality indicator feature which provided access to the pain quality indicator scores of individual participating facilities. This allowed units to compare their facility with average quality indicator scores from all participating facilities from multiple facilities. The third intervention is the community portal feature which included continuing education features to the app, such as best practice recommendations, and user toolkits and as well as a community of users system where health professionals were able to interact and ask each other questions about the topic of pain in LTC. The conditions for this study were as follows:

Condition 1: App-only
Condition 2: App + Quality Indicator Website
Condition 3: App + Community Portal Website
Condition 4: App + Quality Indicator Website + Community Portal Website
Condition 5: App + Community Portal Website + Quality Indicator Website
All eleven units were introduced to the first condition, which was the PACSLAC-II app. However, the second and third conditions were presented in a counterbalanced fashion where not every unit was introduced to all of the community platform features. Features were turned on and off for each participating unit remotely by the research team. Two units were assigned to only the PACSLAC-II app, four units were assigned to the app and one community platform feature, and five units were assigned to the app and both community platform features. Units assigned to the app and all the community platform features were assigned to receive either the Quality Indicator feature first (Condition 4) or the Community Portal feature first (Condition 5). The units not assigned to all three interventions had longer baseline periods whose length was dependent on the number of features they were exposed to. For example, units who were assigned to two out of the three interventions had a six-week baseline prior to starting the treatment phase of this intervention. The participating units were randomly assigned to receive one of these five conditions via block randomization (see Figure 1). This design allowed researchers to determine which features of the app have the most impact on the quality indicators of pain, whether the order the features were presented affected outcomes measures, and whether the same results could be observed with fewer features. Lastly, a three-week follow-up period was included for all the LTC units post-administration of all scheduled interventions. At the end of this follow-up period, a second round of questionnaires was conducted, and individual interviews were held with care staff to learn more about their experiences using the app.
2.5 Measures

The primary outcome measures of this study were the quality indicators that were collected from each LTC unit (see Table 1). The secondary outcome measures include the Nursing Stress Scale, Maslach Burnout Inventory, and individual staff interviews.

Participant Demographic Information

Health care professionals who provided consent to be part of the evaluation portion of the study were asked to provide basic demographic information (see Appendix C) such as their age, years of experience, and their professional designation (e.g., registered nurse, care aide, etc.).

Quality Indicator Scores

The quality indicators are objective measurements of the performance of each LTC unit with regard to the frequency of their pain assessment practices. These quality indicators are based on recommended clinical guidelines developed by pain and public policy experts (Hadjistavropoulos et al., 2009) and have been used successfully in prior research focusing on implementation of pain assessment in long-term care (Zahid et al., 2020; Hadjistavropoulos, et al. 2016). The quality indicators in this study are presented in Table 1.

Nursing Stress Scale (Gray-Toft & Anderson, 1981)

The Nursing Stress Scale (NSS) is a 34-item scale consisting of potentially stressful situations for nursing professionals. Items are rated on a 4-point Likert scale, based on the perceived frequency of stress, and they range from 0 (i.e., never) to 3 (i.e., very frequently). Higher scores suggest a higher degree of perceived stress for nursing professionals. The NSS is composed of seven subscales that were established through
Figure 1

Study design

Baseline Period:
Unit A - K

Phase 1:
- Unit A & B Baseline
- Unit C & D Baseline
- Unit E & F Baseline
- Unit G & H App Only
- Unit I, J, & K App Only

Phase 2:
- Unit A & B Baseline
- Unit C & D App Only
- Unit E & F App Only
- Unit G & H App + QI
- Unit I, J & K App + CP

Phase 3:
- Unit A & B App Only
- Unit C & D App + QI
- Unit E & F App + CP
- Unit G & H App + QI + CP
- Unit I, J & K App + CP + QI

Follow-up Period:
Unit A-K
factor analysis: uncertainty concerning treatment, workload, death and dying, conflict with physicians, conflict with other nurses, lack of support, and inadequate preparation. The initial study conducted by Gray-Toft and Anderson (1981) demonstrated good internal consistency ($\alpha = .89$) and good test-retest reliability ($r = 0.81$). In the present study, internal consistency for the total NSS score was excellent ($\alpha = .93$). Specifically, Cronbach alpha values for the uncertainty concerning treatment, workload, death and dying, conflict with physicians, conflict with other nurses, lack of support, and inadequate preparation subscales were .75, .85, .72, .74, .75, .63, and .63, respectively.

This measure has previously been used to assess nurse stress in studies examining resident pain (Hadjistavropoulos et al., 2016, Fuchs-Lacelle et al., 2008, Zahid et al., 2020). Because care aides constitute the majority of the workforce in LTC and provide the day-to-day care for residents for the purposes of this study, a modified version of the NSS created by Zahid et al. (2020) was used for care aides (Zahid et al., 2020). The modified version of the scale has the same number of items; however, items that discuss “treatment” were changed to “management”, as prescribing treatment is outside of the scope of practice for care aides. Additionally, for items that list a supervisor, “physician” was replaced with “nurse”, as care aides typically report to licensed or registered nurses on their units. Hence, two versions of the NSS, one for the nurses and one for care aides was administered in this study (Zahid et al., 2020).

**Maslach Burnout Inventory (Maslach & Jackson, 1981)**

The Maslach Burnout Inventory (MBI) consists of 22-item describing experiences or situations health care professionals may experience to measure perceived burnout. Items are rated on a 7-point Likert scale, ranging from 0 (i.e., never) to 6 (i.e., everyday) to
measure how frequently health care professionals experience these emotions or situations. The MBI contains three subscales: emotional exhaustion, depersonalization, and personal accomplishment. Higher scores on the emotional exhaustion and depersonalization subscales and lower scores on the personal accomplishment subscale are indicative of higher perceived burnout. Overall, it has demonstrated good psychometric properties (Maslach, Jackson, & Leiter, 1997). Previous research studying health care professionals have also applied the MBI in their protocol, demonstrating the inventory’s reliability and validity with this specific population (Fuchs-Lacelle et al., 2008; Zahid et al, 2020). In the present study, internal consistency was satisfactory for emotional exhaustion (α = .90) and depersonalization (α = .72) subscales but unsatisfactory for personal accomplishment (α = .41) subscale. Hence, the latter subscale was not included in the study’s analysis.

**App and Websites Usage Questionnaire**

Although, the researchers have access to metrics data from the backend of the app and associated websites, this information is not comprehensive. For example, information was available about the last time a user logged onto a website or whether they submitted continuing education material for the Community Portal, but not how often they accessed the website. Therefore, a brief measure created by the researchers was included in the second questionnaire package to determine the frequency of use of the PACSLAC-II app, Quality Indicator website, and Community Portal website (see Appendix D). Participants indicated how often they used each of the previously mentioned resources by selecting one of the following responses: Never, 1-2 times, 3-5 times, more than 5 times. This measure was used as a manipulation check to assess whether or not health care professionals utilized the app and/or website(s) as assigned based on their condition.
**Individual Participant Interviews**

Semi-structured interviews were conducted for all LTC units participating in the study and included nursing managers. Interviews were conducted over the phone or in person if permitted and deemed safe based on the COVID-19 guidelines at the time of the interviews. Regardless of delivery method, the same questions were asked based on the interview moderator guide (see Appendix B). The interviews were audio-recorded with the consent of the participants for data analysis.

Interview questions were adapted from Zahid and associates’ (2020) moderator guide and were developed to gain a better understanding of potential job demands and resources as well as potential technology adoption factors (i.e., ease of use, user effort). The interviews consisted of a number of questions regarding experiences conducting pain assessments in residents with dementia, perceived supports and barriers to effective pain assessment practices, and experiences using the PACSLAC-II app (Zahid, et al., 2020). Specific questions relating to the new community platform were also asked to determine which features health care professionals preferred, such as whether accessing facility-specific quality indicators was helpful, whether they found the community portal feature beneficial, and how health professionals acted on the data available to them. The opportunity to participate in the interviews was offered to all health care professionals regardless of whether they completed the self-report questionnaires. All participants who expressed interest were interviewed by the researchers. By the end of the interview process, it was believed that data saturation was achieved as no new themes were brought up (Braun & Clarke, 2021).
3. Data Analysis

3.1 Quantitative Analysis

Descriptive statistics were calculated for the quality indicator data in accordance with behavioural analysis approaches because of anticipated low statistical power and limited sample size (limited participating LTC facilities) due to COVID-19. All analyses were performed at the unit level rather than at the resident level. For the quality indicator data, the percentage scores were calculated for each quality indicator on a weekly basis. Percentages of the weekly quality indicator data were graphed to evaluate for changes throughout the study period. The data were presented graphically to facilitate interpretation. For the self-report data, regression analysis were conducted to determine whether the demographics of the health care professionals (i.e., occupational title, years of experience) and their exposure to the different features of the app predicted final burnout and stress scores.

3.2 Qualitative Analysis

Audio files were transcribed by the primary researcher and a medical transcriptionist. Transcripts were transcribed verbatim and included non-verbal communication (i.e., laughter) as well as potential interruptions during the interview such as resident call bell systems and cell phone disruptions. Responses were analyzed using thematic analysis with NVivo (QSR International, Melbourne, Australia), a qualitative data analysis software. Thematic analysis involves identifying and analyzing common themes within data, allowing researchers to capture and organize common experiences and realities of participants (Braun & Clarke, 2006; Braun & Clarke, 2021). Thematic analysis is flexible as there is no explicit definition of what constitutes as a theme allowing for a
detailed interpretation of the data (Braun & Clarke, 2006; Braun & Clarke, 2021). Qualitative analysis followed the thematic analysis guideline set out by Braun and Clarke (2006). The phases of thematic analysis include: familiarizing oneself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Braun & Clarke, 2006). Specific measures taken included prolong engagement with data, the use of a coding framework, researcher triangulation (involving at two coders), and the vetting of themes and subthemes by team members. Intercoder agreement was also reported. Lastly, to assist in the interpretation of the results, the primary findings for each thematic category were reported, a figure to convey the relationship between themes was created, and quotes for each category were reported if appropriate to assist in the interpretation of the results.

4. Results

4.1 Demographics

In total, 11 LTC units participated in the study. Thirty-four individual participants completed both surveys. The demographic characteristics of the participants (i.e., gender, years of experiences, professional title) are presented in Table 2.

4.2 Unit-Level Quality Indicator Data

Tables 3 and 4 present the aggregated data for all units in two different ways. Figures 2-9 present the scores for each specific quality indicator graphically with units grouped together based on their assigned condition. Table 5 presents the percentage change and change in magnitude of quality indicator scores from baseline to intervention period for each unit. Overall, the tables show increases in all four quality indicators (over 25%) during the study period, reflecting meaningful change, although these changes were not
maintained through follow-up. The first quality indicator, which examined the percentage of new residents assessed within 24 hours of admission, showed the most consistent improvements as a majority of the units, with the exception of Units A (App only condition) and K (App + CP + QI condition), were able to successfully assess 100% of their new residents during the intervention phase. The second quality indicator, which evaluated the percentage of residents assessed a minimum of once a week, was more variable but increased consistently with some units reaching 100% of residents compared to the average baseline (0%). Gains were also not maintained during the follow-up period with the exception of Unit I (App + CP + QI condition) which continued to assess 100% of their residents weekly at three weeks follow-up. The third quality indicator, percentage of residents with moderate-severe pain with a documented treatment plan, also had high uptake across units with the exception of Units B (App only condition), & G (App + QI + CP). Lastly, the fourth quality indicator on whether residents with moderate-to-severe pain were reassessed within 24 hours after their initial assessment, was also highly reported with the exception of Units A (App only condition), B (App only condition), and K (App + CP + QI condition). Although Units E & F (App + CP) had achieved high quality indicator scores by using the app, the addition of the community portal website did not appear to play a role in quality indicator scores.

