INTRODUCTION

In Switzerland and more particularly in the canton of Geneva, home care has a central place in the delivery of curative, preventive, educational and palliative care. The organization of home care is a response to the population's desire to stay at home for as long as possible and to receive home assistance and care services. With the ageing population, home care nurses are increasingly faced with patients with multiple clinical, chronic and fluctuating conditions (Valderas et al., 2009), who are at high risk of decompensation and hospital readmission (Joyce et al., 1981; Koné Pefoyo et al., 2015). These situations are alternatively characterized by “patient complexity” (Peek et al., 2009), “case complexity” (de Jonge et al., 2005), “care complexity,” “needs complexity” (de Jonge et al., 2006) or “practice complexity” (Davidson et al., 2011), suggesting that complexity is a multifaceted construct. Complexity can be broadly defined as a “multidimensional concept involving interactions between biological, socioeconomic, cultural, environmental and behavioral forces as health determinants” (Bonizzi et al., 2018). In the same vein, the World Health Organization (WHO, 2009) posits that “a complex system is one where there are so many interacting parts that it is difficult, if not impossible, to predict the behavior of the

RESEARCH ARTICLE

Tooling nurses to assess complexity in routine home care practice: Derivation of a complexity index from the interRAI-HC

Catherine Busnel¹ | Fanny Vallet¹ | Catherine Ludwig²

Abstract

Aim: Home care nurses often use the Resident Assessment Instrument-Home Care (interRAI-HC) to assess health needs. However, this tool does not assess complexity. This study proposes to derive a complexity index (CI) from the interRAI-HC using the operational definition of the dedicated COMID checklist (COMplexité Multidimensionnelle des prises en soins en Infirmières à Domicile).

Design: Data were collected at the baseline assessment of the fraXity study (N = 231, aged ≥ 65), which relied on an observational longitudinal design.

Methods: Measures were the interRAI-HC, from which the CI binary variables were computed and the COMID, used as a reference.

Results: Twenty-six CI variables were computed from the interRAI-HC, and all but three correlations were significant. The correlation between the CI score and the COMID score was ρ = 0.730 (p < .001).

Conclusions: The study demonstrates that complexity can be assessed directly from the interRAI-HC by deriving a CI.

KEYWORDS
assessment, complexity, home care, interRAI-HC, nurses, nursing

¹Research and Development Unit, Geneva Institution for Homecare and Assistance (imad), Carouge, Switzerland
²Geneva School of Health Sciences, HES-SO, University of Applied Sciences and Arts Western Switzerland, Geneva, Switzerland

Correspondence
Catherine Busnel, Research and Development Unit, Geneva Institution for Homecare and Assistance (imad), Avenue Cardinal Mermillod 36, 1227 Carouge, Switzerland. Email: catherine.busnel@imad-ge.ch

Funding information
fraXity study has financed by the Swiss National Science Foundation: Grant # 10001C_179453/1, and the Geneva Institution for Homecare and Assistance (imad) has also financed a 0.5 EFT of the research staff. The sponsors played no role in the study design, data analysis, decision to publish or preparation of the manuscript.
system based on a knowledge of its component parts. The term “complex situation” is often used by professionals in their practice and although it may cover heterogeneous realities and definitions, it consensually refers to the features of non-linear and dynamic systems (Plsek & Greenhalgh, 2001). Considering a biopsychosocial perspective (Engel, 1980), not only does the presence of one or multiple chronic diseases contribute to rendering situations complex, but also social and psychological dimensions. Contributing to this complexity is also the characteristics of the care, especially linked with the presence of multiple formal or informal actors who interact with each other and with the healthcare system, as well as the instability of the situation (Shippee et al., 2012). Complexity in care has developed either through the biomedical approach or through the determinants of health approach (vector model of complexity; (Safford et al., 2007)). In the home, these two approaches are important and need to be considered together (Johnson & Bacsu, 2018). Home care requires nurses to take a multidimensional, interdisciplinary and holistic approach. They must take into account factors intrinsic to the patient (health, religion, socioeconomic status), factors related to health professionals (physicians, nurses, others), factors related to the delivery of care, organizational factors, the team environment (structure, planning) and political factors. The nurse must mobilize in his or her practice “complex thinking,” “complexity assessment” (assessment of multidimensionality) and “complex acting” (interdisciplinarity and interprofessionality) (Richard et al., 2012). Complexity is a construct that concerns the person, the environment, health and care, and as such, complexity can be understood in the light of the nursing metaparadigm (Busnel et al., 2020; Fawcett, 1984).

