Exploratory factor analysis and reliability of the Primary Health Care Engagement (PHCE) Scale in rural and remote nurses: findings from a national survey

Julie G. Kosteniuk¹, Norma J. Stewart², Chandima P. Karunanayake³, Erin C. Wilson⁴, Kelly L. Penz⁵, Judith C. Kulig⁶, Kelley Kilpatrick⁷, Ruth Martin-Misener⁸, Debra G. Morgan⁹ and Martha L.P. MacLeod¹⁰

¹Professional Research Associate, Canadian Centre for Health and Safety in Agriculture, College of Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada
²Professor of Nursing, College of Nursing, University of Saskatchewan, Saskatoon, Saskatchewan, Canada
³Professional Research Associate, Canadian Centre for Health and Safety in Agriculture, University of Saskatchewan, Saskatoon, Saskatchewan, Canada
⁴Assistant Professor, School of Nursing, University of Northern British Columbia, Prince George, British Columbia, Canada
⁵Assistant Professor, College of Nursing, University of Saskatchewan, Regina Campus, Regina, Saskatchewan, Canada
⁶Professor Emerita, Faculty of Health Sciences, University of Lethbridge, Lethbridge, Alberta, Canada
⁷Associate Professor, Faculty of Nursing, Université de Montréal and CIUSSS EIM-Maisonneuve-Rosemont Hospital site, Montréal, Québec, Canada
⁸Professor, School of Nursing, Dalhousie University, Halifax, Nova Scotia, Canada
⁹Professor, Canadian Centre for Health and Safety in Agriculture, University of Saskatchewan, Saskatoon, Saskatchewan, Canada
¹⁰Professor and Knowledge Mobilization Research Chair, School of Nursing, University of Northern British Columbia, Prince George, British Columbia, Canada

Aim: The study purpose was to provide evidence of validity for the Primary Health Care Engagement (PHCE) Scale, based on exploratory factor analysis and reliability findings from a large national survey of regulated nurses residing and working in rural and remote Canadian communities. Background: There are currently no published provider-level instruments to adequately assess delivery of community-based primary health care, relevant to ongoing primary health care (PHC) reform strategies across Canada and elsewhere. The PHCE Scale reflects a contemporary approach that emphasizes community-oriented and community-based elements of PHC delivery. Methods: Data from the pan-Canadian Nursing Practice in Rural and Remote Canada II (RRNII) survey were used to conduct an exploratory factor analysis and evaluate the internal consistency reliability of the final PHCE Scale. Findings: The RRNII survey sample included 1587 registered nurses, nurse practitioners, licensed practical nurses, and registered psychiatric nurses residing and working in rural and remote Canada. Exploratory factor analysis identified an eight-factor structure across 28 items overall, and good internal consistency reliability was indicated by an α estimate of 0.89 for the final scale. The final 28-item PHCE Scale includes three of four elements in a contemporary approach to PHC (accessibility/availability, community participation, and intersectoral team) and most community-oriented/based elements of PHC (interdisciplinary collaboration, person-centred, continuity, population orientation, and quality improvement). We recommend additional psychometric testing in a range of health care providers and settings, as the PHCE Scale shows promise as a tool for health
Introduction

There is no single common definition of primary health care (PHC) in the contemporary literature. Further, the term is often not explicitly defined and is sometimes used synonymously with primary care (Henderson et al., 2014; Canadian Nurses Association, 2015; White, 2015). However, PHC is commonly agreed to broadly address the social determinants of health and offer essential education and health care (eg, health promotion; disease prevention, treatment and management) to communities based on principles of accessibility, equity, community participation, and intersectoral collaboration (Henderson et al., 2014; White, 2015; Baum et al., 2016).

As a component of PHC, primary care focuses on clinical health care services and medical care provided after first contact between individuals and health care providers. Part of the confusion in terminology stems from advocacy efforts to advance the PHC philosophy, resulting in bifurcation of the term ‘primary health care’. PHC that is ‘professional’ (Levesque et al., 2011), ‘profession-centred’ (White, 2015), or ‘selective’ has come to represent a primary care approach (Baum et al., 2016), while PHC that is ‘community-based’, ‘societal’, and ‘comprehensive’ signals a contemporary PHC approach founded on the original vision set out in the Alma Ata Declaration on Primary Health Care (World Health Organization, 1978).

In developing the Primary Health Care Engagement (PHCE) Scale for health care providers, we sought to closely align the instrument with a contemporary PHC approach that would be relevant to ongoing PHC reform strategies across Canada (eg, Alberta Health, 2014; Saskatchewan Ministry of Health, 2016) and elsewhere (Liu et al., 2011; Thomas et al., 2014; Galdikiene et al., 2016). Although other instruments are available to measure primary care delivery performance based on perceptions of health care providers (eg, Schoen et al., 2006; Dahrouge et al., 2009), community-based PHC performance has not been well addressed at the provider level.

Aside from the PHCE Scale, the Canadian Institute for Health Information (CIHI) PHC Provider Survey (Johnston and Burge, 2013) is the only other provider-level instrument that specifically targets community-based PHC performance, to our knowledge. Developed to complement the CIHI patient experience and organizational surveys, the CIHI provider survey addresses the PHC principle of intersectoral collaboration but not the principles of accessibility, equity, and community participation. Although these latter attributes may be more appropriately measured at the patient level, it is also worthwhile to gauge the degree of workplace involvement in PHC delivery according to front-line health care providers, given their central role in the actualization of PHC principles.