4.3 Usage of App and Websites

Participants indicated whether they utilized the app and/or website(s) choosing the following options: 1-2 times; 3-5 times; or more than 5 times. Responses from the usage of the app and website questionnaire (Appendix D) indicated that of the health care professionals who were given access to the websites outside of the app (QI website and
Table 2

Demographic characteristics of individual participants

<table>
<thead>
<tr>
<th>Condition</th>
<th>App only</th>
<th>App + QI</th>
<th>App + CP</th>
<th>App + QI + CP</th>
<th>App + CP + QI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Unit A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit B</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Unit C</td>
<td></td>
<td>40.56 (14.41)</td>
<td></td>
<td>31 (1.41)</td>
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<tr>
<td>Unit D</td>
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<td></td>
<td>52 (9.54)</td>
<td>N/A*</td>
</tr>
<tr>
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<td></td>
<td>49 (N/A)</td>
<td>N/A*</td>
</tr>
<tr>
<td>Unit F</td>
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<td></td>
<td>9.88 (6.10)</td>
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<tr>
<td>Unit G</td>
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<td>22 (N/A)</td>
<td>N/A*</td>
</tr>
<tr>
<td>Unit H</td>
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</tr>
<tr>
<td>Unit I</td>
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<td></td>
<td>22 (N/A)</td>
<td>N/A*</td>
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<tr>
<td>Unit J</td>
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<td></td>
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<tr>
<td>Unit K</td>
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<td></td>
<td>42.63 (13.51)</td>
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</tbody>
</table>

<table>
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<tr>
<th>Gender</th>
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<td>3 (50%)</td>
<td>8 (88.89 %)</td>
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<td>Care Aide</td>
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</tr>
</tbody>
</table>

Note. (QI) = Quality Indicator; (CP) = Community Portal; (**) = unit discontinued from the study; (*) no questionnaires were completed
Table 3

Quality indicator (QI) scores for all units

<table>
<thead>
<tr>
<th>Unit</th>
<th>(App only; 40 beds)</th>
<th>% of new residents assessed</th>
<th>% of current residents assessed at least 1/week</th>
<th>% with treatment plan if moderate to severe pain</th>
<th>% reassessed if moderate to severe pain identified</th>
</tr>
</thead>
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<tr>
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</tr>
<tr>
<td>Baseline 2</td>
<td>- 0% - -</td>
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<td></td>
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</tr>
<tr>
<td>App + CP</td>
<td>- 100% 100% 100%</td>
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</tr>
<tr>
<td>Follow-up</td>
<td>- 33% 100% 100%</td>
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<table>
<thead>
<tr>
<th>Unit G</th>
<th>(App + QI + CP; 40 beds)</th>
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</thead>
<tbody>
<tr>
<td>Baseline</td>
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</tr>
<tr>
<td>App</td>
<td>100% 75% 0% 0%</td>
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<tr>
<td>App + QI</td>
<td>- 94% - -</td>
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<tr>
<td>App + QI + CP</td>
<td>- 26% - -</td>
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<table>
<thead>
<tr>
<th>Unit H</th>
<th>(App + QI + CP; 33 beds)</th>
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<tbody>
<tr>
<td>Baseline</td>
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</tr>
<tr>
<td>App</td>
<td>100% 43% 100% 100%</td>
</tr>
<tr>
<td>App + QI</td>
<td>100% 15% 100% 100%</td>
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<td>App + QI + CP</td>
<td>100% 27% - -</td>
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<td>Follow-up</td>
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<table>
<thead>
<tr>
<th>Unit I</th>
<th>(App + CP + QI; 49 beds)</th>
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</thead>
<tbody>
<tr>
<td>Baseline</td>
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</tr>
<tr>
<td>App</td>
<td>100% 64% 77% 69%</td>
</tr>
<tr>
<td>App + CP</td>
<td>- 100% 100% 100%</td>
</tr>
<tr>
<td>App + CP + QI</td>
<td>100% 100% 100% 100%</td>
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<tr>
<td>Follow-up</td>
<td>100% 100% 100% 100%</td>
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</table>

<table>
<thead>
<tr>
<th>Unit J</th>
<th>(App + CP + QI; 40 beds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>- 0% - -</td>
</tr>
<tr>
<td>App</td>
<td>- 100% 100% 62%</td>
</tr>
<tr>
<td>App + CP</td>
<td>100% 80% 88% 75%</td>
</tr>
<tr>
<td>App + CP + QI</td>
<td>- 70% 100% 100%</td>
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<tr>
<td>Follow-up</td>
<td>- 0% - -</td>
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</table>

<table>
<thead>
<tr>
<th>Unit K</th>
<th>(App + CP + QI; 40 beds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>0% 0% 0% 0%</td>
</tr>
<tr>
<td>App</td>
<td>- 34% 100% 0%</td>
</tr>
<tr>
<td>App + CP</td>
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<tr>
<td>App + CP + QI</td>
<td>- 43% - 0%</td>
</tr>
<tr>
<td>Follow-up</td>
<td>- 0% - -</td>
</tr>
</tbody>
</table>

Note. Each study period was 3 weeks in duration. (CP) = Community Portal; (-) = no occurrence during specified time period, such as no new admissions; (*) = unit discontinued from the study
Table 4

Quality Indicator (QI) scores across all units/conditions

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<th>App + QI</th>
<th>App + CP</th>
<th>App + QI + CP</th>
<th>App + CP + QI</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Unit A (N=40)</td>
<td>Unit B (N=22)</td>
<td>Unit C (N=65)</td>
<td>Unit D (N=63)</td>
<td>Unit E (N=38)</td>
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<td></td>
<td></td>
<td></td>
<td>Unit F (N=40)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unit G (N=40)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unit H (N=33)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unit I (N=49)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unit J (N=40)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unit K (N=40)</td>
</tr>
<tr>
<td>% of new residents assessed within 24h</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Baseline 1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Baseline 2</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Baseline 3</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Phase 1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<td>% of current residents assessed at least 1/week</td>
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<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Baseline 1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline 2</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Baseline 3</td>
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<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Phase 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Phase 2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Follow-up</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>% of residents with treatment plan within 24h if moderate to severe pain</td>
<td>75%</td>
<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
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<td>Baseline 2</td>
<td>20%</td>
<td>31%</td>
<td>33%</td>
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<td>N/A</td>
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<td>38%</td>
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<td>100%</td>
<td>100%</td>
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<td>N/A</td>
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<tr>
<td>Follow-up</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>% of residents reassessed within 24h if moderate to severe pain identified</td>
<td>75%</td>
<td>0%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
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<td>8%</td>
<td>0%</td>
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<td>N/A</td>
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<tr>
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<td>N/A</td>
</tr>
<tr>
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<td>N/A</td>
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<td>Phase 3</td>
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<tr>
<td>Follow-up</td>
<td>25%</td>
<td>20%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note. Each study period was 3 weeks in duration. (CP) = Community Portal; (-) = no occurrence during specified time period, such as no new admissions; (N/A) = QI was not applicable for that unit due to the multiple-baseline approach; (*) = unit discontinued from the study.
Table 5

Percentage of change between average baseline score(s) and average intervention score(s) for each unit

<table>
<thead>
<tr>
<th>App only</th>
<th>% of new residents assessed</th>
<th>% reassessed if moderate to severe pain identified</th>
<th>% with treatment plan if moderate to severe pain</th>
<th>% reassessed if moderate to severe pain identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit A (40 beds)</td>
<td>N/A</td>
<td>100%</td>
<td>68%</td>
<td>-35%</td>
</tr>
<tr>
<td>Unit B (22 beds)</td>
<td>N/A</td>
<td>52%</td>
<td>-37%</td>
<td>0%</td>
</tr>
<tr>
<td>App + QI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit C (65 beds)</td>
<td>**100%</td>
<td>56%</td>
<td>70%</td>
<td>77%</td>
</tr>
<tr>
<td>Unit D (63 beds)</td>
<td>100%</td>
<td>100%</td>
<td>65%</td>
<td>100%</td>
</tr>
<tr>
<td>App + CP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit E (38 beds)</td>
<td>**100%</td>
<td>79%</td>
<td>*0%</td>
<td>*0%</td>
</tr>
<tr>
<td>Unit F (40 beds)</td>
<td>**100%</td>
<td>99%</td>
<td>20%</td>
<td>92%</td>
</tr>
<tr>
<td>App + QI + CP</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Unit G (40 beds)</td>
<td>**100%</td>
<td>62%</td>
<td>-94%</td>
<td>0%</td>
</tr>
<tr>
<td>Unit H (33 beds)</td>
<td>100%</td>
<td>28%</td>
<td>*0%</td>
<td>100%</td>
</tr>
<tr>
<td>App + CP + QI</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit I (49 beds)</td>
<td>**100%</td>
<td>81%</td>
<td>4%</td>
<td>90%</td>
</tr>
<tr>
<td>Unit J (40 beds)</td>
<td>**100%</td>
<td>83%</td>
<td>**96%</td>
<td>**79%</td>
</tr>
<tr>
<td>Unit K (40 beds)</td>
<td>100%</td>
<td>45%</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Note. Percentage of change is the change from the average baseline score(s) to the average intervention score(s). Percentage of change was calculated using the following formula: average intervention score(s) – average baseline score(s). (**) = No instances occurred during the baseline period, therefore percentages were calculated under the assumption that baseline was at 0%. (*) = Average baseline and intervention scores were both 100%. (-) = (N/A) = No instances of the quality indicator occurred.
Figure 2

Quality Indicator 1 (percentage of new residents assessed within 24h of admission) for App Only, App + QI, and App + CP condition

App Only Condition

App + QI Condition

App + CP Condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 3

Quality Indicator 1 (percentage of new residents assessed within 24h of admission) for App + QI + CP and App + CP + QI condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 4

*Quality Indicator 2 (percentage of residents assessed weekly) for App Only, App + QI, and App + CP condition*

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 5

Quality Indicator 2 (percentage of residents assessed) for App + QI + CP, and App + CP + QI condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 6

Quality Indicator 3 (percentage of residents with a treatment plan within 24h) for App Only, App + QI, and App + CP condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 7

Quality Indicator 3 (percentage of residents with a treatment plan within 24h) for App + QI + CP, and App + CP + QI condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 8

Quality Indicator 4 (percentage of residents reassessed within 24h) for App Only, App + QI, and App + CP condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Figure 9

Quality Indicator 4 (percentage of residents reassessed within 24h) for App + QI + CP, and App + CP + QI condition

Note. (QI) = Quality Indicator; (CP) = Community Portal
Table 6

Reported usage of PACSLAC-II App, QI and CP Websites

<table>
<thead>
<tr>
<th>Condition</th>
<th>App only</th>
<th>App + QI</th>
<th>App + CP</th>
<th>App + QI + CP</th>
<th>App + CP + QI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit</td>
<td>Unit A</td>
<td>Unit C</td>
<td>Unit E</td>
<td>Unit G</td>
<td>Unit I</td>
</tr>
<tr>
<td></td>
<td>Unit B</td>
<td>Unit D</td>
<td>Unit F</td>
<td>Unit H</td>
<td>Unit J</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unit K</td>
</tr>
<tr>
<td>Number of Participants</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Used App &gt; 1</td>
<td>3 (100%)</td>
<td>6 (100%)</td>
<td>8 (89%)</td>
<td>*</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>Used QI Website &gt; 1</td>
<td>-</td>
<td>2 (33%)**</td>
<td>2 (22%)</td>
<td>*</td>
<td>1 (50%)**</td>
</tr>
<tr>
<td>Used CP Website &gt; 1</td>
<td>-</td>
<td>4 (66%)**</td>
<td>-</td>
<td>*</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* (QI) = Quality Indicator; (CP) = Community Portal; (**) = reported usage although access was not provided; (*) = unit that discontinued from the study; (-) = no questionnaires were completed
Table 7

*Intercorrelations of demographic variables, use of Quality Indicator (QI) Website, use of Community Portal (CP) Website, Nursing Stress Scale scores, Emotional Exhaustion scores, and Depersonalization scores*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nursing Stress Scale Score</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
<td>-0.05</td>
<td>-0.01</td>
<td>0.22</td>
<td>-0.21</td>
<td>-0.31</td>
</tr>
<tr>
<td>2. Emotional Exhaustion Score</td>
<td>1.00</td>
<td>-</td>
<td>0.05</td>
<td>-0.11</td>
<td>0.17</td>
<td>-0.14</td>
<td>-0.17</td>
<td></td>
</tr>
<tr>
<td>3. Depersonalization Score</td>
<td>1.00</td>
<td>-0.12</td>
<td>-0.20</td>
<td>0.39</td>
<td>-0.01</td>
<td>-0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Age</td>
<td>1.00</td>
<td>-0.04</td>
<td>0.67***</td>
<td>-0.48*</td>
<td>-0.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Professional Title</td>
<td>1.00</td>
<td>0.09</td>
<td>0.18</td>
<td>-0.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Years of Experience</td>
<td>1.00</td>
<td>-0.26</td>
<td>-0.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Use of QI Website</td>
<td>1.00</td>
<td>0.52**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Use of CP Website</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *p* < 0.01, **p* < 0.001, ***p* < 0.0001. Professional Title: 1 = Registered Psychiatric Nurses, Registered Nurses, Licensed Practical Nurse, 0 = Continuing Care Aide.
Table 8

Regression analyses examining the unique variance accounted for by the predictors of each measure

**Nursing Stress Scale**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>$F$ (5,28)</th>
<th>$p$</th>
<th>$R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.503</td>
<td>3.714</td>
<td>0.064</td>
<td>0.102</td>
</tr>
<tr>
<td>Professional Title</td>
<td>-0.022</td>
<td>0.017</td>
<td>0.898</td>
<td>0.000</td>
</tr>
<tr>
<td>Years of Experience</td>
<td>0.465</td>
<td>3.937</td>
<td>0.057</td>
<td>0.109</td>
</tr>
<tr>
<td>Use of QI Website</td>
<td>-0.239</td>
<td>1.200</td>
<td>0.283</td>
<td>0.033</td>
</tr>
<tr>
<td>Use of CP Website</td>
<td>-0.134</td>
<td>0.415</td>
<td>0.525</td>
<td>0.011</td>
</tr>
</tbody>
</table>