To face the challenges of complexity in daily nursing practice, some models have been developed, such as the chronic care model (Bodenheimer et al., 2002), to anticipate and coordinate care management and to avoid therapeutic incoherence, which is resource-consuming. Some tools have been developed to assess complexity, but they are mostly designed for use by physicians (Huyse et al., 1999) in hospital settings (Stiefel et al., 2006). In the current care practice less-centred on the hospital model and more on ambulatory and domiciliary care, few instruments enable evaluating complexity. To our knowledge, the only instrument available for home care nurses is a multidimensional complexity assessment instrument, known as the COMID (abbreviation for the French locution “COMplexité Multidimensionnelle des prises en soins Infirmières à Domicile,” or in English, Multidimensional Complexity Assessment Instrument for Home Nursing Practice) (Busnel et al., 2018). Currently, nurses are using the COMID as a complement to the routine comprehensive health assessment. Specifically, the COMID consists of a 30-item checklist coding for the presence or absence of characteristics of “case complexity” (medical circumstances, socioeconomic circumstances, aggravating mental circumstances and aggravating behaviour), “care complexity” (circumstances of care delivery) and “instability.” Home care nurses who intervene regularly at patients’ homes are in the primary position to assess the whole situation of the patients and their needs with regard to the context to plan and coordinate the care. Given the amount of information the nurse has to consider when establishing an intervention plan, some instruments were developed in clinical practice to assess the needs of the patient and to support clinical reasoning. One of these standardized instruments is the Resident Assessment Instrument-Home Care (interRAI-HC), widely used to evaluate the needs of the patients requiring care at home in various domains of health (e.g. pain and behaviour). The interRAI-HC is an instrument dedicated to comprehensive geriatric assessment. The RAI-HC is used by nurses to evaluate each new patient’s care and to regularly re-evaluate patients in long-term care. To structure this data collection, the minimal data set (MDS) of the interRAI-HC is accompanied by alerts and scales targeting various health conditions (Morris et al., 1999). Interestingly to the present purpose, the interRAI-HC does not offer a specific indicator/alert on complexity. These alerts and scales serve to support clinical reasoning in alerting the nurse about a potential risk in a given domain and in guiding the nurse’s analysis to make decisions about further investigation requirements or care needs.

In addition to these implemented alerts and scales, research on relevant concepts in the domains of gerontology and/or of care (Armstrong et al., 2010; Morris et al., 2016) has developed the derivation of other clinical indicators or indexes, with the aim of saving time and avoiding the use of additional external scales. Such indexes give extra information to the nurse, who analyses it and may adapt the care plan accordingly. Among the proposed indexes, a frailty score is gaining popularity (Hubbard et al., 2015; Ludwig & Busnell, 2017, 2020; Searle et al., 2008). The purpose of developing the frailty index was to facilitate the detection of frail patients and to foster a careful analysis of their needs to prevent functional decline. The derivation of an index aims at structuring the data collection in the clinical context to help nurses in their routine assessments. The role of home care nurses to provide care in a coordinated and meaningful way can increasingly be challenged by the presence and interactions of multiple factors, resulting in a complex pattern of patients, patients’ needs and care that may render the clinical analysis of the situation difficult. Therefore, nurses need to be equipped with instruments supporting the detection, synthesis and analysis of the situational elements that contribute to complexity. However, complexity is rarely operationalized and few tools are adapted to the home care nursing context (e.g. the COMID) (Busnel et al., 2018; Vallet et al., 2019). The aim of this study was to propose a computation algorithm to derive a complexity index (CI) from the interRAI-HC that complies with the operational definition of complexity provided by the COMID. The value of the proposed approach is to provide nurses with a complexity score directly available in routine assessments (with the interRAI-HC), hence fostering coherence and saving time (avoiding the need to use an additional COMID assessment). Explicitly stated, the research question addressed by the study is “Can the interRAI-HC be used to derive a complexity index (CI) that complies with the operational definition of complexity provided by the COMID?” Answering this question first implies identifying a set of interRAI-HC items that allow for creating scores that mirror the content of the COMID and second, to test the proposed values against the corresponding ones obtained with the COMID.
METHODS

2.1 | Design

The data used to derive the CI from the interRAI-HC and to validate the score against the COMID were collected at the baseline assessment of the fraXity study (Ludwig & Busnel, 2019) from 30 October 2018–12 May 2019. fraXity is an observational longitudinal study; its protocol is extensively described elsewhere (Ludwig & Busnel, 2019).

2.2 | Setting and sample

A sample of 231 individuals aged 65 years or older living in the community were enrolled in the fraXity study (Ludwig & Busnel, 2019). Participants lived in private dwellings in the canton of Geneva, Switzerland. They were fluent in French and free of major cognitive or communication deficits. All participants volunteered and gave written informed consent for participation. From the fraXity sample, 216 participants (mean age = 79.35, SD 8.1, 78.2% females) were considered for the present analysis.

2.3 | Data sources and measurement

Data were collected through interviews at the participants’ homes in conditions as close as possible to real clinical conditions. Nurses were trained in the use of the instruments included in the protocol. Among other measures, the instruments included the interRAI-HC and the COMID, collected during a single interview conducted by a nurse.