We were also keen that the new PHCE instrument apply to rural and remote (hereafter rural/remote) communities where effective PHC delivery is highly valued in light of persistent difficulties meeting health and social needs (Thomas et al., 2014; Ward et al., 2014). Rural/remote health care providers may work alone or in small multidisciplinary teams with members who are not co-located on a regular basis (MacLeod et al., 2004), and thus it is important to make the best use of scarce health human resources in these settings (Ford, 2016). Community participation in health service planning is also a policy expectation in rural communities, although meaningful participation can be difficult to operationalize and achieve (Kenny et al., 2015). For these reasons, we drew on community-oriented (Levesque et al., 2011) and community-based (CIHR, 2015) conceptualizations of PHC in the development of the PHCE Scale. Community-oriented PHC is understood as including ‘… a wide range of professionals who deliver a broad spectrum of health and social services’ (Levesque et al., 2011: 23). Further, community-based PHC is person-centred, population-centred, coordinated, and integrated care delivered by multiple health care providers in a range of community settings that covers the continuum from primary prevention to palliative care (CIHR, 2015).
The 40-item PHCE Scale was developed in a three-phase process reported previously (Kosteniuk et al., 2016): 10 dimensions of community-oriented PHC most relevant to community-based and rural/remote PHC were endorsed by our 16-member research team and 19-member advisory board, collectively representing the 13 Canadian provinces and territories. The 40-item PHCE Scale consisted of 10 subscales: accessibility/availability, equity, community participation, intersectoral team, patient-centred care, continuity, population orientation, interdisciplinary collaboration, comprehensiveness, and quality improvement. Based on initial psychometric testing in a pilot survey of 89 nurses in current practice in Canada with nursing experience in rural/remote communities, the 40-item PHCE Scale (3–5 items per subscale) demonstrated good reliability ($\alpha = 0.91$). Although Cronbach’s $\alpha$ coefficients below 0.70 indicated evidence of low reliability for three subscales (equity, comprehensiveness, and patient-centred care), these were nonetheless retained in the final 40-item version given their theoretical importance to community-oriented PHC delivery in rural/remote communities.

The purpose of the present study was to provide validity evidence for the PHCE Scale, by evaluating the scale’s internal structure based on factor analysis and reliability findings from a large national survey of rural/remote regulated nurses in Canada. Recent years have seen major health care reforms targeting PHC in Canada (Strumpf et al., 2012) and other countries (Liu et al., 2011; Thomas et al., 2014; Galdikiene et al., 2016). We anticipate the PHCE Scale will be useful to researchers and health care planners in assessing the level of PHC delivery in health care settings, identifying the degree to which PHC elements are being enacted and the elements that may require intervention, and tracking progress in PHC reform.

**Methods**

**Design**

This study uses data from the pan-Canadian study ‘Nursing Practice in Rural and Remote Canada II (RRNII),’ which included a cross-sectional survey with a target sample of 10072 regulated nurses [registered nurses (RNs), nurse practitioners (NPs), licensed practical nurses, and registered psychiatric nurses] residing in rural/remote Canada. Further details of the RRNII survey are reported elsewhere (MacLeod et al., 2017).

**Participants**

The RRNII survey population included a stratified systematic sample of regulated nurses in every Canadian province, as well as all regulated nurses working in the Territories and all rural and remote NPs. Eligible nurses practiced in a rural or remote community at the time of the survey, or had been on leave for six months or less. For the purposes of eligibility, communities with a core population of less than 10 000 were considered rural (du Plessis et al., 2001), and northern communities in the Territories (Nunavut, Northwest, and Yukon) were considered remote.

Regardless of their primary place of employment, we chose to include all survey participants in the exploratory factor analysis (EFA) for two reasons. First, community-based PHC is delivered ‘in a range of community settings’ outside of clinics and public health settings (CIHR, 2015). Second, institutional settings such as hospitals have a long history of health and wellness promotion in both urban and rural communities (Olden and Hoffman, 2011). Therefore, participants were included whose primary place of employment was a community-based health care site [i.e., directly accessible by patients and outside of an inpatient setting (Gibson et al., 2015)], hospital/rehabilitation or convalescent centre/integrated facility, nursing home/long-term care facility, or other setting (Table 1).

A total of 3822 participants completed the RRNII survey. Of 10 072 sampled, 450 were ineligible (e.g., incorrect addresses, duplicate registrations, retired) and 9622 were eligible, resulting in a response rate of 40% (3822/9622). Of these participants, 1587 completed all 40 items in the PHCE Scale and were included in the factor analysis; 2235 participants completed fewer than 40 items and were excluded to avoid artificially high correlations that may result from imputing missing values. Compared with excluded participants, those included were more highly educated and held higher registration status, and were more likely to work in smaller communities under 10 000 population (Table 1).

**Data collection**

RRNII survey data were collected from April 2014 to August 2015, with surveys distributed by the RRNII’s research centre at the University of
Northern British Columbia as well as by provincial and territorial nursing associations. Participant recruitment relied on the Dillman method (Dillman et al., 2014) to improve the response rate (eg, participants were offered a chance to win an iPad as an incentive). Online and paper survey packages were provided in English and French; non-respondents received a total of four contacts that included a first survey package, first reminder, second reminder, and final survey package.

Measures
Development of the original 40-item PHCE Scale consisted of a literature review and expert consultation, content evaluation and item revision, and testing in a small pilot survey of 89 nurses (Kosteniuk et al., 2016). Items developed for the original PHCE Scale drew from multiple indicators of quality and performance [World Health Organization, 1986; Flocke, 1997; Shi et al., 2001; Canadian Institute for Health Information (CIHI), 2006; Davis et al., 2007; Bloch et al., 2011; Levesque et al., 2011; Wong et al., 2011; Saskatchewan Ministry of Health, 2012], including nine items that were minimally adapted with permission from a study by Dahrouge et al. (2009).