**Emotional Exhaustion Subscale - Maslach Burnout Inventory**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>$F$ (5,28)</th>
<th>$p$</th>
<th>$R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.186</td>
<td>0.424</td>
<td>0.520</td>
<td>0.014</td>
</tr>
<tr>
<td>Professional Title</td>
<td>-0.121</td>
<td>0.410</td>
<td>0.527</td>
<td>0.014</td>
</tr>
<tr>
<td>Years of Experience</td>
<td>0.260</td>
<td>1.027</td>
<td>0.320</td>
<td>0.034</td>
</tr>
<tr>
<td>Use of QI Website</td>
<td>-0.094</td>
<td>0.133</td>
<td>0.718</td>
<td>0.004</td>
</tr>
<tr>
<td>Use of CP Website</td>
<td>-0.089</td>
<td>0.153</td>
<td>0.699</td>
<td>0.005</td>
</tr>
</tbody>
</table>

**Depersonalization Subscale - Maslach Burnout Inventory**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>$F$ (5,28)</th>
<th>$p$</th>
<th>$R^2$ Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.181</td>
<td>0.451</td>
<td>0.507</td>
<td>0.013</td>
</tr>
<tr>
<td>Professional Title</td>
<td>-0.257</td>
<td>2.097</td>
<td>0.159</td>
<td>0.062</td>
</tr>
<tr>
<td>Years of Experience</td>
<td>0.159</td>
<td>0.431</td>
<td>0.517</td>
<td>0.013</td>
</tr>
<tr>
<td>Use of QI Website</td>
<td>0.186</td>
<td>0.582</td>
<td>0.452</td>
<td>0.017</td>
</tr>
<tr>
<td>Use of CP Website</td>
<td>-0.364</td>
<td>2.873</td>
<td>0.101</td>
<td>0.084</td>
</tr>
</tbody>
</table>

*Note.* (QI) = Quality Indicator; (CP) = Community Portal
CP website), only a small proportion utilized the websites. Seven of the possible 20 participants (35%) indicated that they utilized the QI website more than once while only 1 indicated that they utilized the website more than five times. Similarly, 7 out of 16 participants (44%) indicated that they utilized the CP website more than once, with one participant using the website 3-5 times, and another participant 5 times or more. With regards to the PACSLAC-II app, 31 out of the 34 participants (91%) reported that they utilized the app more than once, while 55% indicated that they used the app more than five times during the study period (see Table 6).

Additionally, 5 out of 34 participants (15%) erroneously reported that they utilized websites that they did not have access to. Therefore, based on this questionnaire, out of the three possible resources, the PACSLAC-II app was reportedly utilized the most, with the majority indicating that they used it more than five times, followed by the CP website at least once, and the QI website at least once.

4.4 Stress and Burnout Measures

A total of 34 participants completed stress and burnout surveys. Pearson correlations between the stress and burnout scores, the demographic variables and the usage of the QI website and CP website were calculated prior to conducting the analyses. The intercorrelations for the three regression models examining overall stress scores from the NSS and burnout scores (i.e., emotional exhaustion and depersonalization) are presented in Table 7.

Three multiple regression equations were used to determine whether or not QIs and use of CP websites were associated with staff stress and burnout levels after controlling for demographic characteristics (i.e., professional title, years of experience and age). The
regression models were not statistically significant (overall stress scores, $F(5,28) = 1.650, p = .180, R^2 = .228$; emotional exhaustion scores, $F(5,28) = 0.461, p = .802, R^2 = .076$; and depersonalization, $F(5,28) = 1.207, p = .331, R^2 = .177$). See Table 8. Separate examination of each of the NSS subscales, using the same predictors as the above regressions, did not yield any significant results.

4.5 Qualitative Thematic Analysis

A total of 32 interviews with participating LTC staff were conducted and analysed (see Table 9 for demographic information of interview participants). Interviews were coded based on four main areas of questioning (see Appendix B), hence, four code books were developed (see Figure 10). The areas of focus were: LTC pain assessment and pain management practices; PACSLAC-II App; Quality Indicator Website; and Community Portal Website. The interviews were coded by two researchers. Approximately 20% of the interview files were randomly selected and were initially assessed for interrater reliability. Moderate agreement between the coders was observed, $\kappa = 0.61$. Although moderate agreement was observed, steps were taken to increase coder consensus. Several recommendations from the literature were followed to improve agreement (Steemler & Tsai, 2008; MacPhail et al., 2016; O’Connor & Joffe 2020). Specifically, the code manuals were refined and a negotiated agreement approach was utilized for any identified disagreements. Another randomly selected subset of data, approximately 15% of the interviews, was evaluated utilizing the new code books. Substantial agreement between the coders was observed $\kappa = 0.75$. Utilizing these revised code manuals, the remaining interviews were analyzed by both coder. In total, 933 narrative responses were identified and coded. All
identified disagreements underwent negotiated agreement until consensus was reached between both coders.

**Assessing Pain in LTC & Pain Assessment Practices**

The first part of the interview aimed to examine how health care professionals assessed pain in LTC, specifically for residents with dementia, by considering the tools used for assessments, their role in assessing pain, and the way decisions are typically made to manage pain (see Table 10 for the coding manual and Figure 11 for the identified themes and subthemes). In addition, perceived workload and stressors, perceived adequacy of pain assessment and pain management, and suggestion to improve pain assessment practices were also explored.

The majority of participants (63%) indicated that they utilized the PACSLAC-II to assess pain prior to the introduction of the study. This was followed by informal assessment methods without the use of a tool, such as examining facial expressions and verbal behaviours (28%). The third most reported method was the use of a numerical scale such as the 0-10 pain rating scale (22%) if residents were able to verbally communicate. Based on the responses of participants, pain is typically first identified by the care aides who work closely with residents to provide their care. Care aides would report their initial findings to a nurse who would then complete an assessment which may or may not incorporate the use of an observational assessment tool such as the PACSLAC-II. Nurses would then implement a treatment plan and report their findings to physicians when they deemed it necessary (e.g., when they believed that a new prescription was needed).

Approximately 2/3 of participants reported moderate to high stress or workload associated with assessing pain in residents with dementia due the high levels of personal
### Table 9

*Distribution of interviews conducted across units*

<table>
<thead>
<tr>
<th>Condition Unit</th>
<th>App only Unit A</th>
<th>App + QI Unit C</th>
<th>App + CP Unit E</th>
<th>App + QI + CP Unit G</th>
<th>App + CP + QI Unit I</th>
<th>Total per Profession</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Title</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>RCC/Manager</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (12.5%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (12.5%)</td>
</tr>
<tr>
<td>Nurse</td>
<td>3 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>1 (50%)</td>
<td>1 (100%)</td>
</tr>
<tr>
<td>Care Aide</td>
<td>0 (0%)</td>
<td>4 (100%)</td>
<td>7 (87.5%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Number of Interviews</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Total per Condition</td>
<td>7 (22%)</td>
<td>8 (25%)</td>
<td>2 (6%)</td>
<td>3 (9%)</td>
<td>12 (38%)</td>
<td>38</td>
</tr>
</tbody>
</table>

*Note.* (QI) = Quality Indicator; (CP) = Community Portal; (RCC) = Resident Care Coordinator
Figure 10

Areas of questioning during individual semi-structured interviews

- Assessing Pain in LTC & Pain Assessment Practices
- PACSLAC-II App
- Quality Indicator Website (if applicable)
- Community Portal Website (if applicable)
care (i.e., toileting, feeding etc.) required by residents on their unit, high workload associated with COVID-19, or difficulties in assessing pain due to dementia (see Table 11 for examples of relevant quotations from participants). Supportive factors that assisted in pain assessment practices identified by participants included strong communication and teamwork amongst different health care professionals, such as reporting possible instances of pain, collaboration between team members, and through documentation of assessments. Another supportive factor reported was a culture of prioritizing resident pain, although this was only mentioned in 4 out of the 11 units. Sixty-nine percent of participants indicated that the biggest barriers to pain assessment practices included limited ability to communicate with residents who may be experiencing pain and difficulties distinguishing between pain behaviours and responsive behaviours. A total of 47% percent of participants reported that limited resources such as lack of time to spend with residents, understaffing, and heavy workloads also negatively impacted pain assessment practices (see Table 12 for examples of relevant quotations from participants). Suggestions by participants to improve pain assessment practices included hiring more staff to reduce the staff-to-resident ratio and more education opportunities for care aides on pain assessment practices.

_PACSLAC-II App_

The second goal of the interview was to explore participant’s experiences using the PACSLAC-II app, such as reasons why they would or would not consider using the app, the impact of the app on workload, preference for the paper or app version of the PACSLAC-II, suggestions for improvement, and overall impressions (see Table 13 for the coding manual and Figure 12 for the identified themes and subthemes).
**Reasons for using the PACSLAC-II app.** Overall, the majority of participants reported enjoying the use of the PACSLAC-II app for a variety of reasons such as its design, ease of use, and convenience which allowed participants to save time when conducting pain assessments (see Table 14 for examples of representative quotations from participants). Fifty-six percent of participants reported that having previous assessments readily available on the app, allowed them to easily access residents’ graphs and pain scores to assist in the interpretation of pain scores as compared to previously when they had to physically search for the information in resident charts. Additionally, 56% of staff members reported that the app was easy to use and intuitive due to its user-friendly design. Initial training, as well as support from the Pain Champion, also contributed to staff members’ uptake and implementation.

Another theme that emerged was the app’s ability to provide useful contextual information such as the circumstances surrounding an assessment (i.e., observed activity, time of day) as well as which staff member conducted the assessment to assist in follow-up if needed. This reportedly provided participants with a broader perspective of residents’ pain over time and the circumstances surrounding it. Feedback from the app-generated resident pain graphs was also positive. 28% of participants, mostly nurses and managers, reported that it allowed for easy interpretation of the PACSLAC-II assessments, tracking of resident’s pain over time, evaluation of the effectiveness of treatment interventions, and communication with other health professionals (i.e., sending the graph to physicians).

Another perceived benefit of utilizing the PACSLAC-II app was that it helped to prioritize pain in the units. Staff members in one unit reported that due to the assessment tool being presented in an electronic format, it eliminated instances where assessments
Table 10

Coding manual for Assessing Pain in LTC and Pain Assessment Practices

<table>
<thead>
<tr>
<th>Themes</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment Tools Used to Assess Pain</td>
<td>Identified assessment tools used by health professionals to assess pain in LTC</td>
</tr>
<tr>
<td><em>Subthemes</em></td>
<td></td>
</tr>
<tr>
<td>Assessment Tool or No Tool/Clinical Judgement</td>
<td></td>
</tr>
<tr>
<td>Workload and Stress Associated with Pain Assessment</td>
<td>Perceived workload and stress levels associated with conducting pain assessments for residents with dementia</td>
</tr>
<tr>
<td>No-Low or Mod-High Stress/Workload</td>
<td></td>
</tr>
<tr>
<td>Role in Pain Assessment</td>
<td>Identified role in specific to pain assessments</td>
</tr>
<tr>
<td><em>Formal or Informal Pain Assessment</em></td>
<td></td>
</tr>
<tr>
<td><em>Reporting Pain or Supervising Assessments</em></td>
<td></td>
</tr>
<tr>
<td>Decisions in Pain Assessments</td>
<td>How decisions are made after a pain assessment has been conducted, identified roles, and perceived impact of role</td>
</tr>
<tr>
<td><em>Decision Makers</em></td>
<td></td>
</tr>
<tr>
<td><em>Role in Decision Making</em></td>
<td></td>
</tr>
<tr>
<td>Perceived Adequacy of Pain Assessment and Pain Management</td>
<td>Perceptions of pain, whether pain is adequately addressed and factors that contribute to pain assessment practices</td>
</tr>
<tr>
<td><em>Factors that Impact the Adequacy of Pain Assessment Practices</em></td>
<td></td>
</tr>
<tr>
<td>Suggestions for Improving Pain Assessment and Management</td>
<td>Identified suggestions for how to improve pain assessment practices</td>
</tr>
<tr>
<td><em>Increasing Staffing Levels</em></td>
<td></td>
</tr>
<tr>
<td><em>Pain Assessment Education</em></td>
<td></td>
</tr>
</tbody>
</table>
Figure 11

Themes and subthemes under Assessing Pain and Pain Assessment Practices
Table 11

Representative quotes for the themes of workload and stress, role in assessing pain, and suggestions for improvement