Data used to derive the CI were collected from the French Canadian interRAI-HC (edition v.9.1) (Morris et al., 2009) as used in the fraXity study. The instrument belongs to the RAI instrument suite developed by the interRAI consortium (https://www.interrai.org/). The interRAI-HC is designed as a tool guiding comprehensive geriatric assessment and is available in many languages. All these national/local versions rely on a common structure and a common item coding system to foster coherence and comparability. The interRAI-HC covers 19 health-related domains: (A) administrative information; (B) living conditions; (C) cognition; (D) sensory abilities; (E) health-related behaviours; (F) social behaviours; (G) activities of daily living; (H) continence; (I) medical diagnoses; (J) falls, physical abilities, physical symptoms and pain; (K) nutrition; (L) skin and feet problems; (M) medication; (N) ongoing therapies and formal care; (O) advanced care instructions and legal representation; (P) informal care; (Q) living environment; (R) observed change in activities of daily living; and (S) record information. The instrument embeds 24 clinical assessment protocols and 18 clinical scales. In the clinical setting of the study, the interRAI-HC is routinely used by nurses to evaluate the care needs of each home care patient at admission and in routine reassessments.

Another instrument analysed in the present study was the COMID, which was considered a standard from which to choose the different interRAI-HC items to compose the CI variables. The COMID is an instrument for assessing multidimensional complexity in home care nursing practice and is completed by home care nurses in addition to a comprehensive health assessment to support their clinical analysis of complexity. Based on factors identified in the literature, the COMID was developed to provide an operational definition of complexity by identifying variables that contribute to the complexity of home care situations. It is a checklist of 30 binary items, with 5 items in each of the 6 complexity domains (medical health factors, social and economic factors, mental health factors, behavioural factors, instability factors and factors related to care providers and the care system). The COMID, developed in French (an English version is also available at https://comid.imad-ge.ch/), has shown good acceptability (Busnel et al., 2018) and reliability (Vallet et al., 2019). Based on their clinical assessment of a given situation, nurses code 1 (“yes”) if the item is present or 0 (“no”) if it is absent. In its original version, the total COMID score is calculated by summing the “yes” responses over the 30 items (COMID-30) and can range from 0–30, with a higher score indicating a greater accumulation of factors contributing to the complexity of a situation.

2.4 | The complexity index variables derived from the interRAI-HC

The principle used for creating the complexity index (CI) was to first identify variables in the interRAI-HC that mirror the COMID items. For each COMID item, one or more interRAI-HC items were combined to find the best proxy. Each of the interRAI-HC candidate items was used only once. Some CI variables were composed of single interRAI-HC items when they were similar or very close to the formulations used in the COMID variable (e.g. financial difficulties). For other CI variables, a combination of several items fit the definition of the COMID variable. For instance, the CI variable 2d, a situation where patients live alone and have few social interactions or who report a change in social activities, fits the definition of social isolation. The choice of the interRAI-HC items used to compute the CI variables, as well as their best combination to mirror the COMID, relied on a consensus-reaching approach involving two clinical experts. Ultimately, each variable composing the CI was binary. In case of divergent opinions across experts, phi tests were conducted to assess the link between a given CI variable and its corresponding COMID variable. The combination with the highest coefficient value was selected.

A total of 26 CI variables were created, and four variables of the COMID items, linked with the care providers and the care system dimension, could not be derived from the interRAI-HC. These items were 6b, absence or low degree of partnership between the different actors; 6c, therapeutic incoherence; 6d, health insurance problems; and 6e, emotional and/or physical burden perceived by the secondary network.

Table 1 presents the selected computation used to create each of the 26 CI variables. As the version of the interRAI-HC used in
fraXity is comparable to the Standard English edition v.9.1.2, the coding used to create the CI was employed for the standard version to be used by as many people as possible (all details about the formula and the specificity of coding in fraXity are presented in Table S1). The total complexity score was calculated by summing the 26 variables composing the CI, for a total score ranging from 0–26.

2.5 | Data analyses

Beyond the descriptive analyses presenting the distribution of frequency of responses for each CI variable (and comparatively for the COMID variables), phi tests were conducted to test the relationship between each of the 26 CI variables and its corresponding COMID variable. Given the number of phi tests that were conducted to assess the relationship between the CI variables and the COMID variables, the 5% risk of type I errors needed to be adjusted for multiple comparisons. Bonferroni’s correction was applied to adjust the p-value to the α = 0.05 threshold used to reject the null hypothesis. An adjusted p-value of .0019 was used (α/26, the number of CI variables). The internal consistency of the CI was tested with Cronbach’s alpha.

The correlation between the CI total score and the COMID total score was assessed by means of Spearman’s rank correlation coefficient. To be comparable with the CI total score, the total score of the COMID was computed by summing the “yes” responses on the 26 variables (COMID-26) from those used as a reference for the creation of the CI. It should be noted that because the number of “yes” answers for the four excluded COMID items was low (i.e. it did not exceed 7, being 3.2%, for the item 6e, emotional and/or physical burden perceived by the secondary network), this should not have a strong impact on the total score.

Missing data on the relevant variables considered to compute the CI variables and their correlations with the COMID (i.e. any missing data on the CI variables or on the COMID-30 variables: N = 15, representing 6.5% of the whole sample) were not replaced. Analyses were conducted using the list-wise deletion method.

2.6 | Ethics

The study protocol was approved by the Ethics Committee of the canton of Geneva, Switzerland (affiliated with 253 Swissethics) on 7 August 2018 (registration number: 2018-01039). The study protocol was a prospective observational design using coded data on non-genetic personal health data.