The 27-page RRNII survey employed in the present study consisted of five sections that focused on participants’ individual characteristics, work community, workplace, nursing practice, and aspects of their psychosocial health. The 40-item PHCE Scale included three to five items in each of 10 subscales, with items rated on a five-point scale as 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), 5 (disagree), or 97 (not applicable). ‘Not applicable’ responses were coded as ‘missing’. Participants were instructed to respond in relation to the primary workplace where they spent most of their work time in the past 12 months, and to the community represented by the catchment area of their primary workplace. After reverse scoring negatively worded items, higher scores for each subscale and the overall scale suggest perceptions of greater workplace engagement in primary health care delivery.

Across the 40 PHCE items, the proportion of ‘not applicable’ responses (1.9–49.2%) was substantially higher than the proportion of true missing responses (3.1–7.7%). Specifically, between 20.1 and 49.2% of participants chose the ‘not applicable’ option in each of eight items across three subscales (accessibility/availability, population orientation, and intersectoral team). Participants whose primary place of employment was a community-based health care setting were more likely to provide a valid response to all of the scale items and also significantly more likely than their counterparts in other settings (ie, hospital, nursing home/long-term care facility, and other) to be included in the present analysis (57.1 versus 35.2%; \( P < 0.001 \)). However, those outside of community-based settings accounted for the majority of included participants (59.9%), demonstrating the wide applicability of the PHCE Scale across health care settings.

Statistical analyses
Initial principal component analysis and descriptive statistics were performed with IBM SPSS Statistics 23 and EFA was conducted with SAS 9.3.

The sample of 1587 participants in the present study exceeded the recommended 5:1 participant-to-item ratio and 200 participant minimum (Howard, 2016). The large sample size took into account the small number of items per factor (<5) in the 40-item PHCE scale (Gaskin and Happell, 2014) as well as potentially weak item communalities (<0.40) (Costello and Osborne, 2005), which would indicate that the factor model accounted for a small amount of variance in those items (Tabachnick and Fidell, 2013). Missing values were not imputed, as imputation with estimated values may result in overfit data and artificially high correlations (Tabachnick and Fidell, 2013). Instead, listwise deletion was employed to delete every case with one or more missing items.

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity were first calculated with the 1587 participants to assess whether factor analysis was warranted (Howard, 2016). A KMO value of 0.80 or above, on a range of 0–1, indicates that the items share a common factor and factor analysis is supported (Kellar and Kelvin, 2013).

An initial principal component analysis to calculate eigenvalues was conducted, and the number of factors to extract was identified with the assistance of web-based parallel analysis (Patil, 2008). Parallel analysis compares eigenvalues calculated from the actual data to eigenvalues generated on the basis of random data matrices matched to the actual data on sample size and number of factor analysis items.
(Patil et al., 2008). The number of factors to extract is equal to the number of eigenvalues in the actual data that are greater than the corresponding eigenvalues in the random data.

A first EFA was then conducted using unweighted least squares with polyehoric correlations, a method recommended when extracting factors from ordinal data (Basto and Pereira, 2012; Gaskin and Happell, 2014). We selected promax oblique rotation given that oblique rotation methods allow the derived factors to be correlated (Costello and Osborne, 2005), consistent with our assumption of correlations between factors in the present study.

We compared several factor solutions to identify the ‘cleanest factor structure’ in terms of data and theoretical fit (Costello and Osborne, 2005: 3). Items were initially assessed for retention on the basis of the 0.40–0.30–0.20 rule: primary factor loadings ≥0.40, secondary factor loadings <0.30, and ≥0.20 difference between primary and secondary loadings (Howard, 2016). Any remaining items with low communalities between 0.20 and 0.40 (Gaskin and Happell, 2014) indicated that the factor solution accounted for a low proportion of variance in these items (Tabachnick and Fidell, 2013). These items were evaluated for their theoretical contribution to the overall model, and considered for removal (Costello and Osborne, 2005). Furthermore, factors that consisted of only two items were considered for removal on the basis of their correlation with each other as well as with other items in the factor model (Tabachnick and Fidell, 2013).

A second EFA was conducted with the items remaining after the first EFA. We report the mean item scores and standardized Cronbach’s α coefficients for the final PHCE subscales and overall scale, using a cut-off point of 0.70 as evidence of adequate internal consistency reliability (Nunnally and Bernstein, 1994).

Results

Sample characteristics

As shown in Table 1, the majority of included participants were female, RNs, staff nurses, had attained a diploma as their highest level of education, were primarily employed outside of community-based health care settings, and were employed in communities with less than 10000 population. Included participants were 47.0 years of age on average (SD = 11.6) and had been registered to practice in Canada an average of 21.0 years (SD = 13.0).

Exploratory factor analysis

Based on principal component analysis with data from 1587 participants, the KMO measure (0.91) and significant Bartlett’s test of sphericity ($\chi^2 (780) = 23859.80, P = 0.000$) pointed to a strong association among the scale items, which supported the use of factor analysis. Parallel analysis suggested an eight-factor solution, with eigenvalues generated by principal component analysis exceeding random values (in brackets) for the first eight factors: 9.68 (1.34), 2.65 (1.31), 2.27 (1.27), 1.60 (1.25), 1.49 (1.23), 1.47 (1.21), 1.38 (1.19), 1.21 (1.17), 1.10 (1.16).