<table>
<thead>
<tr>
<th>Themes</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workload and Stress Associated with Pain</td>
<td></td>
</tr>
<tr>
<td><strong>Subthemes</strong></td>
<td></td>
</tr>
<tr>
<td>Moderate-High Stress</td>
<td>“[Residents] don't know for sure if they're actually in pain, you know? So, when we’re reading their face sometimes we think it's pain, but they're actually just scared. So that’s why I say it’s a 7-8 because we're not sure.” (Care Aide)</td>
</tr>
<tr>
<td>Low Stress</td>
<td>“I don’t think I have a very high stress level doing that. Like it’s fairly routine for us on the floor, I think, like we participated in an anti-psychotic reduction program quite a few years ago and it was part of that program. So, it’s just kind of, as soon as we think somethings up with our residents we just automatically do those assessments” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td>Role in Assessing Pain</td>
<td></td>
</tr>
<tr>
<td>Informal Pain Assessment</td>
<td>“We’re the ones, as [care aides], we’re the ones whose doing care, right, for the residents. So we’re the first ones who really, you know, assess or see if the residents have pain. Then after that confirm with the nurse” (Care Aide)</td>
</tr>
<tr>
<td>Formal Pain Assessment</td>
<td>“It'll be brought to our attention that someone wants to talk to us – that they look uncomfortable. But then it's kind of our role is actually go in and do the assessment and contact the doctor, or if we already have PRNs available. To know that, to be able to put together that critical thinking of connecting all the dots of what we're assessing and what we can do fix what we're assessing.” (Nurse)</td>
</tr>
<tr>
<td>Suggestions for Improving Pain Assessment</td>
<td></td>
</tr>
<tr>
<td>Increasing Staffing Levels</td>
<td>“It [comes] down to numbers and funding, you know? Wish we had more nursing support for the elders in our neighborhood that goes a long way for assessments and whatnot - taking the time.” (Nurse)</td>
</tr>
<tr>
<td>Pain Assessment Education</td>
<td>“So I think the more we can educate our aides to look for pain and perhaps have them actually do the pain assessments would certainly help us to manage pain better, cause they are our eyes out there for most of our nurses.” (Nurse)</td>
</tr>
</tbody>
</table>
### Table 12

**Representative quotes for the subthemes under supportive factors and barriers**

<table>
<thead>
<tr>
<th>Themes</th>
<th>Subthemes</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supportive Factors</strong></td>
<td><strong>Strong Teamwork and Communication</strong></td>
<td>“We do have pain meetings and just kind of bring to attention that we need to be monitoring this a little bit more frequently and make sure everyone is using all the tools that they are supposed to be using. That is the biggest support pain wise.” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Positive factors are we work as a team, we listen to every member of the team. Nurses are ultimately responsible to the resident and to the other members of the team for implementing pharmaceutical pain management. Special care aides can help with the pain with turning, positioning, keeping skin clean, prevention, wounds ...” (Nurse)</td>
</tr>
<tr>
<td></td>
<td><strong>Prioritizing Resident Pain</strong></td>
<td>“I found it at [facility’s name] here, we stress pain assessment and treatment very strongly.” (Nurse)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“For the most part we do a pretty good job addressing pain on our floor just because, like I said, it is kind of just a habit now from the other things (research projects) we participated in. So, I think we do a pretty good job monitoring for pain in our residents.” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td><strong>Barriers</strong></td>
<td><strong>Limited Resident Ability to Communicate or Responsive Behaviours</strong></td>
<td>“It’s a little bit frustrating cause most of the dementia patients, right, they don’t, they cannot express what they truly feel like, especially if they have pain, they cannot express it, so it’s very challenging for us.” (Care Aide)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Sometimes it can be a little bit stressful, just because there is those responsive behaviours that can add stress to the workload. [And] because there’s a little bit of that barrier of communication, they can’t communicate their pain.” (Nurse)</td>
</tr>
<tr>
<td></td>
<td><strong>High workload, limited resources (i.e., time and staff)</strong></td>
<td>“We have a fairly heavy workload so it would be nice to be able to do more pain assessment more frequently for residents but just like the time and manpower we currently have doesn’t allow for extra basically.” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I mean we do lack staff altogether. We have a lot of excessive overtime and exhaustion and I think staff do get exhausted and that’s just one of the things that’s important to do, but it’s not the top of their priority to get done every single week” (Care Manager/Champion)</td>
</tr>
</tbody>
</table>
Table 13

*Coding manual for PACSLAC-II app specific questions*

<table>
<thead>
<tr>
<th>Themes</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subthemes</strong></td>
<td></td>
</tr>
<tr>
<td>Perceptions of App</td>
<td></td>
</tr>
<tr>
<td><em>Reasons For or Against Using App</em></td>
<td>Perceptions of the reasons for or against the implementation of the PACSLAC-II app in the LTC unit</td>
</tr>
<tr>
<td>App Impact on Workload</td>
<td></td>
</tr>
<tr>
<td><em>Significant Increase or Minimal Increase/No Change</em></td>
<td>The extent to which the use of the PACSLAC-II app affected the workload of LTC staff</td>
</tr>
<tr>
<td>Preference for App or Paper</td>
<td></td>
</tr>
<tr>
<td><em>App, Paper, or No Preference</em></td>
<td>Individual staff member’s preference for format of PACSLAC-II scale</td>
</tr>
<tr>
<td>Suggestions for Improvement</td>
<td></td>
</tr>
<tr>
<td><em>App Specific Recommendations or No Improvements Needed</em></td>
<td>User feedback on areas of improvement for future versions of the app</td>
</tr>
<tr>
<td>Overall Impressions of App</td>
<td></td>
</tr>
<tr>
<td><em>Positive or Negative Experience</em></td>
<td>Overall impressions of the PACSLAC-II app</td>
</tr>
</tbody>
</table>
Figure 12
Thesis and subthemes identified related to use of the PACSLAC-II app

 Reasons For and Against Use of App
  - Reasons for Using App
  - Reasons for Not Using app

 Impact on Workload
  - No Increase/Minimal Increase (74%)
  - Significant Increase (26%)

 Preference for App or Paper
  - Preference for App (74%)
  - Preference for Paper (26%)

 Suggestions for Improvement
  - App Specific Recommendations
  - No Improvements Needed

 Overall Impressions of App
  - Positive Experience (87%)
  - Negative Experience (13%)
Figure 13

Themes and subthemes of reasons for and against use of app and the percentage of participants reporting each subtheme
were not completed in full. For example, with paper assessments, sometimes certain information may not be filled in and is not later completed due to staff members forgetting to follow up or other competing tasks requiring the staff’s attention. However, with the app, specific prompts such as “Please indicate the activity” or “Please indicate the date/time” eliminated these instances. Follow-up was also more immediate as after an assessment is initially completed by a care aide, a prompt would appear asking them to pass the tablet to a nurse to review. If a nurse does not review the assessment, it cannot be submitted. Therefore, nurses were able to follow up and introduce interventions within a more appropriate timeframe rather than the resident experiencing long delays between pain identification and appropriate pain management.

Data security (as identified by 22% of participants) was a theme that emerged during the interview as a potential benefit of using the app. Participants explained that often with pen-and-paper systems, data might become lost or misplaced, or the information may be changed without the staff member’s knowledge. Therefore, by having the pain assessments stored electronically, and with the name of the staff member who completed the assessment automatically collected, staff believed that the data was more secure, and they were able to more easily follow up with the original assessor if they required follow-up information.

Moreover, a majority of health care professionals (74%) reported that the app did not impact or had minimal impact on their workload suggesting the feasibility of the app in assisting pain assessment and pain management (see Table 15 for representative quotes from participants). For the few staff (26%) that reported an increase in perceived workload, this was not necessarily due to the app but other factors such as the increased frequency of
assessments due to the study protocol (i.e., all residents had to be assessed a minimum of once a week) or was associated to lack of technological infrastructure. For these reasons, 87% of participants reported an overall positive experience using the app and 74% reported a preference for the app over the paper version of the PACSLAC-II (see Table 15 for representative quotes from participants).

**Reasons for not using the PACSLAC-II app.** Although a majority of participants felt positively about the app, some comments were identified as to why participants may not use the app including limited technological infrastructure, incongruence with the unit’s current health records system, discomfort with technology or difficulties adjusting to change or perception that the app does not add value to current pain assessment practices. Participants in one out of the eleven units reported limited technological infrastructure in their unit, such as unreliable Wi-Fi, which made it more difficult to conduct the assessments on the app. Another example of limited technological infrastructure is staff members not having assigned email addresses by their employer (1/11 units). In that particular unit, no staff member other than the Resident Care Coordinator (RCC) had email access. Therefore, staff in that unit expressed that the app could only take them so far as they were unable to print off the graphs and would have to rely on their RCC who was not always available (see Table 14 for examples of representative quotations from participants).

A similar theme that arose was incongruence with the unit’s current health record system. As a participant accurately stated, “the way of nursing is pen and paper”. Although there has been a gradual shift to move to electronic charting, many LTC units still heavily relied on paper charting for their daily progress notes. Therefore, the app and tablet was
often the only tool that was not paper-based. Another related theme that emerged was difficulties logging on. Although only a few participants mentioned this (22%), most of such feedback came from care aides who typically do not need to use a username and password to perform their daily roles. Similarly, as many participants do not use technology as part of their daily activities at work, some expressed hesitancy or discomfort with technology. Others experienced a learning curve or relied more heavily on their Pain Champion. However, by the end of the study, there was an overall impression that participants were able to comfortably use the app without support.

Lastly, for a small number of units, (2/11 units) some staff reported that although they found the app easy to use, it did not add extra value to their current practice. Some reasons for this may be that residents are still able to verbally communicate, hence, the use of an assessment observational tool was viewed as unnecessary regardless of whether it was presented in paper or app form. Hence for these reasons, the app could not be fully integrated into the system or culture in certain units. However, many participants, particularly managers and care coordinators mentioned that although the app is not compatible with their current system, they still found the app to be useful and user-friendly and that they would consider implementing the app in their units again if their units shifted to electronic record keeping.

**Overall impressions and areas of improvement.** A great majority of participants (87%) reported positive experiences using the app (see Table 16 for representative quotations from participants). The few that had less positive experiences linked these experiences to circumstances unrelated to the app itself, such as increased frequency of assessments or lack of reliable Wi-Fi. With regards to areas for improvement, the majority
of staff members reported that they enjoyed the app and believed that no improvement was needed. The suggestions that were offered often came from nurses, resident care coordinators, or managers as they are the ones who typically followed up on assessments and reassessed the residents who have moderate to severe levels of pain. Suggestions included simplifying the log-in process for staff members, improving the ability to view pain scores of residents without having to go into individual profiles, and refining or including other categories for pain such as emergent or constant pain (see Table 16 for representative quotations from participants). This would better enable health care professionals to follow up with residents and have more accurate quality indicator scores based on their responses to the app’s prompts.

**App-based community websites**

The third goal of the interview was to explore participants’ experiences using the Quality Indicator and Community Portal websites, such as how frequently participants utilized the websites, their perceived ease of use, the applicability of the website, and potential suggestions for improvement. The coding manual and summary of themes and subthemes for both the quality indicator website and the community portal website are presented in Table 17 and Figure 14 respectively.

**Quality Indicator Website.** For the units that were assigned to use the quality indicator website, it was clear that although the researchers and Pain Champions encouraged the use of the website, many staff members did not use the website regularly (83%). Reasons for not using the website included lack of time during their shift or perceived lack of applicability of the app to their daily role (see Table 18 for examples of relevant quotes from participants). For example, some care aides and nurses reported that
Table 14

Representative quotes for the subtheme of reasons for or against using the app

<table>
<thead>
<tr>
<th>Themes</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reasons for Using PACSLAC-II App</strong></td>
<td></td>
</tr>
<tr>
<td><em>Convenience/ User-friendly</em></td>
<td>“Once you get used to doing it, and how to do it, the way it should be done - it's easy. You can do it with your eyes close.” (Care Aide)</td>
</tr>
<tr>
<td></td>
<td>“For me I would consider the application because it helps a lot and it will really save time. Especially in our unit that is very busy.” (Care Aide)</td>
</tr>
<tr>
<td><em>Provides Useful Information</em></td>
<td>“I think, especially by the end, I had good feedback from care aides for sure. They were finding it quick and easy to jump on there. And then I think it gives us a lot of good information that we might not have otherwise.” (Nurse)</td>
</tr>
<tr>
<td></td>
<td>“I think the PACSLAC App was a very great tool but the thing that we, or myself, even loved about it was that it is very valuable with the graphing. We could see the trends and those types of things happening. That was one of the greatest benefits I think of it.” (Care Manager/Pain Champion)</td>
</tr>
<tr>
<td><em>Prioritizes pain assessments</em></td>
<td>“It was really helpful to us because you could actually sit there and we have to think about if the resident was in pain or not ... People are in such a rush they don't pay attention to that kind of stuff because we only have eight minutes to get residents ready in the morning.” (Care Aide)</td>
</tr>
<tr>
<td></td>
<td>“I like too how they have to ask the nurse at the very end if there's pain or not. Because before when we’re doing it on paper, the care aides fill them out and after the five days I’m usually the only one that looks at it. So there’s not really that follow-up from most of the nurses. So this way it’s made them do it and I think it really helped with our results for dealing with the pain instead of it sitting there for five days and no one looking at it.” (Nurse)</td>
</tr>
<tr>
<td><em>Increases Security of Data</em></td>
<td>“I think that the app on the tablet is nice because sometimes paperwork can go missing, it’s just nice to have it all in one place and that’s all you have to refer to and you don’t have to go like searching back through paperwork in their charts and stuff.” (Nurse)</td>
</tr>
<tr>
<td></td>
<td>“On the paperwork somebody can go and change it. The one on tablet nobody can go there because you know you have your password, you have your username, so nobody can go there when you are not there to change the information you have.” (Care Aide)</td>
</tr>
</tbody>
</table>
Reasons for Not Using PACSLAC-II App