3 | RESULTS

3.1 | Participants

From the fraXity sample of 231 participants, only those with full data on every item of the CI and the COMID were retained for the analyses (N = 216). This final sample was aged from 65–97 (mean age = 79.35, SD 8.1), with 78.2% females.

3.2 | Complexity Index

3.2.1 | CI variables: description and comparison with COMID variables

Descriptive analyses for each of the CI variables and its corresponding COMID variable are presented in Table 2. The number of “yes” responses (i.e. element coded as problematic) was different between the CI variables. Some variables were frequently rated “yes” (e.g. 1b, chronic pain: N = 155 “yes”), and others were rarely or never rated “yes” (e.g. 4e, resistance or opposition to care; N = 0 “yes”). The number of “yes” responses was relatively similar between the CI and the COMID for several variables, with some exceptions (e.g. 1a, chronic diseases).

The phi tests (Table 2) showed that 23 CI variables correlated significantly with the corresponding COMID variables, and the phi test for one variable (i.e. 4e, resistance or opposition to care) was not calculated because the number of “yes” responses on the CI was 0. The highest values for phi tests (>0.50) were obtained for 1a, chronic diseases; 1b, chronic pain; 1c, allergies/drug intolerances; 1d, polymedication; 2a, financial difficulties; and 3c, addiction. The lowest and non-significant values (≤0.20) were obtained for 4a, recurring solicitations, and 5c, transition period.

Complementary results about the number of “yes” responses and phi tests obtained for the whole sample using all the available data for each analysis (i.e. pairwise deletion method) are presented in the Table S2. Globally, these results presented no major differences with the pairwise deletion method, as the values of the phi tests were largely comparable.

3.2.2 | Internal consistency

The CI exhibited an acceptable internal consistency (Cronbach’s alpha = 0.689), comparable with that of the COMID-26 (Cronbach’s alpha = 0.763) and the original version of the COMID (COMID-30, Cronbach’s alpha = 0.770).

3.2.3 | CI total score: description and comparison with the COMID total score

Regarding the total scores, the CI total score had a mean = 4.49 (SD 3.04, Min = 0, Max = 14), which was higher than the mean of the COMID-26 = 3.34 (SD 2.94, Min = 0, Max = 17). This suggests that the CI (just like several CI variables) was more sensitive than the COMID.

The correlation between the CI and COMID-26 was significant, with Spearman’s rank coefficient correlation of ρ = 0.730, p < .001.
### TABLE 1 Correspondence between the COMID items and interRAI-HC items used for the derivation of the Complexity Index

| COMID | Item | Var. label | interRAI-HC | Item | Var. description |
|-------|------|------------|-------------|------|-----------------|
| 1a    | Several chronic diseases (more than 2) and/or unexplained symptoms | I1c, I1d, I1f, I1h, I1j; I1k, I1l, I1m, I1t, I1u, BMI (K1b, K1a), J3u, J4, J2 | More than 2 chronic diseases among a list of 13 diseases (plus one disease counted for any response in the question “other diagnostic”) |
| 1b    | Chronic pain | J6a | Any pain |
| 1c    | Any allergies and/or drug intolerances | M2 | A known drug allergy |
| 1d    | Polymedication | M1f (M2f, M3f, M4f, M5f, etc.) | Five or more substances regularly taken |
| 1e    | Cognitive deficits | C2a, C1, C2b, C2c | Short-term memory problem and at least one another deficit among the following cognitive functions: decision-making, procedural memory or long-term memory |
| 2a    | Financial difficulties and/or an inability to afford the services of assistance, care, treatments, auxiliary devices, a means of transportation and/or a food supply | Q4 | Financial difficulties |
| 2b    | No informal care, an exhausted informal caregiver and/or family tensions | P1a1, P1a2, P4, P2a, P2b, P2c | No informal caregiver/helper and no supportive relationship with family OR a caregiver/helper who is unable to continue his/her help or reports distress/anger or is overwhelmed |
| 2c    | Low level of literacy (related to alphabetization issues, language and/or cultural barriers) | D2 | Not good and clear understanding |
| 2d    | Social isolation | A13a, F1b, F1c, F3 | Living alone and: not visiting or receiving visits from family and friends and not having other interactions during the last 3 days, or a change in social activities |
| 2e    | Inadequate housing and/or environmental barriers | Q1a, Q1b, Q1e | Any problem with (or uncertainty about) degradation, squalid conditions or limited access to housing |
| 3a    | Depression and/or suicidal ideation | I1p, E2c | Diagnostic of depression or self-reported depressed mood |
| 3b    | Psychiatric diseases and/or mental disorders (delusions, hallucinations, etc.) | J3g, J3h, J3i, I1q, I1o | Any symptoms of abnormal thought process, delusions or hallucinations, or a diagnosis of psychosis or bipolar disorder |
| 3c    | Addiction | J9a, J9b | Daily smoking or consumption of at least 5 drinks of alcohol in one go |
| 3d    | Anxiety or anguish that renders the clinical picture unclear | I1n, E2b | Diagnostic of anxiety or self-reported anxious mood |
| 3e    | Variations in mental function during the day | C3c | Mental function varies over the day |
| 4a    | Recurring solicitations of the primary and/or secondary network | E1e | Repetitive anxious complaints |
| 4b    | Ambivalent and/or conflictual communication with a member of the primary and/or secondary network | F1d, E1b | Conflicts/angry with friends or family and a perpetual anger against oneself or others |
| 4c    | Worries about symptoms, health conditions, and/or medical information | E1d | Repetitive health complaints |
| 4d    | Aggressiveness (verbal and/or physical) or mutism | E3b, E3c | Any manifestation of verbal or physical aggressiveness |
| 4e    | Resistance or opposition to care, whether active or passive | E3f | Manifestation of resistance to care |
| 5a    | Recent degradation of health status perceived by the patient | J7b | Experiencing an acute crisis or flare-up of a recurrent or chronic problem |
| 5b    | Overall change in the degree of independence (ADL/IADL) in the last month | G6, R2 | Deterioration (or uncertainty) of the ADL performance or a significant change in general independence |