In the first EFA ($n = 1587$), we produced solutions of 5, 6, 7, 8, 9, and 10 factors for comparison. An eight-factor solution was optimal in terms of data fit as well as conceptual fit with the majority of the original subscales in the 40-item PHCE scale (Table 2). From the original 40 items, a total of 12 items were removed based on the 0.40–0.30–0.20 rule (Howard, 2016). First, 11 items with primary factor loadings <0.40 were removed, as well as one item (C3) with a low factor loading of 0.41 and a low communality of 0.19 (Table 3). Second, the secondary factor loadings of all 40 items were <0.30 and therefore no items were removed on the basis of this criterion. Third, of the 12 items removed, 10 also demonstrated a difference of <0.20 between their primary and secondary factor loadings.

With respect to the remaining 28 items with factor loadings ranging from 0.42 to 0.89, the majority demonstrated communalities in the recommended range (0.42–0.79). However, five items had communalities below 0.40, namely G1 and G4 (factor 3), F1 and F4 (factor 4), and C4 (factor 8). We made the decision to retain these five items given their theoretical contributions to the final scale.

The eight-factor solution (Table 2) included five factors (1, 2, 3, 5, and 7) that retained all of the items from five original dimensions (community participation, patient-centred care, intersectoral team, accessibility/availability, and interdisciplinary collaboration). Factor 4 included items that loaded from two separate original dimensions (population orientation and equity). Given that the population orientation items (D3 and D5) had higher loadings...
than the equity items (F1 and F4), and the equity items measured barriers between the community population and the participant's workplace, we preserved the label 'population orientation' for Factor 4 and dropped the label 'equity'. Factors 6 and 8 consisted of a reduced but sufficient number of items supporting two original dimensions (quality improvement and continuity) and were therefore retained. Although Factor 6 consisted of only two items, it was retained because these items were highly correlated with one another (>0.70) and uncorrelated or moderately correlated (<0.40) with other items. The factor loadings of items from the last original dimension (comprehensiveness) were <0.40, and as a result this factor was not included in the eight-factor solution. Therefore, the two original dimensions that were not included in the final eight-factor model were equity and comprehensiveness.

Based on the second EFA performed with the final 28 items, the total variance explained by the final eight-factor solution was 14.8%, with the proportion of variance explained by each factor 2.4%
Table 2  Factor loadings of items included in the eight-factor solution based on first exploratory factor analysis