Limited Technological Infrastructure

“One of the downfalls that didn’t work well for us is the connection to Wi-Fi in our building. It was very glitchy. We weren’t able to access the app at all times ... I think there would be no question that we would continue to use that app but unfortunately [facility’s name] just does not allow us to do that with the technology and the building set-up that we have.” (Care Manager/Pain Champion)

“I think the biggest roadblock with the app was the fact that we don’t have email. Like our nurses don’t have email in this facility ... I can’t email the graph or anything to a doctor ... So, we can rely on the Resident Care Coordinators, but they’re not here 24/7 either. So that’s the huge roadblock in a nutshell ... Yeah, and that’s no fault of the app at all. That’s facility regulation.” (Nurse)

Incongruent with Current System
(Dominant Pen-and-Paper System)

“The barrier is that it's the only like real time software we use. We don't have electronic charting. We don't have electronic orders. We do everything, either by fax or verbally or written. So it's the only tool we have that's digital, so it changes things.” (Nurse)

“I think it would be good again given the right circumstances and situations. It was a little more difficult at this point because we don’t do a lot things digital based we do it paper based ... I think one day when we are more computerized, I think it would be great. (Care Coordinator/Pain Champion)

Discomfort with Technology or Difficulties Adjusting to Change

“The staff some of them might not want to do. I don’t know. Some of them will tell you I’m not comfortable with using things like that. Some of them don’t want to learn. So there are just barriers to that” (Nurse)

“I think that you know, anybody that was a little bit afraid of computers or afraid of technology, struggled out of the gate. But, you know, everybody kind of caught up to speed and I think in the end I think we had pretty good results.” (Nurse)

Difficulties Logging In

“The login procedure for me is usually the tough part because I got to try to remember things and I can't remember if it had a password or not. But yeah just getting into it was the hardest part for me.” (Care Aide)

Does Not Add Perceived Value

“I just thought the pain assessments were a waste of time because the majority of our residents did not need to use the PACSLAC. Not everybody in LTC has dementia and we have a number of residents who can say very clearly ‘I don’t have pain’ ” (Nurse)
### Table 15

**Representative quotes for the themes of app impact on workload and preference for paper vs app**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Subtheme</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>App Impact on Workload</strong></td>
<td><strong>No Increase/Minimal Increase</strong></td>
<td>“It really helps a lot. It didn't add any workload on our end. Because when we do the chart at the end of the day, we have a time for charting so it's very easy. We only take a few minutes or not even a minute to complete the PACSLAC so it's not really adding a lot on our workload.” (Care Aide)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Well, it made it better, because we were quickly like just enter the information in the PACSLAC-II app. We would update that and the care aides would also be involved and saying what they see and then it would be very good for our workload.” (Nurse)</td>
</tr>
<tr>
<td></td>
<td><strong>Significant Increase</strong></td>
<td>“It was very time consuming once again because of the technology within [the facility] and the glitches that we’ve seen. So, we could go to rooms 1 and 2 but we couldn’t go to rooms 3, 4, and 5 to do the assessments because the system didn’t allow us to because of poor connections. (Care Manager/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Yeah, it’s like an extra work. You set up the tablet, make sure the Wi-Fi is working and everything. Extra work that has to be done and completed if we want it to be done accurately.” (Nurse)</td>
</tr>
<tr>
<td><strong>Preference for App or Paper</strong></td>
<td><strong>Preference for App</strong></td>
<td>“I prefer the application because it saves more time as we are very busy in our unit. And it's more secure. We don't lose the data or the paper and it's more convenient. You just need to log-in quick.” (Care Aide)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“It’s actually fairly quick to do one and then you know right away if there’s pain that you need to try and manage. So, like if we were able to have the app that’s what my preference would be.” (Manager/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td><strong>Preference for Paper</strong></td>
<td>“I feel like right now, until we do start doing electronic charting and stuff like that I feel like the paper copy is better.” (Nurse)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“We write everything down, pen and paper, but if you go to another unit within our building a lot of them do it all electronically. Even their charting is electronically. So, if we were to move to that I don’t think there would be a question, yes we would absolutely do online. But our method on our unit is pen and paper for every single thing, so that’s why I say pen and paper would probably be preferred.” (Manager/Pain Champion)</td>
</tr>
</tbody>
</table>
### Table 16

**Representative quotes for the themes of overall experience and suggestions for improvement for PACSLAC-II app**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall Impressions of App</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Positive Experiences</strong></td>
<td>“Overall, it was a great experience. I think it’s a great idea to implement it here.” (Care Aide)</td>
</tr>
<tr>
<td></td>
<td>“Like I said, we quite liked it. I’m still waiting to hear back from my boss to see if we can keep it.” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td><strong>Negative Experience</strong></td>
<td>“I think it would be good again given the right circumstances and situations. It was a little more difficult at this point because we don’t do a lot things digital based - we do it paper based.” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td>“I think overall there were challenges, absolutely. Um, the overall concept of it I think was great. I, as I mentioned before, I think it was great to see that we can see our trends and identify those very quickly. Um, I think the downfall is the technology [infrastructure].” (Care Manager/Pain Champion)</td>
</tr>
<tr>
<td><strong>Suggestions for Improvement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>App Specific Recommendations</strong></td>
<td>“The only thing I didn’t like about it is like, from my side of it being the one that’s following up on all the results, is that like I had to go into each individual resident to check their graphs.” (Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td>“If there was a way to make the app kind of have a few more options of like whether someone already is on the pain regime or like whether this is like interpreted as breakthrough pain. (Nurse)</td>
</tr>
<tr>
<td></td>
<td>“And I think it needs to improve the log-in, or the username, or the log-in process. Username most of us forgot it or forget the password, so I think we need a shorter or easier password. I think application needs to accept easier password.” (Care Aide)</td>
</tr>
<tr>
<td><strong>No Improvement Needed</strong></td>
<td>“I enjoyed it all. I don't think you guys need to improve anything on it.” (Care Aide)</td>
</tr>
</tbody>
</table>
Table 17

**Coding manual for Quality Indicator Website and Community Portal Website specific questions**

<table>
<thead>
<tr>
<th>Themes</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subthemes</strong></td>
<td></td>
</tr>
<tr>
<td>Usage</td>
<td></td>
</tr>
<tr>
<td><em>Use or did not use and barriers</em></td>
<td>How actively participants used the websites as well as identified barriers towards usage</td>
</tr>
<tr>
<td><strong>Ease of Use</strong></td>
<td></td>
</tr>
<tr>
<td><em>High ease of use or low ease of use</em></td>
<td>The extent to which the use of the PACSLAC-II app affected the workload of LTC staff</td>
</tr>
<tr>
<td><strong>Applicability of Website</strong></td>
<td></td>
</tr>
<tr>
<td><em>Website was Applicable or Not Applicable</em></td>
<td>Perceived applicability of website to role or to LTC unit in real life</td>
</tr>
<tr>
<td><strong>Suggestions for Improvement</strong></td>
<td></td>
</tr>
<tr>
<td><em>Website Specific Recommendations or No Improvements Identified</em></td>
<td>User feedback on areas of improvement for future versions of the websites</td>
</tr>
</tbody>
</table>
Figure 14

_Themes and subthemes identified related to use of the Quality Indicator and Community Portal Websites_

![Diagram of themes and subthemes related to use of the Quality Indicator and Community Portal Websites.](AttachedDiagram)
Table 18

Representative quotes for Quality Indicator (QI) Website and Community Portal (CP) Website subthemes

<table>
<thead>
<tr>
<th>Themes</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage</strong></td>
<td></td>
</tr>
<tr>
<td>Use or did not use and barriers</td>
<td>“It’s very busy so we don’t have time really to explore those.” (QI &amp; CP Websites, Care Aide)</td>
</tr>
<tr>
<td></td>
<td>“Like I didn't have time to go on it a lot, but I peeked at it a few times and like it was interesting to see the different graphing’s and scores and stuff” (QI Website, Nurse)</td>
</tr>
<tr>
<td><strong>Ease of Use</strong></td>
<td></td>
</tr>
<tr>
<td>High ease of use or low ease of use</td>
<td>“I would say it was pretty useful, but did I access it? No, I didn’t access them as much as I probably should have. But when I did go on there, I found it pretty useful and easy to use, for sure, yeah.” (CP Website, Manager)</td>
</tr>
<tr>
<td></td>
<td>“Yes, the tab on the side made it easy to see material organized in an easy way to [filter] out research articles and videos and other resources.” (CP website, Manager)</td>
</tr>
<tr>
<td><strong>Applicability of Website</strong></td>
<td></td>
</tr>
<tr>
<td>Website was Applicable or Not Applicable</td>
<td>“I thought it was interesting, but did I look at more than once or twice, probably not but yeah, I think if it was used more frequently it would be more beneficial” (QI Website, Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td></td>
<td>“Yeah, we definitely did a lot of those things. We’d go over some of the tools that were on there or information and we have huddles on the floor daily that we talk about different things like that and talk about residents and we address pain and all that.” (CP Website, Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td><strong>Suggestions for Improvement</strong></td>
<td></td>
</tr>
<tr>
<td>Website Specific Recommendation or Improvements Identified</td>
<td>No “Maybe it’s a little out of the way.” (QI Website, Nurse)</td>
</tr>
<tr>
<td></td>
<td>“Improvement wise I don't know if I really have any statement for that. Like it's a good website it's just didn't have a lot of time to fully use it.” (CP Website, Nurse)</td>
</tr>
</tbody>
</table>
Table 19

Representative quotes for perceived barriers and supports subthemes

<table>
<thead>
<tr>
<th>Themes</th>
<th>Representative Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Barriers</td>
<td></td>
</tr>
<tr>
<td>Increased frequency of assessments</td>
<td>“A lot of the staff found it quite time consuming to try and get all [the assessments] done and it’s a new thing too, so they are having to learn something new and having to do something that’s at a very high frequency compared to what they are used to doing.” (Resident Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td>Timing of the study/COVID-19</td>
<td>“It was challenging for our staff … We’re in the middle of COVID, we had an outbreak. It was not the best timing [for the study] to be implemented.” (Manager/Pain Champion)</td>
</tr>
<tr>
<td>Summertime is challenging right and had you not been doing this during you know COVID, that might have been something a little bit more successful for you …I think everyone is feeling kind of like stretched … Just because people are just worn out, tired out from the daily juggle of everything we have to do with you know COVID included right? I think that was a big barrier and an unfortunate thing for you.” (Manager/Pain Champion)</td>
<td></td>
</tr>
<tr>
<td>Lack of staff</td>
<td>“We just couldn’t manage, or we would have a casual person, or I wasn’t here” (Manager/Pain Champion)</td>
</tr>
<tr>
<td>“We were often very short-staffed of special care aides and so I am a nurse and I worked as a special care aide for a good chunk of that time” (Nurse)</td>
<td></td>
</tr>
<tr>
<td>Identified Supports</td>
<td></td>
</tr>
<tr>
<td>Scheduling/delegating assessments</td>
<td>“I just made a schedule in the calendar, on the floor we have six different care aides every shift, so I just assigned them and in reports in the morning we agreed, okay group 1 your PACSLAC is this resident and this resident, group 2 yours is this resident and this resident. And I just put a schedule in for [the duration of the study]. It was all ready to go ahead of time.” (Resident Care Coordinator/Pain Champion)</td>
</tr>
<tr>
<td>“I think everybody has an interest to get the tablet and its well assigned so that everybody wants to have their residents checked out.” (Nurse)</td>
<td></td>
</tr>
<tr>
<td>“Definitely [helpful]. If we are looking at any type of selection of residents we needed to have something not vague. It needs to be specific and scheduled.” (Nurse)</td>
<td></td>
</tr>
</tbody>
</table>
the website might be more helpful for their Care Coordinator or Manager rather than themselves. Moreover, there was reportedly limited discussion of the information provided on the website among nursing staff on the units. Of the few staff members who did use the website, 80% perceived the website to be easy to use and had limited suggestions for improvement.