(Continues)
TABLE 1 (Continued)

| COMID Item | Var. label | interRAI-HC Item | Var. description |
|------------|------------|-----------------|-----------------|
| 5c         | Transition period (ex. announcement of diagnosis, hospital discharge, death of caregiver, divorce, work, etc.) | F5, A14, A13b | Major life stressor or hospitalization or change in the household composition |
| 5d         | Acute change in cognitive abilities | C5 | Deterioration (or uncertainty) of the decision-taking capacities during the last 3 months |
| 5e         | Unpredictability of health status (unusual symptoms, decompensation of a chronic disease, wounds, pain, etc.) | J7a, J7c, C4, N4b | Health conditions or diseases making cognitive state, ADL, mood or behaviour patterns unstable or end-stage disease or acute change in the mental state with regard to the usual functioning, or at least two visits to the hospital emergency |
| 6a         | Multiple care providers in the secondary network (primary care doctors, medical specialists, formal caregivers, curators, etc.) | N3aA, N3bA, N3cA, N3dA, N3eA, N3fA, N3gA, N3hA, O1 | At least three providers |

Abbreviations: ADL, activities for daily living; IADL, instrumental activities for daily living.

4 | DISCUSSION

4.1 | Derivation of a CI

This aim of the study was to derive a CI from the interRAI-HC based on the operational definition of complexity from the literature used to create the COMID. After a careful selection of interRAI-HC items, 26 CI variables were computed—using different methods of computation—to match 26 out of the 30 COMID binary variables. When the correspondence between the CI variables and the COMID ones was assessed, the results were satisfying. The correlation tests were significant for 23 variables, and the phi values were substantial. For the two non-significant phi values (i.e. 4a, recurring solicitations, and 5c, transition period) and the one correlation that could not be calculated (i.e. 4e, resistance or opposition to care), further testing on other samples would be needed and some adjustments might be necessary. Nevertheless, taken together, correlational analyses support the combinations chosen to create the CI variables. Otherwise, the internal consistency of the CI was high (i.e. 0.689) and similar (i.e. <0.1 difference) to that of the COMID. The total score of the CI, corresponding to the sum of the CI variables, was strongly and significantly correlated with the COMID-26 total score. These results mean that the CI total score presented an acceptable reliability similar to that of the COMID and shares a large part of its variance with the checklist. Overall, the results of this study support the possibility to create a CI based on 26 variables that complies with the operational definition of complexity of the COMID. The variables and the CI score demonstrate suitable characteristics (i.e. internal consistency comparable with that of the COMID, a large number of significant correlations), and as a whole, the study can be viewed as a proof of concept supporting the derivation of a CI from the interRAI-HC MDS.

4.2 | Clinical application

The creation of a CI follows the creation of other indexes from the interRAI-HC, offering a new index assessing complexity but different conceptually and in its computation from other indexes derived from interRAI instruments. As complexity is often conceptualized but rarely measured, creating a CI from the interRAI-HC is a unique opportunity to assess complexity based on existing and widely used instruments.

In clinical practice, the possibility to create the CI variables automatically should help nurses to detect complex situations and to orientate the assessment and analysis of the elements contributing to the complexity. To enable routine use, it will be necessary to develop the CI as an alert by complementing the algorithm with clinical assessment protocols. When the CI variables alert the nurses about the risk of complexity of a situation, it would be possible to complement this by filling in a tool, such as the COMID. This would enable evaluation of the nurse’s clinical analysis of the situation and deepen the assessment of care system complexity factors not entirely included in the CI. This process could also lead to the evaluation of specific aspects of the situation (e.g. informal caregiver exhaustion, pain). Finally, this should allow nurses to analyse the complexity more precisely to discuss interprofessional coordination and specify the care plan. The international nature of the interRAI-HC and the common structure and coding across instruments allow for deriving a CI from virtually all available versions, hence fostering international dissemination of results and comparisons across different countries.