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Item</th>
<th>Original subscale</th>
<th>Factor loadings</th>
<th>( h^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>E3</td>
<td>My workplace supports health care providers to think of the community as a partner in health care service delivery</td>
<td>Community participation</td>
<td>0.86  0.04 0.00  -0.11  0.02  0.01  0.01  -0.01  0.71</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>My workplace has implemented changes that emerged from community consultations</td>
<td>Community participation</td>
<td>0.84  -0.03 0.02  -0.06  0.02  0.05  0.01  -0.02  0.71</td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>Community members are treated as partners when deciding about health care service delivery changes in my workplace</td>
<td>Community participation</td>
<td>0.82  -0.03 -0.02  -0.07  0.06  0.00 -0.04  0.05  0.59</td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>My workplace does not seek input from the community about the health care services it needs (reversed)</td>
<td>Community participation</td>
<td>0.47  0.04 0.11  0.27 -0.02  0.00  0.00 -0.08  0.50</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Health care providers and/or staff in my workplace treat patients with respect and dignity</td>
<td>Patient-centred care</td>
<td>-0.03  0.77 -0.01  0.04  0.02  0.00 -0.02  0.01  0.60</td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>My workplace is a safe place for patients to receive health care services</td>
<td>Patient-centred care</td>
<td>-0.05  0.75 0.01 0.08 0.01 0.05 -0.04 0.05 0.61</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Health care providers and/or staff in my workplace are concerned with maintaining patient confidentiality</td>
<td>Patient-centred care</td>
<td>-0.01  0.69 0.04 -0.08 0.00 0.08 0.00 0.02 0.49</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>My workplace supports health care providers to think of patients as partners in their own care</td>
<td>Patient-centred care</td>
<td>0.11  0.61 0.06 -0.02 -0.02 0.09 -0.01 0.02 0.51</td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Community agencies meet on a regular basis to discuss common issues that affect health</td>
<td>Intersectoral team</td>
<td>0.01  0.02 0.78 -0.11 0.02 0.10 -0.06 -0.02 0.56</td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>There have been improvements in the way community services (eg, health, social, education) are now delivered, based on community agencies working together</td>
<td>Intersectoral team</td>
<td>0.09  0.00 0.70 -0.06 0.00 0.09 0.01 -0.07 0.59</td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>I work closely with community agencies (eg, education, government, law enforcement, civic facilities, non-profit groups)</td>
<td>Intersectoral team</td>
<td>-0.02  0.04 0.68 -0.10 0.03 -0.20 0.04 0.10 0.39</td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td>Health care providers in my workplace do not work closely with community agencies (eg, education, government, law enforcement, civic facilities, non-profit groups) (reversed)</td>
<td>Intersectoral team</td>
<td>0.02  0.04 0.55 0.14 0.03 -0.03 0.01 -0.06 0.38</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>There is a poor fit between the services in my workplace and the community’s health care needs (reversed)</td>
<td>Population orientation</td>
<td>0.22  0.04 -0.06 0.61 -0.05 -0.04 0.03 -0.04 0.49</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>My workplace is slow to respond to the health needs of the community (reversed)</td>
<td>Population orientation</td>
<td>0.16  0.09 -0.06 0.60 0.00 -0.07 0.00 -0.08 0.42</td>
<td></td>
</tr>
<tr>
<td>F1</td>
<td>Due to their individual or social characteristics (eg, poverty language, culture, ethnicity, sexual orientation, etc.), some patients have problems accessing the health care services offered in my workplace (reversed)</td>
<td>Equity</td>
<td>-0.16  0.07 -0.11 0.52 0.11 0.05 -0.02 -0.01 0.26</td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Some patients in my workplace do not receive the health care they need because they cannot afford it (eg, do not fill prescriptions, do not get recommended treatment such as physiotherapy, dental work, etc.) (reversed)</td>
<td>Equity</td>
<td>-0.14 -0.07 0.06 0.45 0.15 0.00 -0.11 0.08 0.21</td>
<td></td>
</tr>
<tr>
<td>Item no.</td>
<td>Item</td>
<td>Original subscale</td>
<td>Factor loadings</td>
<td>h²</td>
</tr>
<tr>
<td>---------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------</td>
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<td>-------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A3</td>
<td>Even if my workplace has closed for the day, patients can still see a health care provider <em>in person</em> from my workplace if they need urgent care</td>
<td>Accessibility/availability</td>
<td>-0.04</td>
<td>-0.06</td>
</tr>
<tr>
<td>A4</td>
<td>Even if my workplace has closed for the day, patients can still get medical advice from a health care provider in my workplace <em>by phone</em> if they need urgent care</td>
<td>Accessibility/availability</td>
<td>0.00</td>
<td>-0.07</td>
</tr>
<tr>
<td>A1</td>
<td>When my workplace is open, patients can see a health care provider the same day if they need urgent care</td>
<td>Accessibility/availability</td>
<td>0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>A2</td>
<td>The services in my workplace are organized to be as accessible as possible to as many patients as possible (eg, appointment times are flexible, extended hours of operation, walk-ins accepted, etc.)</td>
<td>Accessibility/availability</td>
<td>0.11</td>
<td>0.13</td>
</tr>
<tr>
<td>I2</td>
<td>My workplace regularly measures quality improvement</td>
<td>Quality improvement</td>
<td>0.02</td>
<td>0.09</td>
</tr>
<tr>
<td>I1</td>
<td>My workplace regularly uses patient health indicators to measure quality improvement</td>
<td>Quality improvement</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>H2</td>
<td>Health care providers from other disciplines in my workplace consult me regarding patient care (eg, family physicians, occupational therapists, social workers, etc.)</td>
<td>Interdisciplinary collaboration</td>
<td>0.00</td>
<td>-0.05</td>
</tr>
<tr>
<td>H1</td>
<td>In my workplace, there is a collaborative atmosphere between health care providers from different disciplines to provide health care services (eg, nurses, family physicians, occupational therapists, social workers, etc.)</td>
<td>Interdisciplinary collaboration</td>
<td>-0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>H3</td>
<td>Where there is overlap in responsibilities of health care providers from different disciplines in my workplace, it is understood who should take the lead for a particular patient’s care (eg, nurses, family physicians, occupational therapists, social workers, etc.)</td>
<td>Interdisciplinary collaboration</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>C2</td>
<td>I have easy access to information about my patients’ past health care provided by the health care providers <em>in my workplace</em></td>
<td>Continuity</td>
<td>0.02</td>
<td>0.19</td>
</tr>
<tr>
<td>C1</td>
<td>I have a good understanding of the health history of most of the patients I see</td>
<td>Continuity</td>
<td>-0.02</td>
<td>0.28</td>
</tr>
<tr>
<td>C4</td>
<td>I have easy access to information about my patients’ past health care provided by other health care providers <em>outside of my workplace</em></td>
<td>Continuity</td>
<td>-0.03</td>
<td>-0.12</td>
</tr>
</tbody>
</table>

Bold font indicates primary factor loadings.
Table 3  Factor loadings of items removed from the 8-factor solution based on first exploratory factor analysis

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Original subscale</th>
<th>Factor loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3</td>
<td>Continuity</td>
<td>-0.02 -0.08 -0.03 <strong>0.41</strong> -0.05 0.08 0.10 -0.03 0.19</td>
</tr>
<tr>
<td>D1</td>
<td>Population orientation</td>
<td>0.29 0.01 0.18 0.07 -0.03 0.15 -0.04 0.07 0.34</td>
</tr>
<tr>
<td>D2</td>
<td>Population orientation</td>
<td>0.13 -0.15 0.14 0.19 0.07 0.07 -0.05 <strong>0.35</strong> 0.35</td>
</tr>
<tr>
<td>D4</td>
<td>Population orientation</td>
<td>0.12 -0.12 0.02 0.11 0.08 <strong>0.32</strong> -0.06 0.26 0.32</td>
</tr>
<tr>
<td>F2</td>
<td>Equity</td>
<td>0.07 <strong>0.26</strong> 0.18 0.13 -0.02 -0.07 0.10 -0.06 0.25</td>
</tr>
<tr>
<td>F3</td>
<td>Equity</td>
<td>0.04 0.13 <strong>0.28</strong> <strong>0.28</strong> -0.03 0.00 0.07 -0.01 0.36</td>
</tr>
<tr>
<td>F5</td>
<td>Equity</td>
<td>-0.11 0.07 0.14 <strong>0.35</strong> 0.14 0.00 0.00 0.03 0.23</td>
</tr>
<tr>
<td>I3</td>
<td>Quality improvement</td>
<td>0.06 0.18 0.04 0.04 0.01 <strong>0.34</strong> 0.07 -0.03 0.29</td>
</tr>
<tr>
<td>I4</td>
<td>Quality improvement</td>
<td>0.00 0.14 -0.16 0.19 -0.01 <strong>0.20</strong> 0.01 0.02 0.12</td>
</tr>
<tr>
<td>J1</td>
<td>Comprehensiveness</td>
<td>0.02 0.04 0.06 0.15 -0.01 -0.01 <strong>0.24</strong> 0.06 0.17</td>
</tr>
<tr>
<td>J2</td>
<td>Comprehensiveness</td>
<td>0.06 0.01 <strong>0.23</strong> 0.18 -0.12 0.17 0.09 0.14 0.38</td>
</tr>
<tr>
<td>J3</td>
<td>Comprehensiveness</td>
<td>0.11 -0.03 <strong>0.20</strong> 0.18 -0.10 0.12 0.15 0.17 0.41</td>
</tr>
</tbody>
</table>