**Community Portal Website.** Similar results were found with regard to the community portal website. Although not many individuals regularly used the website due to limited time (82%), the staff that did look at the website reported the resources as useful (70%) and the website as easy to use (60%). Please see Table 18 for relevant quotations from participants. All staff members who used the website were passive participants of the website (i.e., looking at resources) rather than active participants (i.e., commenting, sharing new resources). However, a majority of the units that were assigned to the Community Portal (86%) had at least one staff member report that the resources from the website were shared in their unit either in the form of group discussion during huddles or printed off and posted in the units. No suggestions for improvement were brought up during the interviews.

**Perceived barriers and supports to regular app use**

A theme that was revealed from the interview data was participants’ perceived barriers to the regular app use. Table 19 outlines examples of statements falling under this theme. The barriers that were the most highly reported was the increased frequency of pain assessments as required by the study (22%) and lack of staff (22%). Although individual pain assessments typically took less than five minutes to complete, there was a significant increase in the number of pain assessments that were completed weekly compared to a unit’s standard practice. This increase in assessments contributed to a perceived increase
in staff’s workload. However, this was only reported by nurses, resident care coordinators or managers. This perceived increase in workload was coded as a ‘barrier’ as it was due to increases in the frequency of pain assessments rather than utilization of the PACSLAC-II app itself. Lack of staff was another reported difficulty due to a combination of reasons such as units being short-staffed, high resident-to-staff ratios, or staff vacations as part of the study was conducted over the summer period. Staff vacations were difficult to navigate especially if Pain Champions were away for an extended period of time and were unable to facilitate the study protocol. Lastly, 9% of participants also acknowledged that the timing of the study was another barrier, as they experienced increased workload associated with the COVID-19 pandemic (i.e., infectious control measures and vaccine rollouts). Hence, there were other competing tasks that needed to be completed and units were unable to dedicate all their resources to the study as described by a manager: “We're spread so thin that I felt we wanted to [participate in the study] but it was kind of on the side of our desk you know?”

In contrast, scheduling and delegating assessments was reportedly helpful in offsetting the higher frequency of assessments (9%). In one of the participating units, the Pain Champion utilized a schedule to introduce the study protocol to their unit. This schedule reportedly assisted staff members in knowing which residents they needed to assess each week and consequently made the weekly pain assessments more manageable. This may have contributed to the high quality indicator scores that the unit acquired throughout both the study and follow-up period. As questions related to barriers and supports were not initially incorporated in the interview guide, not all participants were asked about their perceived barriers and supports. Once this theme became apparent to the
researchers, participants were queried as needed based on their previous responses. Hence, there may have been supports (i.e., training, having a Pain Champion) that were not identified during the interviews.

5.0 Discussion

The International Association for the Study of Pain’s (IASP) recently updated definition of pain explicitly identifies that verbal self-report is only one of many ways to express pain, hence limited ability to communicate does not imply the absence of an individual’s pain experience (Srinivas, et al. 2020). As such, timely and consistent pain assessments are necessary for individuals with dementia in LTC. Although, pain in individuals with dementia is a longstanding problem in LTC (Cohen-Mansfield, 2014; Miu & Chan, 2014), through the use of validated pain assessment tools such as the PACSLAC-II, health care professionals are in a position to evaluate and effectively treat pain in residents living with dementia (Hadjistavropoulos et al., 2014). This study is the first to examine the impact of an app-based community platform for an established app that was developed specifically for health care professionals working in LTC environments. In contrast to the practices of many unregulated app developers (Portelli & Eldred, 2016), the PACSLAC-II app has undergone systematic evaluations in long-term care environments. Hence, this study provides much needed evidence for the possible efficacy of mHealth technology in LTC settings.

Through the use of the updated version of the PACSLAC-II app, this study provides further support for the utilization of the app (Zahid et al., 2020), and mHealth technology overall, to improve quality indicators relating to resident pain in LTC facilities. Meaningful changes were observed as many units demonstrated 25% or higher improvements in their
quality indicators scores. Improvements were most drastic in the first and second quality indicators which addressed timely pain assessments upon admission and weekly assessments of residents. Hence, this study provides further support for the feasibility of clinical pain assessment recommendations and their associated quality indicators (Hadjistavropoulos et al., 2009; Hadjistavropoulos et al., 2014).

Complementing the quality indicator data, individual interviews with health care professionals revealed that overall, most health care professionals (87%) had positive experiences utilizing the app for a number of reasons, such as its ability to track resident pain scores over time, its convenience compared to the utilization of the paper version of the PACSLAC-II, increased security, and high ease of use. Similarly, a majority of health care professionals (74%) reportedly preferred the PACSLAC-II app over the paper version of the PACSLAC-II which they may have used during care as usual. These experiences were especially true for health care professionals who worked in LTC facilities that had established technological infrastructure in place such as reliable Wi-Fi, electronic health information systems for resident charting, and emails. Overall, a majority of health care professionals who discussed the app did not identify areas that needed improvement. However, a few suggestions were brought forward. These suggestions included improving the app’s log-in process and other simple changes that can be easily addressed in future updates. The information obtained from the individual interviews support the conclusions of previous research on the PACSLAC-II app and highlights the benefits of mHealth technology in LTC (Zahid et al., 2020).

One particular strength of the study is that its multiple-baseline between-units design allowed for the evaluation of differences not only between conditions, but also
within the same unit without the need for treatment withdrawal as new resources were introduced. Although there did not appear to be apparent differences between conditions, amongst all conditions, quality indicator scores were elevated up to 100% after the introduction of the PACSLAC-II app where the average baseline scores were between approximately 0-5%. The multiple baseline design is more rigorous in its design as improvements in quality indicators were observed multiple times, for different units, and at different points in time. This strengthens both the internal and external validity of the effectiveness of the intervention of PACSLAC-II app (Hawkins et al., 2007).

It was initially hypothesized that according to the job demands-resources (JD-R) model, the PACSLAC-II app and its associated websites presumably act as job resources for the health care professionals participating in the study and work to offset the job demands associated with working in LTC as well as the difficulty of assessing residents with dementia who are unable to communicate. Therefore, it was anticipated that LTC units that were randomly assigned to the app and both websites (the quality indicators website and community portal websites) would see the most positive gains such as increased quality indicator scores and positive staff satisfaction with the app as they would have the most relevant resources. This would be followed by units who were randomly assigned to the app and only one feature (quality indicator or community portal feature), and lastly by units who only had access to the PACSLAC-II app with no additional features. However, based on the review of the units’ quality indicator scores and the multiple regression models, there were no notable differences amongst units assigned to different conditions. This is likely due to the low usage of these resource websites. According to the JD-R model, it is possible that staff did not readily use these websites if they did not find the websites helpful.
in reducing job demands or in achieving work goals (Baker & Demerouti, 2007). For example, current job demands due to the high workload related to COVID-19 may be much higher than what these job resources may be capable of buffering. As such, if frontline staff’s immediate goals are related to completing tasks related to infection control and outbreak management, staff may have reduced time dedicated to pain management. Therefore, these websites may not have been as relevant to their immediate job goals and subsequently limited participants’ performance expectancy of these websites. Performance expectancy according to Unified Theory of Acceptance and Use of Technology (UTAUT) is the strongest predictor of behavioural intention to adopt and use technology (Venkatesh et al., 2003). As such, given the added stresses of the pandemic, stress and burnout scores would not have been adequately managed by peripheral resources (e.g., the community resource portal) focusing on specific pain assessment issues as shown in our regression analyses. Nonetheless, when focusing specifically on the PACSLAC-II app, a majority of the health care professionals indicated that they found the app to be a useful job resource in terms of its convenience, clinical feasibility, and the helpful information that it provides (i.e., resident graphs, contextual information). As a result, the PACSLAC-II app was used more frequently than the websites. Hence, it can be assumed due to the high proportion of app versus website utilization that the increases in observed in quality indicator scores were due to the app itself rather than the websites, which speaks to the clinical utility of the app in assisting health care professionals to improve their pain assessment practices.

5.1 Limitations

Although the use of the PACSLAC-II app generated positive feedback from health care professionals, the quality indicator website and community portal websites were not
readily used. As suggested by the participants, this may be due to the lack of opportunity to utilize the websites due to existing high workloads during shifts or because these websites were perceived as less applicable for frontline staff. The few health care professionals who used the websites during the study period, however, described the websites as helpful and easy to use. Due to the limited usage of these websites, it is difficult to determine potential differences amongst conditions. As the participants mentioned during the individual interviews, however, these websites may be more applicable to managers and facility administrators who may be more interested in quality indicators at a broader unit- or facility-level. Hence, future applications of these websites will be geared toward these administrators to assist in their pain assessment practices.

Due to the limited participating units, the researchers anticipated low statistical power, hence descriptive statistics and an applied behavioural analysis approach were used to evaluate quality indicator data. Future research employing a much larger number of LTC units, taking into account the nesting of observations within units and allowing for statistical comparisons between various experimental conditions would be important to conduct. However, as a case-series approach was taken for each unit with a large emphasis on implementation science, it is not possible to determine the intervention effects associated with the use of the Pain Champions or adaptable aspects of the intervention (i.e., interview format), as they were an integral part of the implementation process in all cases. Without Pain Champions and the necessary modifications made to tailor the intervention to each unit, agreement to participate may have been sparse and the implementation of the study protocol would have likely been even more difficult.
Another limitation of the study is that the quality indicator data are dependent on the proper documentation of pain assessment practices within each unit. It would be important for future research to have accuracy checks in place to confirm the validity of the quality indicator data. A frequent component of pain management is the prescription of pharmacological interventions. Although the app had the built-in option for nursing staff to send pain assessment information to nurse practitioners and physicians, the involvement of these clinicians was not measured in this study. As the sharing of pain assessment information with such practitioners may be linked to reduced polypharmacy (Hadjistavropoulos et al., 2014), their participation in future mHealth studies based in LTC may be helpful. Lastly, in the present study, clinical utility was assessed based on the frequency of usage of the app and associated websites and interview data. The impact of the identified changes on resident outcomes was not studied. It would be important to evaluate the impact of changes in pain assessment practices on resident outcomes (e.g., pain levels, quality of life etc.).

5.2 The Impact of COVID-19

COVID-19 has highlighted the systematic underfunding of LTC facilities in Canada resulting in findings of expired medications, delays in basic care, and resident deaths (Canadian Armed Forces Report, 2020; Estrabrooks et al., 2020; Akhtar-Danesh et al., 2022). The challenges associated with the pandemic were also prominent in the study as described by participants. The timing of the study was a reported a barrier due frequent outbreaks and tremendous competing demands for staff. Based on the interviews with participants, COVID-19 related tasks (i.e., infection control measures and vaccine rollouts), lack of staff, and the loss of residents exacerbated high workload levels.
Interestingly, these concerns were identified most often by nurses, managers, and resident care coordinators, rather than care aides. Nurses described that the high resident-to-nurse ratio, increased frequency of assessments, and lack of available nursing staff as challenging to the successful completion of pain assessments and appropriate follow-up. These factors may have also contributed to elevated stress and burnout, fewer health care professionals using the community portal and quality indicator website, as well as fewer participants completing the surveys and interviews for our study compared to other similar studies involving staff in LTC (Zahid et al., 2020; Gallant et al., 2022; Hadjistavropoulos et al., 2016).

With regards to the literature on technology adoption and the Unified Theory of Acceptance and Use of Technology (UTAUT), care was taken to fulfill the four key factors identified by Venkatesh et al. (2003) (performance expectancy, effort expectancy, social influence, and facilitating conditions) as much as possible by designing interfaces with high ease of use, providing training, utilizing a Pain Champion, and offering technical support respectively. Nonetheless, competing demands related to COVID-19 and lack of technological infrastructure may have negatively impacted the facilitating conditions needed for the study. Similarly, the research team endeavoured to modify the adaptable periphery of the intervention and assist the process of implementation in accordance with the Consolidated Framework for Implementation Research (CFIR) so that the intervention would be adapted for each unit. For example, the delivery method of training, interview, and selection of individuals carrying out the intervention (i.e., nurses, care aides, or both) were flexible and based on continuous discussions with Pain Champions throughout the study to facilitate the implementation process. Other domains such as the outer setting (i.e.,
organizational policies, COVID-19 mandates), and characteristics of individuals involved in the intervention (i.e., attitude towards intervention, perceived self-efficacy) were outside of the scope of the current study. However, during training sessions participants were provided with pain assessment education, possible benefits associated with the intervention were explored, and hands-on training to address participants’ self-efficacy as individuals with higher self-efficacy are more likely to adopt the intervention (Damschroder et al., 2009). Nonetheless, factors associated with the inner setting (i.e., culture, implementation climate, readiness for implementation) such as capacity for change, relative priority of pain assessment compared to other aspects of resident care, and inadequate technological infrastructure were highlighted as having a large impact on the implementation and have may been a limiting factor due to the pandemic. Therefore, with these factors taken into consideration, it is plausible that the high workload and competing tasks may have contributed to lower quality indicator scores at follow-up, as the frequency of pain assessments was not maintained during the follow-up phase once the encouragement and support of our research team ceased. Previous research (Hadjistavropoulos et al., 2016) conducted prior to the pandemic demonstrated that similar gains in quality indicators were sustained during the follow-up period. These results support this interpretation that the pandemic contributed to the decreased quality indicators scores during the follow-up period.