4.3 | Limitations

The findings are very encouraging, yet the study suffers from several limitations that need to be addressed. First, all participants volunteered to take part in the study, which is a bias—accounting for lower complexity levels—that cannot be excluded. In this sense, it was observed that the percentage of “yes” responses on the COMID was descriptively lower than that previously found in a clinical population receiving home care (Vallet et al., 2019). Replication of the study with a clinical sample of home care recipients would be necessary to overcome this limit. Doing so would allow for assessing the validity.
of the proposed algorithm based on clinical situations and everyday complexity as encountered routinely by home care nurses.

Another limitation concerns the quality of the nurses’ appraisal of each situation. Indeed, the appraisal required in the fraXity study substantially differs from a routine appraisal where the nurse has become an “expert” of her patients. Although the study protocol fits the clinical situation and possible (i.e. visits at home, the completion of the interRAI-HC and then the COMID, as is done in clinical contexts), nurses in clinical practice usually have better knowledge of the situation because in addition to assessment, they also provide patient care. Again, replicating the study with a clinical sample, in a routine home care setting, would allow for addressing this drawback.

| TABLE 2 | Number of “yes” answers for the COMID items, the corresponding values for the CI and the results of the phi test (coefficient, p-value) assessing the correlation between each pair |
|----------------|----------------|----------------|----------------|
| Short title of the variable | COMID | CI | Correlation (phi, p-value) |
| No | Yes | No | Yes |
| 1a. Chronic diseases | 110 | 106 | 140 | 76 | 0.52, p < .001 |
| 1b. Chronic pain | 73 | 143 | 61 | 155 | 0.84, p < .001 |
| 1c. Allergies/drug intolerances | 162 | 54 | 159 | 57 | 0.89, p < .001 |
| 1d. Polymedication | 131 | 85 | 126 | 90 | 0.82, p < .001 |
| 1e. Cognitive deficits | 197 | 19 | 168 | 48 | 0.38, p < .001 |
| 2a. Financial difficulties | 204 | 12 | 193 | 23 | 0.64, p < .001 |
| 2b. Absence or exhaustion of informal caregiver | 195 | 21 | 167 | 49 | 0.38, p < .001 |
| 2c. Low level of literacy | 208 | 8 | 197 | 19 | 0.29, p < .001 |
| 2d. Social isolation | 191 | 25 | 186 | 30 | 0.32, p < .001 |
| 2e. Inadequate housing | 193 | 23 | 195 | 21 | 0.44, p < .001 |
| 3a. Depression and/or suicidal ideation | 198 | 18 | 167 | 49 | 0.48, p < .001 |
| 3b. Psychiatric diseases | 212 | 4 | 208 | 8 | 0.34, p < .001 |
| 3c. Addiction | 202 | 14 | 197 | 19 | 0.52, p < .001 |
| 3d. Anxiety or anguish | 200 | 16 | 155 | 61 | 0.37, p < .001 |
| 3e. Mental function varies over the day | 209 | 7 | 210 | 6 | 0.45, p < .001 |
| 4a. Recurring solicitations | 206 | 10 | 190 | 26 | -0.01, p = .839 |
| 4b. Ambivalent and/or conflictual communication | 214 | 2 | 211 | 5 | 0.31, p < .001 |
| 4c. Worries about symptoms | 193 | 23 | 174 | 42 | 0.29, p < .001 |
| 4d. Aggressiveness | 214 | 2 | 212 | 4 | 0.35, p < .001 |
| 4e. Resistance or opposition to care | 214 | 2 | 216 | 0 | Not calculated |
| 5a. Recent degradation of health status perceived by the patient | 179 | 37 | 199 | 17 | 0.28, p < .001 |
| 5b. Change in the ADL/IADL | 201 | 15 | 184 | 32 | 0.40, p < .001 |
| 5c. Transition period | 194 | 22 | 149 | 67 | 0.20, p = .003 |
| 5d. Acute change in cognitive abilities | 210 | 6 | 205 | 11 | 0.35, p < .001 |
| 5e. Unpredictability of health status | 180 | 36 | 186 | 30 | 0.47, p < .001 |
| 6a. Multiple care providers | 205 | 11 | 190 | 26 | 0.37, p < .001 |
| Original COMID items | | | |
| 6b. Absence or low degree of partnership between the different actors | 214 | 2 | |
| 6c. Therapeutic incoherence | 216 | 0 | |
| 6d. Health insurance problems | 214 | 2 | |
| 6e. Emotional and/or physical burden perceived by the secondary network | 209 | 7 | |

Abbreviations: ADL, activities for daily living; IADL, instrumental activities for daily living.

The study reported here demonstrates that a CI can be derived from the interRAI-HC, hence tooling up nurses with a means to assess
complexity in clinical home care routines. The results can be viewed as a proof of concept, yet they call for replications in larger, clinical samples.

The interRAI-HC is an instrument used internationally in clinical home care practice. Thus, the CI has an important potential for implementation and for further studies to test it on clinical samples, as well as to assess the psychometric characteristics of the CI, with a special interest in its predictive validity on adverse health outcomes.

The interRAI-HC is rich enough in its data set to reconsider patient issues and resources through the concept of complexity in a less linear approach. From this, too, it is possible to tool the nurses to identify complex situations. The development of guidelines will enable a generalized understanding and use, positioning the nurse even more as an essential actor in the health system (Busnel et al., 2020).