Bold font indicates primary factor loadings.
(community participation), 2.4% (patient-centred care), 2.1% (intersectoral team), 2.1% (accessibility/availability), 1.6% (interdisciplinary collaboration), 1.5% (quality improvement), 1.5% (population orientation), and 1.2% (continuity). The eight factors demonstrated moderate correlation (>0.30) between one another with the exception of: patient-centred care and quality improvement (0.27), continuity with all other factors except patient-centred care, and accessibility/availability with all other factors (Table 4).

Reliability and summary statistics

Internal consistency reliability was estimated by the Cronbach’s α coefficient, which was 0.89 for the final 28-item PHCE Scale (Table 5). Six of the final eight subscales demonstrated α estimates ranging from 0.77 to 0.88, which exceeded the recommended standard of 0.70 (Nunnally and Bernstein, 1994). The α estimates for two of the final eight subscales fell below 0.70, specifically continuity (α = 0.61) and population orientation (α = 0.61).

The mean item scores for the final 28-item PHCE Scale and eight subscales demonstrated low (3.1–4.0) to high agreement (4.1–5.0) among rural/remote nurses on workplace engagement in key dimensions of primary health care (Table 5). Mean scores ranged from a low of 3.1 (SD = 0.7) on intersectoral team indicating a low level of agreement that collaboration exists between the primary workplace and community sectors, to a high of 4.2 (SD = 0.6) on patient-centred care indicating high agreement that respect, safety, and confidentiality toward patients is present in the primary workplace. Overall, the mean PHCE Scale score of 3.6 (SD = 0.5) indicated low agreement that the primary workplaces of rural/remote nurses were engaged in primary health care delivery.

Discussion

The present study describes an evaluation to provide validity evidence for an instrument to measure workplace engagement in primary health care delivery. Evidence for the construct validity of conclusions that may be drawn from an instrument is generally derived from five sources, including the scale’s content and internal structure (Cook and Beckman, 2006). In an earlier study, we provided

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Community participation</th>
<th>Patient-centred care</th>
<th>Intersectoral team</th>
<th>Accessibility/availability</th>
<th>Interdisciplinary collaboration</th>
<th>Quality improvement</th>
<th>Population orientation</th>
<th>Continuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor correlation matrix of eight-factor solution based on second exploratory factor analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community participation</td>
<td>1.00</td>
<td>0.33</td>
<td>0.15</td>
<td>0.25</td>
<td>0.19</td>
<td>0.45</td>
<td>0.49</td>
<td>0.46</td>
</tr>
<tr>
<td>Patient-centred care</td>
<td>0.35</td>
<td>1.00</td>
<td>0.38</td>
<td>0.24</td>
<td>0.36</td>
<td>0.45</td>
<td>0.49</td>
<td>0.46</td>
</tr>
<tr>
<td>Intersectoral team</td>
<td>0.35</td>
<td>0.24</td>
<td>1.00</td>
<td>0.24</td>
<td>0.46</td>
<td>0.45</td>
<td>0.39</td>
<td>0.19</td>
</tr>
<tr>
<td>Accessibility/availability</td>
<td>0.35</td>
<td>0.33</td>
<td>0.38</td>
<td>1.00</td>
<td>0.38</td>
<td>0.24</td>
<td>0.49</td>
<td>0.46</td>
</tr>
<tr>
<td>Interdisciplinary collaboration</td>
<td>0.45</td>
<td>0.35</td>
<td>0.35</td>
<td>0.24</td>
<td>1.00</td>
<td>0.45</td>
<td>0.39</td>
<td>0.19</td>
</tr>
<tr>
<td>Quality improvement</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>1.00</td>
<td>0.25</td>
<td>1.00</td>
</tr>
<tr>
<td>Population orientation</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.25</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Continuity</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td>0.19</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Two of the subscales (population orientation and equity), and however, the remaining items were sufficient in number and demonstrated adequate loadings for the factors to be retained. The last of the eight factors consisted of items loading from two separate original subscales (population orientation and equity), and therefore the label that was consistent with the highest loading items was retained (population orientation). Lower than expected reliability estimates (α < 0.70) were demonstrated by two of the final factors (continuity and population orientation), which may be due to low correspondence between items or heterogeneity of concepts within the factors (Tavakol and Dennick, 2011).

The overall 28-item PHCE score provides a broad measure of workplace engagement in primary health care delivery, while the eight separate 2–4 item subscales allow measurement of particular aspects of PHC engagement. Higher scores on the PHCE Scale indicate a higher level of workplace participation in PHC delivery. The final 28-item scale directly represents three of four principles common to a contemporary approach to PHC (Henderson et al., 2014; White, 2015; Baum et al., 2016). Based on the results of EFA, the original 40-item PHCE Scale across 10 subscales was reduced to 28 items across eight factors. Five of the final eight factors retained all of the items proposed in the original subscales (community participation, patient-centred care, intersectoral team, accessibility/availability, and interdisciplinary collaboration). The factor loadings of these items were well above the recommended cut-off, and reliability estimates of the five factors were satisfactory (α > 0.70). Two of the final eight factors (continuity and quality improvement) lost items from the original subscales, however, the remaining items were sufficient in number and demonstrated adequate loadings for the factors to be retained. The last of the eight factors consisted of items loading from two separate original subscales (population orientation and equity), and therefore the label that was consistent with the highest loading items was retained (population orientation). Lower than expected reliability estimates (α < 0.70) were demonstrated by two of the final factors (continuity and population orientation), which may be due to low correspondence between items or heterogeneity of concepts within the factors (Tavakol and Dennick, 2011).