Although the pandemic brought about logistical challenges, it also provided a unique opportunity to assess the clinical utility of the app in a setting where workload and competing demands were even more prominent than usual. Therefore, even during these challenging times, the positive results observed demonstrate the clinical utility of the app
and the PACSLAC-II assessment tool itself as described in previous studies and suggest that health care professionals may have even more positive experiences using the app when COVID-19 is no longer a barrier (Zahid et al., 2020; Paulson-Conger et al., 2011; Hadjistavropoulos, et al., 2014; Herr et al., 2019).

5.3 Future Directions and Recommendations

Overall, the app received praise from LTC professionals due to its ease of use, convenience, and ability to easily track residents’ pain over time. Due to Unit I’s positive experience using the app during the implementation period, the unit along with other units in its facility is currently using the PACSLAC-II app to assess and manage pain on a long-term/permanent basis. Interest has also been expressed from other facilities around the world to use the PACSLAC-II app as part of their practice. Therefore, findings from this study will contribute to the further development and evaluation of the PACSLAC-II app and will bring it closer to widespread use. Simple suggestions participants brought forward during the interviews such as improved log-in processes are being currently addressed for the next update. App development is also ongoing to improve the overall functioning of the app for users and to improve the security of resident data. In the current version of the app, pain management strategies (i.e., analgesic medication, repositioning, etc.) were not inputted or tracked. However, the incorporation of pain management strategies in future versions of the app may provide more comprehensive information to facilitate interpretation of resident pain scores and assist in the selection of appropriate pain management interventions. As the PACSLAC and PACSLAC-II have already been translated and validated in a number of different languages thus far such as Farsi (Haghi et al, 2019), French (Poulin et al., 2021), Japanese (Takai et al., 2013), Portuguese (Santos et
al., 2012). Korean (Kim et al., 2014), Dutch (Zwakhalen et al., 2006) and Turkish (Buyukturan et al., 2018), creating different language versions of the app is the natural next step if interest abroad continues to rise.

Currently, to access the quality indicator and community portal resource, users need to leave the app and go to separate web pages. Therefore, the possible merging of websites and the PASLAC-II app may be beneficial. With all the resources found in one location, this would eliminate the extra step for health care professionals to access different websites and remember different log-in information for each site. Another area of improvement brought forward by nurses was an easier way to determine which residents require follow-up. Currently, nurses need to individually go into each resident’s profile to determine which resident needs to be reassessed. Therefore, the introduction of a “Unit Home Screen” or similar feature for staff to easily identify which residents have been assessed each week, which residents still need to be assessed, and which residents with moderate-to-severe pain need to be reassessed may help ease follow-up assessments. In this way, all staff members, and not just the nurses who typically engage in follow-up assessments, will be able to see which residents need to be assessed as the need emerges. These aggregated data may not only help to improve users’ experiences but also improve QI scores as well. Lastly, with regards to the quality indicator website and community portal website, they may be more geared toward managers and directors as indicated by care aides and nurses during the interviews. Although the care aides and nurses find the information interesting, it was reportedly not as applicable to their role of assessment and pain management at the resident level. For managers and directors, however, this may be more applicable as their roles are broader and focused on improving the quality of care for the entire unit or facility. As most
mHealth applications require large and passionate user bases to achieve visible health-related outcomes (Hooker et al., 2012), future studies examining electronic communities of practice (eCOPS) in LTC or other health settings may need to explore ways to attract users and keep users motivated to use the application and become active members of the community such as engaging in information-sharing and interacting with other members in discussion forums.

The implementation of the PACSLAC-II app has also assisted in the identification of potential practice issues in LTC. As more Canadian seniors enter LTC, the need for appropriate infrastructures to support their engagement with technology is crucial (Powell et al., 2019), as seniors are becoming more and more adept at the use of technology (Pew Research Center, 2019). The importance of having stable Wi-Fi connections was also highlighted during the COVID-19 pandemic (Gallistl et al., 2021; Moyle et al. 2018), as residents often had to rely on virtual interactions to connect with loved ones during the pandemic (Chu et al., 2020). With new technologies evolving and being introduced that may potentially have immense benefits in LTC, it is important that technological infrastructure is prioritized so that LTC residents are not left behind and are able to receive the benefits associated with innovation and advancements in technology.

Similarly, paper charting continues to be a norm in LTC. Due to this reliance on pen and paper charting, some staff members were initially less comfortable with the use of the app. Some noted that although they found the app to be helpful it was, unfortunately, the only electronic system that they were using, hence the app did not fully integrate with other aspects of their charting and care. Although EHR systems have a number of benefits, such as improved legibility and ease of access to patient records (Zhang, Yu, & Shen, 2007;
Kruse et al., 2017), uptake has been slow in LTC compared to other health settings. Similarly, the adoption and diffusion of mHealth technology remain to be low in health care settings although mHealth also has the potential to improve the quality and effectiveness of patient care (Maiga & Namagembe, 2014). Some barriers to adoption in health care settings include technical literacy of health care professionals, and the privacy, confidentiality and security concerns for personal health information of patients (Zanifa et al., 2010; Yarbrough, 2007; Paul & McDaniel, 2004). However, in our study participants did not voice concerns about privacy or security. On the contrary, some health care professionals suggested that the utilization of the app actually increased data security as health information is less likely to be lost or misplaced when it is completed electronically compared to when it is completed on paper. In another study that examined the prevalence and nature of charting information gaps experienced in LTC during resident encounters, more than one-third of resident encounters were missing at least one item of information that was needed for the encounter (Tharmalingam, Hagens & English, 2017). The potential of missing information due to the use of paper charting was also noted by participants in the present study. They indicated that with paper charting pages may go missing or some sections are not completed during assessments. Furthermore, when this incomplete data is identified, follow-up may be difficult if it is unknown which staff member completed the initial assessments. In the PACSLAC-II app, for example, the names of assessors are automatically tracked and incorporated in reports and assessment cannot be finished without all the necessary fields completed. Therefore, incorporating technologies such as EHRs or mHealth technology may assist in reducing missing data resulting in more timely and appropriate care to residents. However, as more technologies are introduced into LTC,
steps should also be taken to ensure that these systems interact with each other seamlessly, as seen in some LTC facilities with RAI-MDS and their electronic health records, to reduce potential workload on health care professionals.

Based on the results of this study the following recommendations may improve the implementation of the PACSLAC-II app or other mHealth apps in future LTC settings:

- The inclusion of both nurses and care aides in the utilization of the app as there are more care aides than nurses working during each shift. Therefore, if units wish to continue assessing residents a minimum of once a week, the involvement of care aides may alleviate potential high workloads and perceived stress associated with the higher frequency of assessments. Care aides are a valuable resource in LTC, therefore providing care aides additional pain assessment education, as suggested by interviewed participants, may be helpful in the detection of specific pain behaviours as they often work more closely with residents. However, it should be noted that nurses are still needed to interpret assessment results and make treatment recommendations;

- Facilities with established infrastructure for technology, such as stable Wi-Fi, emails for staff members, and electronic health record systems, may find the app more beneficial than facilities without these established infrastructures, as they may require less adjustment to technology and experience fewer technical difficulties. For facilities that have more limited technological infrastructure in place, such as LTC facilities located in rural settings, focus groups to determine ways in which the app can be better introduced and integrated into their units may be beneficial before the app is utilized;
• Careful selection of Pain Champions to oversee and facilitate the implementation of the app and all aspects of pain assessment is essential. Pain Champions are an important facilitating factor towards the successful implementation of any new pain-related intervention and can assist in various ways such as scheduling training sessions and monitoring the completion of resident assessments. Hence their involvement in future mHealth interventions may reduce potential barriers and improve the workload and quality indicators of participating units.

In conclusion, the updated version of the PACSLAC-II app demonstrated positive effects in the care of residents with regards to pain and was positively received by health care professionals working in LTC settings. The COVID-19 pandemic has highlighted to the public the chronic and systematic gaps in the funding and care provided to residents in LTC. Therefore, resources aimed to alleviate workload and improve the quality of resident care are essential and should continue to be advocated in the years to come. With the anticipated aging population and expected growth of mHealth, it is essential that high quality apps, such as the PACSLAC-II app, which are informed and validated by research, are available for residents and health care professionals in LTC settings. As such, the PACSLAC-II app and its novel community platform represent a positive direction toward continued innovation and technological advancements in LTC.
References


Ballard, C. G., Gauthier, S., Cummings, J. L., Brodaty, H., Grossberg, G. T., Robert, P.,
& Lyketsos, C. G. (2009). Management of agitation and aggression associated with


Binnekade T. T., Van Kooten J, Lobbezoo F, Rhebergen D, C Van der Wouden, J,

Boudreaux, E. D., Waring, M. E., Hayes, R. B., Sadasivam, R. S., Mullen, S., & Pagoto,
providers and healthcare organizations. TBM, 4, 363-371.

diabetes care and patient outcomes in skilled-care communities: Successes and

and validity of the Turkish version of Pain Assessment Checklist for Seniors with
Limited Ability to Communicate (PACSLAC-T). Turkish Journal of Medical
Sciences, 48, 805-810.

Braun, V., & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales. *Qualitative research in sport, exercise and health, 13*(2), 201-216.


Cohen-Mansfield, J. (2014). Even with regular use of an observational scale to assess pain among nursing home residents with dementia, pain-relieving interventions are not frequently used. *Evidence Based Nursing, 17*(1), 24-25.


Hadjistavropoulos, T., Marchildon, G. P., Fine, P. G., Herr, K., Paliey, H. A.,

Assessing pain in dementia patients with comorbid delirium and/or depression.
*Pain Management Nursing, 9*, 48-54.

Hadjistavropoulos, T., Williams, J., Kaasalainen, S., Hunter, P. V., Savoie, M. L., &
Wickson-Griffths, A. (2016). Increasing the frequency and timelines of pain
assessment and management in long-term care: Knowledge transfer and sustained
implementation.

Haghi, M., Fadayevatan, R., Alizadeh-khoei, M., Kaboudi, B., Foroughan, M., &
Limited Ability to Communicate-II (PACSLAC-II) in Iranian older adults with

The multiple baseline design for evaluating population-based research. *American

Health Canada (2021). Second annual report on medical assistance in dying in Canada


ISBN: 978-1-905824-44-1


Moyle, W., Jones, C., Murfield, J., Dwan, T., & Ownsworth, T. (2018). ‘We don’t even have Wi-Fi’ a descriptive study exploring current use and availability of communication technologies in residential aged care. *Contemp Nurse, 54*, 35-43.


Ozdalga, E., Ozdalga, A., Ahuja, N. (2012). The smartphone in medicine: A review of
current and potential uses among physicians and students, *J Med Internet Res, 14,*
e128.


Comparison of two pain assessment tools in nonverbal critical care patients. *Pain
Management Nursing, 12,* 218-224.

Pew Research Center. (2019). Americans 60 and older are spending more time in front of
their screens than a decade ago. Retrieved from: https://www.pewresearch.org/fact-
tank/2019/06/18/americans-60-and-older-are-spending-more-time-in-front-of-their-
screensthanadecadeago/?utm_source=Pew+Research+Center&utm_campaign=041
770d7ae-Internet-
 Science_2019_06_27&utm_medium=email&utm_term=0_3e953b9b70-
041770d7ae-400310621 (Accessed 2022-04-04).

Portelli, P. & Eldred C. (2016). A quality review of smartphone applications for the


Appendix A: PACSLAC-II Scale

| Pain Assessment Checklist for Seniors with Limited Ability to Communicate-II (PACSLAC-II) |
|---|---|---|
| Date of Assessment: ________ Time: ________ | Check if present |

### Facial Expressions
1. Grimacing
2. Tighter face
3. Pain expression
4. Increased eye movement
5. Wincing
6. Opening mouth
7. Creasing forehead
8. Lowered eyebrows or frowning
9. Raised cheeks, narrowing of the eyes or squinting
10. Wrinkled nose and raised upper lip
11. Eyes closing

### Verbalizations and Vocalizations
12. Crying
13. A specific sound for pain (e.g., ‘ow’, ‘ouch’)
14. Moaning and groaning
15. Grunting
16. Gasping or breathing loudly

### Body Movements
17. Flinching or pulling away
18. Thrashing
19. Refusing to move
20. Moving slow
21. Guarding sore area
22. Rubbing or holding sore area
23. Limping
24. Clenched fist
25. Going into foetal position
26. Stiff or rigid
27. Shaking or trembling

### Changes in Interpersonal Interactions
28. Not wanting to be touched
29. Not allowing people near

### Changes in Activity Patterns or Routines
30. Decreased activity

### Mental Status Changes
31. Are there mental status changes that are due to pain and are not explained by another condition (e.g., delirium due to medication, etc.)?