ACKNOWLEDGEMENTS

The authors acknowledge the contribution of volunteered participants. They thank the fraXity staff—Sophie Bontemps, Tobias Burckhardt, Michael Cennamo and Debora Verissimo—for their rigorous involvement in the recruitment of participants, for the data collection and for their valuable reflexive clinical inputs. Finally, the authors thank the Geneva School of Health Sciences, HES-SO and the imad for their institutional support for the fraXity study.

CONFLICT OF INTEREST

The authors declare they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

CB and CL: Study concept and design. CL and CB: Acquisition of data. FV, CB and CL: Analysis and interpretation of data. CB and FV: Drafting of the article. CL: Critical revision of the manuscript. All authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data sets generated (coded, free of personal information), used and analysed during the fraXity study will be deposited at the end of the study at DARIS/FORS (http://forscenter.ch) for data sharing and reuse purposes. FORS/DARIS complies with the FAIR (findable, acceptable, interoperable, reusable) principles.

ORCID

Catherine Busnel 🔗 https://orcid.org/0000-0002-0165-022X
Catherine Ludwig 🔗 https://orcid.org/0000-0003-4634-2092

REFERENCES

Armstrong, J. J., Stolee, P., Hirdes, J. P., & Poss, J. W. (2010). Examining three frailty conceptualizations in their ability to predict negative outcomes for home-care clients. Age and Ageing, 39(6), 755–758. https://doi.org/10.1093/ageing/afq121

Bodenheimer, T., Wagner, E. H., & Grumbach, K. (2002). Improving primary care for patients with chronic illness: The chronic care model, part 2. JAMA, 288(15), 1909–1914. https://doi.org/10.1001/jama.288.15.1909

Bonizzoni, E., Gussoni, G., Agnelli, G., Antonelli Incalzi, R., Bonfanti, M., Mastroianni, F., Candela, M., Franchi, C., Frasson, S., Greco, A., La Regina, M., Re, R., Vescovo, G., & Campanini, M. (2018). The complexity of patients hospitalized in Internal Medicine wards evaluated by FADOI-COMPLIMED score(s). A hypothetical approach. PLoS One, 13(4), e0195805. https://doi.org/10.1371/journal.pone.0195805

Busnel, C., Ludwig, C., & Da Rocha Rodrigues, M. G. (2020). [Complexity in nursing practice: Toward a new conceptual framework in nursing care]. La complexité dans la pratique infirmière: Vers un nouveau cadre conceptuel dans les soins infirmiers. Recherche En Soins Infirmiers, 140, 7–16. https://doi.org/10.3917/rsi.140.0007

Busnel, C., Marjollet, L., & Perrier-Gros-Claude, O. (2018). [Complexity in home care: Development of an assessment tool dedicated to nurses and results of an acceptability study] Complexité des prises en soins à domicile: développement d’un outil d’évaluation infirmier et résultats d’une étude d’acceptabilité. Revue Francophone Internationale De Recherche Infirmière, 4, 116–123. https://doi.org/10.1016/j.refiri.2018.02.002

Davidson, A. W., Ray, M. A., & Turchel, M. C. (2011). Nursing, caring and complexity science: For human environment well-being. New York: Springer Publishing Company.

de Jonge, P., Huyse, F. J., Slaets, J. P., Solnier, W., & Stiefel, F. C. (2005). Operationalization of biopsychosocial case complexity in general health care: The INTERMED project. Australian and New Zealand Journal of Psychiatry, 39(9), 795–799. https://doi.org/10.1111/j.1440-1614.2005.01684.x

de Jonge, P., Huyse, F. J., & Stiefel, F. C. (2006). Case and care complexity in the medically ill. Medical Clinics of North America, 90(4), 679–692. https://doi.org/10.1016/j.mcna.2006.04.005

Engel, G. L. (1980). The clinical application of the biopsychosocial model. American Journal of Psychiatry, 137(5), 535–544. https://doi.org/10.1176/ajp.137.5.535

Fawcett, J. (1984). The metaparadigm of nursing: Present status and future refinements. Journal of Nursing Scholarship, 16(3), 84–89. https://doi.org/10.1111/j.1547-5069.1984.tb01393.x

Hubbard, R. E., Peel, N. M., Samanta, M., Gray, L. C., Fries, B. E., Mitnitski, A., & Rockwood, K. (2015). Derivation of a frailty index from the interRAI acute care instrument. BMC Geriatrics, 15(1), 27. https://doi.org/10.1186/s12877-015-0026-z

Huyse, F. J., Lyons, J. S., Stiefel, F. C., Slaets, J. P. J., de Jonge, P., Fink, P., Gans, R. O. B., Guex, P., Herzog, T., Lobo, A., C. Smith, G., & Strack van Schijndel, R. (1999). “INTERMED”: A method to assess health service needs. I. Development and reliability. General Hospital Psychiatry, 21(1), 39–48. https://doi.org/10.1016/S0163-8343(98)00057-7