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Table 5 Summary statistics of final 28-item Primary Health Care Engagement (PHCE) scale and subscales

<table>
<thead>
<tr>
<th>Scale and subscales</th>
<th>Number of items</th>
<th>Mean (SD)</th>
<th>Range</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHC Engagement Scale</td>
<td>28</td>
<td>3.6 (0.5)</td>
<td>1–5</td>
<td>0.89</td>
</tr>
<tr>
<td>PHC Engagement subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality improvement</td>
<td>2</td>
<td>3.4 (0.9)</td>
<td>1–5</td>
<td>0.88</td>
</tr>
<tr>
<td>Community participation</td>
<td>4</td>
<td>3.3 (0.8)</td>
<td>1–5</td>
<td>0.86</td>
</tr>
<tr>
<td>Patient-centred care</td>
<td>4</td>
<td>4.2 (0.6)</td>
<td>1–5</td>
<td>0.83</td>
</tr>
<tr>
<td>Accessibility/availability</td>
<td>4</td>
<td>3.8 (1.0)</td>
<td>1–5</td>
<td>0.80</td>
</tr>
<tr>
<td>Intersectoral Team</td>
<td>4</td>
<td>3.1 (0.7)</td>
<td>1–5</td>
<td>0.78</td>
</tr>
<tr>
<td>Interdisciplinary collaboration</td>
<td>3</td>
<td>3.9 (0.7)</td>
<td>1–5</td>
<td>0.77</td>
</tr>
<tr>
<td>Continuity</td>
<td>3</td>
<td>3.7 (0.6)</td>
<td>1–5</td>
<td>0.61</td>
</tr>
<tr>
<td>Population orientation</td>
<td>4</td>
<td>3.3 (0.7)</td>
<td>1–5</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Scale scoring: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.
missing from the final PHCE Scale is comprehen-
siveness, the delivery ‘of a broad spectrum of
health and social services’ (Levesque et al., 2011: 23) considered essential to community-based/
oriented PHC. Although it is possible that as a
conceptual category, comprehensiveness may not
be an essential dimension of PHCE, it is more
likely that the items did not adequately capture the
complexity of this concept in the context of diverse
rural/remote patient populations.

Some study limitations must be acknowledged.
First, the proportion of participants that responded
‘not applicable’ was greater than 20% and as high
as 49% for eight of the original 40 items across
two subscales. We chose not to impute these ‘not
applicable’ responses and other missing values,
since including these values may have resulted
in artificially high correlations (Tabachnick and
Fidell, 2013). Six of these items remained in the final
28-item scale (A2, A3, and A4 in accessibility/
availability; G1, G2, and G3 in intersectoral team).
The high proportion of ‘not applicable’ responses to
the accessibility/availability items indicates that
some participants may view questions regarding
workplaces that ‘open’ and ‘close’ as irrelevant to
their practice context. These items may be more
relevant to community-based settings that offer
regular office hours and appointment times than to
institutional settings that offer 24/7 care. The high
proportion of ‘not applicable’ responses to the
intersectoral team items may reflect a ‘tyranny of
the acute’ organizational culture that places a low
emphasis on population health issues in some
workplaces, as well as challenges to working
intersectorally without formal supporting structures
in place (CIHI, 2014). However, accessibility/
availability and intersectoral collaboration are
principles of a contemporary approach to PHC and
therefore it is important and appropriate to retain
these items in the final 28-item PHCE Scale.

A second limitation is that we applied a stringent
listwise deletion criterion to exclude cases with at
least one missing item, resulting in a large number of
excluded cases ($n = 2235$). Participants employed in
community-based health care settings were more
likely to provide a valid response to all of the scale
items and to be included in the analysis than their
counterparts in institutional settings (eg, hospital,
long-term care). However, the majority of included
participants were employed outside of community-
based health care sites, indicating that the overall
PHCE Scale may be applicable across a range of
health care settings. We recommend the use of a
case mean imputation strategy (El-Masri and
Fox-Wasylyshyn, 2005) when employing the PHCE
Scale for purposes other than psychometric testing,
so as to obtain the maximum number of valid
responses (see the PHCE Scale in the Appendix for
specific imputation guidelines). Third, the study
sample included only regulated nurses working in
rural/remote Canadian communities, and as such
this limits the generalizability of our findings in
terms of professional discipline and geography.
Future research should evaluate the instrument
outside of these populations. Finally, the compre-
prehensive 27-page RRNI survey provided an oppor-
tunity to administer the original 40-item PHCE
Scale to regulated nurses working across rural/
remote Canada. However, the purpose of the survey
was to gather data on the overall nature of rural/
remote nursing practice across five wide-ranging
content domains such as work community and
nursing practice (MacLeod et al., 2017) and as such
we were unable to include other measures that may
be expected to correlate with the PHCE Scale.
Therefore, future research should focus on assessing
the relations between the 28-item PHCE Scale and
other variables, to provide further evidence of the
construct validity of conclusions drawn from the
scores (Cook and Beckman, 2006).