**TOTAL SCORE** (Add up checkmarks)

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Appendix B: Interview Moderator Guide

Instructions: Please note that this interview will be audio recorded. Participation is voluntary, and you may withdraw at any time from the interview. You may choose to answer only those questions that you are comfortable answering. If you choose to withdraw from the interview at any point, notify the researcher and he or she will end the interview. The interview will be conducted by researcher and will take 30-45 minutes to complete. The researcher will ask questions regarding your experience using the tablet version of PACSLAC-II. All responses will be anonymous and will be kept secure. All the data collected will be securely stored.

Assessing Pain among LTC Residents with Dementia

1. What were some of the pain assessment tools that you had previously used to assess pain among LTC residents?

2. How would you describe your workload/ stress levels when assessing pain in LTC residents with dementia?

3. What role did you play in assessing pain among residents with dementia in your facility?

4. In what ways do you believe pain to be adequately or inadequately addressed for residents with dementia?

Pain Assessment Practices

5. What are particular barriers or challenges to changing or improving pain assessment practices within your facility?

6. What are supporting factors that assist in changing or improving pain assessment practices within your facility?

7. How are decisions about changes in pain assessment practices made within your facility?

8. What role do you play in the decisions made about pain assessment practices?

Implementation of PACSLAC-II App

9. Why would you or why would you not consider using tablet app version of the PACSLAC-II?

10. In what ways would it or would it not be feasible to use the tablet app version of the PACSLAC-II in your facility?

11. How did the tablet app version of the PACSLAC-II affect the workload levels?

12. How would you describe your overall experience using the tablet app version of the PACSLAC-II?
13. Would you prefer a paper-and-pencil or the online application version of the PACSLAC-II to assess pain?

**Feature Specific Questions**

14. Did you find it beneficial having access to your facility’s quality indicator scores for pain as well as other facilities?

15. How did your facility use this information?

16. Did you find the website that provided the visualizations for PACSLAC-II scores and quality indicator scores easy to use?

17. What aspects of the quality indicator website did you enjoy and what do you think could be improved?

18. Did you find the community portal website (the website where the resources and forums are found) useful and easy to use?

19. Did you participate on the community portal website (e.g., submitting resources, commenting on resources, or using the forum)? If no, why not?

20. What aspects did you enjoy about the community portal website and what do you think could be improved?

21. How was the information that was available on the community portal website translated or utilized in your unit in real life (e.g., used to facilitate huddles, used to promote in person discussions)?

22. Do you believe that a sense of community was achieved online through the use of the app and its accompanying websites? For example, a sense of shared interest and passion amongst members, interactions between community members through the forum and comments section, and the sharing of information between members.
Appendix C: Demographic Information Sheet

Evaluation of an app-based community platform in reducing pain in long-term care facilities

Instructions: Please provide a response for each of the following questions.

1. What is your age?

2. What is your gender?

   Female

   Male

   Other: __________________________

3. How many years of experience do you have working in long-term care?

4. What is your professional title?

   Registered Psychiatric Nurse

   Registered Nurse

   Licensed Practical Nurse

   Special Care Aide

   Other: __________________________
Appendix D: App and Website(s) Usage Questionnaire

Participant ID: ____________________
Please create your own ID using the first 3 letters of your mother’s maiden name and the first 3 digits of a familiar phone number (e.g., DOA297). Then enter it here. We will then use this ID to link your responses from these questionnaires to any other questionnaires you will fill out for our team.

App and Website(s) Usage Questionnaire

Instructions: Please provide a response for each of the following questions.

1. How many times did you use the PACSLAC-II App?
   - None
   - 1-2 times
   - 3-5 times
   - More than 5 times

2. How many times did you use the Quality Indicator Website/ Data Repository Website?
   - None
   - 1-2 times
   - 3-5 times
   - More than 5 times

3. How many times did you use the Community Portal Website?
   - None
   - 1-2 times
   - 3-5 times
   - More than 5 times
Appendix E: Ethics Certificate

Research Ethics Board
Certificate of Approval

PRINCIPAL INVESTIGATOR
Vivian Tran

DEPARTMENT
Psychology

REB#
2020-210

SUPERVISOR
Thomas Hadjistavropoulos

TITLE
Systematic Implementation and Evaluation of Advanced App-Based Pain Assessment in Long-Term Care Facilities

APPROVED ON
February 15, 2021

RENEWAL DATE
February 15, 2022

APPROVAL OF
Application for Behavioural Research Ethics Review
Consent Forms
Measures
Interview Moderator Guide

Full Board Meeting

Delegated Review

The University of Regina Research Ethics Board has reviewed the above-named research project. The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this research project, and for ensuring that the authorized research is carried out according to the conditions outlined in the original protocol submitted for ethics review. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol, or related documents.

Any significant changes to your proposed method, procedures or related documents should be reported to the Chair for Research Ethics Board consideration in advance of implementation.

ONGOING REVIEW REQUIREMENTS
In order to receive annual renewal, a status report must be submitted to the REB Chair for Board consideration one month in advance of the current expiry date each year the study remains open, and upon study completion. Please refer to the following website for the renewal and closure forms:
https://www.uregina.ca/research/for-faculty-staff/ethics-compliance/human/ethicsforms.html

Kim Dorsch PhD
REB Chair
University of Regina

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Telephone: (306) 585-4775
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Appendix F: Informed Consent Forms

Participant ID:
Please create your own ID using the first 3 letters of your mother’s maiden name and the first 3 digits of a familiar phone number (e.g., DOA297). Then enter it here. We will then use this ID to link your responses from these questionnaires to any other questionnaires you will fill out for our team.

Consent Form (Questionnaires)

Project Title: Systematic Implementation and Evaluation of Advanced App-Based Pain Assessment in Long-Term Care Facilities

Principal Investigator: Vivian Tran
Graduate Student, University of Regina
viviantran@uregina.ca
(780) 297-8626

Supervisor: Thomas Hadjistavropoulos, Ph.D., ABPP
Research Chair in Aging and Health and Professor
Department of Psychology, University of Regina
thomas.hadjistavropoulos@uregina.ca
(306) 585-4457

What is the purpose of the study?
Pain assessment in residents with dementia has always been challenging because of their limited ability to communicate. As a result, quality of life is adversely impacted for these residents. As well, the work load and stress levels of caregivers increases. The PACSLAC-II is an effective, evidence-based measure used to assess pain in residents with dementia. Therefore, we are interested in exploring the use of an advanced version of the PACSLAC-II app and of different features associated with the app on staff work satisfaction and its impact of resident pain.

What does the study involve?
The study focuses on the administration of the PACSLAC-II as adopted by your LTC facility. Nursing staff stress and workload levels will be assessed throughout the study using the Nurse Stress Scale, Continuing Care Aide Stress Scale, and Maslach Burnout Inventory. The questionnaires will be completed either in-person or online before the study begins and at the end of the study. A subsample of the participants will be invited to participate in interviews to discuss their experiences using the online application of the PACSLAC-II. A separate consent form will be used for these interviews. Administration of the questionnaires will take 30 minutes.

What are the potential benefits of participating in the study?
Whether or not you decide to participate in this project, you will be given the opportunity to learn about the PACSLAC-II for pain assessment and management for individuals living in LTC. The project may also lead to increased knowledge about staff workload and stress levels in assessing pain and using pain measures which, in turn, may improve the quality of care received by LTC residents. However, there are no guaranteed benefits for participants. Staff who complete a set of questionnaires (before and after the study) will receive a $10 Tim Hortons gift card for their participation for a maximum of $20. For the purposes of record keeping, the names of staff who receive a gift card will be forwarded to University of Regina’s Financial Services and will be listed as a recipient.
What are the potential risks of participating or not participating in the study?
Although there is a potential risk of some participants feeling pressured to participate, efforts have been made to ensure that there is no coercion for participation. Participation is voluntary and will no way affect your position within the organization or your employment status. There are no other known risks involved in participating in this study.

What will the study cost me?
There is no cost associated with participation in this study.

Will my participation in the study be kept confidential?
All data will be linked using a participant ID rather than participant names to protect confidentiality. This ID code is required each time questionnaires are completed. Data will be collected at LTC facilities and will be transported and kept secure with the researchers. We will use password protected computers to store the data. Paper data will be securely kept, using locked cabinets, at the University of Regina (Health Psychology Laboratory). All data will be securely stored. The study’s researchers and research assistants will be the only persons with access to the data and these persons will employ the strictest rules of confidentiality. Electronic data will be kept in password-protected databases and on password-protected computers. Participants will be assigned a participant number and all identifying information will be removed from the data. We expect that group data from this study will be published and presented at conferences, but no identifying information will be released or published without your specific consent to the disclosure. Only group results will be presented in our reports and the site of data collection will be not be mentioned. All data will be stored for no less than seven years following publication. When it is time to destroy the data, electronic data will be deleted, and paper data will be shredded by the researchers. Secure deletion of the data will be ensured by the researchers.

What happens if I decide to withdraw my consent to participate in the study?
We hope that you will assist us with this research project; however, your decision to participate is completely voluntary. You can choose to answer only those questions that you are comfortable answering. You may withdraw from the study at any time and for any reason without a need for explanation and without penalty of any sort. If you wish to withdraw from this study, please notify the researcher so that he or she can immediately end the study. If you choose to withdraw, all data will be permanently shredded and deleted. Your refusal to provide consent will in no way affect your position at your LTC facility. Once analysis of the data begins (approximately in August 2021) removal of individual data will not feasible.

What will happen after the study?
We will send a summary of the results of this study to each participating LTC facility. If you would like to receive a summary of these results, you may request a copy of the results from the facility, or you may contact the Health Psychology Laboratory at (306) 385-4428 or the principal investigator at (780) 297-8626 or at viviantran@uregina.ca

Who do I contact if I have any questions or concerns?
If you have any questions or would like more information about the study, please contact the Health Psychology Laboratory at (306) 385-4428 or the principal investigator at (780) 297-8626 or at viviantran@uregina.ca. If you have any questions or concerns about your rights as a research participant, you may contact the Chair of the University Research Ethics Board at (306) 385-4775 or at research.ethics@uregina.ca.
Please select all statements that are true.

☐ I have read and understood the information and consent form.
☐ I have had sufficient time to consider the information provided and to ask for advice.
☐ I have had the opportunity to ask questions and have had satisfactory responses.
☐ I understand that all of the information collected will be kept confidential and that the results will only be used for scientific objectives.
☐ I understand that my participation in this study is voluntary.
☐ I understand that I am completely free to refuse my participation or to withdraw myself from this study at any time and for any reason without changing in any way my position within the facility where I work.
☐ I understand that I am not waiving any of my legal rights as a result of signing this consent form.
☐ I understand that there is no guarantee that this study will provide any benefits to me.

Please select your choice below.

Select “Agree” to indicate that you have read the above information, you voluntarily agree to participate in this study, and you are at least 18 years of age.

Select “Disagree” to indicate that you would decline to participate in this study.

☐ Agree
☐ Disagree

Name: ___________________________

Signature: ________________________ Date: ________________________
Participant ID: ____________________________
(first 3 letters of mother’s maiden name and first 3 digits of phone number i.e., DOA297)

Consent Form (Interviews)

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Participant ID: 
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What are the potential risks of participating or not participating in the study? 
Although there is a potential risk of some participants feeling pressured to participate, efforts have been made to ensure that there is no coercion for participation. Participation is voluntary and will no way affect your position within the organization or your employment status. If Zoom is used to conduct the interview, please note that Zoom servers are located outside of Canada and Zoom stores users’ names and usage data outside of Canada. The researchers will work to ensure that Zoom sessions will be confidential and secure to the best of our abilities.

What will the study cost me? 
There is no cost associated with participation in this study.

Will my participation in the study be kept confidential? 
All the data will be collected at LTC facilities and will be transported and kept secure with the researchers. We will use password protected computers to store the data. Paper data will be securely kept, using locked cabinets, at the University of Regina (Health Psychology Laboratory). All data will be securely stored. The study’s researchers and research assistants will be the only persons with access to the data and these persons will employ the strictest rules of confidentiality. Electronic data will be kept in password-protected databases and on password-protected computers. Participants will be assigned a participant number and all identifying information will be removed from the data. We expect that group data from this study will be published and presented at conferences, but no identifying information will be released or published without your specific consent to the disclosure. Only group results will be presented in our reports and the site of data collection will be not be mentioned. All data will be stored for no less than seven years following publication. When it is time to destroy the data, electronic data will be deleted, and paper data will be shredded by the researchers. Secure deletion of the data will be ensured by the researchers.

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Select “Agree” to indicate that you have read the above information, you voluntarily agree to
participate in this study, and you are at least 18 years of age.

Select “Disagree” to indicate that you would decline to participate in this study.

☐ Agree
☐ Disagree

Name: __________________________

Signature: ________________________  Date: ________________________