Johnson, S., & Bacsu, J. (2018). Understanding complex care for older adults within Canadian home care: A systematic literature review. Home Health Care Services Quarterly, 37(3), 232–246. https://doi.org/10.1080/01621424.2018.1456996

Joyce, P. R., Khan, A., & Jones, A. V. (1981). The revolving door patient. Comprehensive Psychiatry, 22(4), 397–403. https://doi.org/10.1016/0010-440X(81)90024-9

Koné Pefoyo, A. J., Bronskill, S. E., Gunein, A., Calzavara, A., Thavorn, K., Petrosyan, Y., Maxwell, C. J., Bai, Y. Q., & Wodchis, W. P. (2015). The interRAI medical acute care instrument. BMC Public Health, 15(1), 415. https://doi.org/10.1186/s12889-015-1733-2

Ludwig, C., & Busnel, C. (2017). Derivation of a frailty index from the resident assessment instrument - home care adapted for Switzerland: A study based on retrospective data analysis. BMC Geriatrics, 17(1), 205. https://doi.org/10.1186/s12877-017-0604-3

Ludwig, C., & Busnel, C. (2019). Protocol of a case-control longitudinal study (fraXity) assessing frailty and complexity among Swiss home service recipients using interRAI-HC assessments. BMC Geriatrics, 19(1), 207. https://doi.org/10.1186/s12877-019-1230-z

Ludwig, C., & Busnel, C. (2020). Derivation of a frailty index from the interRAI-HC to assess frailty among older adults 2 receiving home care...
and assistance (the “fraXity” study). Advances in Geriatric Medicine and Research, 2(2), 1–27. https://doi.org/10.20900/agmr20200013
Morris, J. N., Fries, B. E., Bernabei, R., Steel, K., Ikegami, N., Carpenter, I., & Belleville-Taylor, P. (2009). interRAI Home-Care (HC). Assessment form and user’s manual. Version 9.1. Standart Edition. Washington, DC: interRAI.
Morris, J. N., Fries, B. E., & Morris, S. A. (1999). Scaling ADLs within the MDS. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 54(11), M546–M553. https://doi.org/10.1093/gerona/54.11.m546
Morris, J. N., Howard, E. P., & Steel, K. R. (2016). Development of the interRAI home care frailty scale. BMC Geriatrics, 16(1), 188. https://doi.org/10.1186/s12877-016-0364-5
Peek, C. J., Baird, M. A., & Coleman, E. (2009). Primary care for patient complexity, not only disease. Families, Systems & Health, 27(4), 287–302. https://doi.org/10.1037/a0018048
Plsek, P. E., & Greenhalgh, T. (2001). The challenge of complexity in health care. British Medical Journal, 323(7313), 625–628.
Richard, L., Gendron, S., & Cara, C. (2012). Modélisation de la pratique infirmière comme système complexe: Une analyse des conceptions de théoriciennes en sciences infirmières. Aporia, 4(4), 25–39.
Safford, M. M., Allison, J. J., & Kiefe, C. I. (2007). Patient complexity: More than comorbidity. The Vector Model of Complexity. Journal of General Internal Medicine, 22(3), 382–390. https://doi.org/10.1007/s11606-007-0307-0
Searle, S. D., Mitnitski, A., Gahbauer, E. A., Gill, T. M., & Rockwood, K. (2008). A standard procedure for creating a frailty index. BMC Geriatrics, 8, 24. https://doi.org/10.1186/1471-2318-8-24
Shippee, N. D., Shah, N. D., May, C. R., Mair, F. S., & Montori, V. M. (2012). Cumulative complexity: A functional, patient-centered model of patient complexity can improve research and practice. Journal of Clinical Epidemiology, 65(10), 1041–1051. https://doi.org/10.1016/j.jclinepi.2012.05.005
Stiefel, F. C., Huyse, F. J., Söllner, W., Slaets, J. P. J., Lyons, J. S., Latour, C. H. M., van der Wal, N., & de Jonge, P. (2006). Operationalizing integrated care on a clinical level: The INTERMED project. Medical Clinics of North America, 90(4), 713–758. https://doi.org/10.1016/j.mcna.2006.05.006
Valderas, J. M., Starfield, B., Sibbald, B., Salisbury, C., & Roland, M. (2009). Defining comorbidity: Implications for understanding health and health services. Annals of Family Medicine, 7(4), 357–363. https://doi.org/10.1370/afm.983
Vallet, F., Busnel, C., & Ludwig, C. (2019). [Analysis of the reliability of a multidimensional complexity scale instrument (COMID) for home care nurses]. Analyse de la fidélité d’un instrument d’évaluation de la complexité multidimensionnelle (COMID) pour les infirmières à domicile. Recherche En Soins Infirmiers, 138(3), 53–64. https://doi.org/10.3917/rsi.138.0053
World Health Organisation (2009). WHO patient safety curriculum guide for medical schools. Geneva: WHO.

SUPPORTING INFORMATION
Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Busnel C, Vallet F, Ludwig C. Tooling nurses to assess complexity in routine home care practice: Derivation of a complexity index from the interRAI-HC. Nurs Open. 2021;8:815–823. https://doi.org/10.1002/nop2.686