Conclusion

The most important finding of the present study is
that the results supported an eight-factor structure of
the PHCE Scale with 28 items in total, offering a
comprehensive measure of workplace engagement in
primary health care that is short and easy to admin-
ister. The scale is intended to be administered by
researchers and health care planners to any health
care provider likely to be involved in PHC delivery.

The 28-item PHCE Scale reflects the high
priority placed on community participation in
rural/remote PHC programs and services (Preston
et al., 2010), and the importance of community
participation in PHC more broadly as emphasized
in recent position papers (Henderson et al., 2014;
Canadian Nurses Association, 2015; White, 2015;
Baum et al., 2016) and PHC reform strategy
reports (Alberta Health, 2014; Saskatchewan
Ministry of Health, 2016). Although the scale may

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be more relevant to community-based than institutional health care settings such as hospitals and nursing homes, findings from the present study indicate that it is relevant to rural/remote providers from both settings. Further psychometric testing with a diversity of health care providers and settings is recommended.

Acknowledgements

The article stems from the study: ‘Nursing Practice in Rural and Remote Canada II’, led by Martha MacLeod, Norma Stewart and Judith Kulig (http://ruralnursing.unbc.ca). The authors are grateful to the nurses who responded to this survey and to Nadine Basto, M., Leana Garraway, and Larine Sluggett for their assistance with data analysis.

Financial Support

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Conflicts of Interest

None.

Ethical Standards

The ethics committees of the research team approved the RRNII survey: University of Northern British Columbia Research Ethics Board (E2013.0320.037.02), University of Saskatchewan (Behavioural Research Ethics Board Certificate of Approval), University of Lethbridge (Certificate of Human Participant research), Aurora College (Scientific Research License), University of Montreal (Hospital Maisonneuve-Rosemont), and Dalhousie University (Health Science Research Ethics Board letter of approval).

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Thomas, S., Wakerman, J. and Humphreys, J. 2014: What core primary health care services should be available to Australians living in rural and remote communities? *BMC Family Practice* 15, 143.


Appendix

Table A1  28-item Primary Health Care Engagement (PHCE) Scale

1. My workplace regularly uses patient health indicators to measure quality improvement
2. My workplace regularly measures quality improvement
3. My workplace does not seek input from the community about the health care services it needs
4. Community members are treated as partners when deciding about health care service delivery changes in my workplace
5. My workplace supports health care providers to think of the community as a partner in health care service delivery
6. My workplace has implemented changes that emerged from community consultations
7. Health care providers and/or staff in my workplace treat patients with respect and dignity
8. My workplace supports health care providers to think of patients as partners in their own care
9. Health care providers and/or staff in my workplace are concerned with maintaining patient confidentiality
10. My workplace is a safe place for patients to receive health care services
11. When my workplace is open, patients can see a health care provider the same day if they need urgent care
12. The services in my workplace are organized to be as accessible as possible to as many patients as possible (eg, appointment times are flexible, extended hours of operation, walk-ins accepted, etc.)
13. Even if my workplace has closed for the day, patients can still see a health care provider in person from my workplace if they need urgent care
14. Even if my workplace has closed for the day, patients can still get medical advice from a health care provider in my workplace by phone if they need urgent care
15. I work closely with community agencies (eg, education, government, law enforcement, civic facilities, non-profit groups)
16. Community agencies meet on a regular basis to discuss common issues that affect health
17. There have been improvements in the way community services (eg, health, social, education) are now delivered, based on community agencies working together
18. Health care providers in my workplace do not work closely with community agencies (eg, education, government, law enforcement, civic facilities, non-profit groups)
19. In my workplace, there is a collaborative atmosphere between health care providers from different disciplines to provide health care services (eg, nurses, family physicians, occupational therapists, social workers, etc.)
20. Health care providers from other disciplines in my workplace consult me regarding patient care (eg, family physicians, occupational therapists, social workers, etc.)
21. Where there is overlap in responsibilities of health care providers from different disciplines in my workplace, it is understood who should take the lead for a particular patient’s care (eg, nurses, family physicians, occupational therapists, social workers, etc.)
22. I have a good understanding of the health history of most of the patients I see
23. I have easy access to information about my patients’ past health care provided by the health care providers in my workplace
24. I have easy access to information about my patients’ past health care provided by other health care providers outside of my workplace
25. My workplace is slow to respond to the health needs of the community
26. There is a poor fit between the services in my workplace and the community’s health care needs
27. Due to their individual or social characteristics (eg, poverty language, culture, ethnicity, sexual orientation, etc.), some patients have problems accessing the health care services offered in my workplace
28. Some patients in my workplace do not receive the health care they need because they cannot afford it (eg, do not fill prescriptions, do not get recommended treatment such as physiotherapy, dental work, etc.)

Scoring: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree (including a ‘not applicable’ response option is not recommended).
Reverse items: 3, 18, 25, 26, 27, 28.
Subscales: quality improvement (1, 2); community participation (3, 4, 5, 6); patient-centred care (7, 8, 9, 10); accessibility-availability (11, 12, 13, 14); intersectoral team (15, 16, 17, 18); interdisciplinary collaboration (19, 20, 21); continuity (22, 23, 24); population orientation (25, 26, 27, 28).
Case mean imputation guidelines: in the four-item subscales, the case mean may be imputed where 25% or less of items is missing (ie, 1 item) (El-Masri and Fox-Wasylyshyn, 2005); if a participant’s subscale is missing two or more items, then that participant’s subscale should be discarded. Case mean imputation should not be performed in the two-item and three-item subscales; if a participant is missing one or more item, then that participant’s subscale should be discarded.

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