Review

A scoping review and thematic classification of patient complexity: offering a unifying framework

Alexis K. Schaink1, Kerry Kulski1,5, Renée F. Lyons1,5, Martin Fortin2, Alejandro R. Jadad3, Ross Upshur4, Walter P. Wodchis5

1Bridgepoint Collaboratory for Research and Innovation, Bridgepoint Health, Toronto, ON, Canada; 2Centre de Santé et de Services Sociaux de Chicoutimi, Chicoutimi, QC, Canada; 3Centre for Global eHealth Innovation, Toronto General Hospital, Toronto, ON, Canada; 4Department of Family and Community Medicine, University of Toronto, Toronto, ON, Canada; 5Institute of Health Policy Management and Evaluation, University of Toronto, Toronto, ON, Canada

Abstract

The path to improving healthcare quality for individuals with complex health conditions is complicated by a lack of common understanding of complexity. Modern medicine, together with social and environmental factors, has extended life, leading to a growing population of patients with chronic conditions. In many cases, there are social and psychological factors that impact treatment, health outcomes, and quality of life. This is the face of complexity. Care challenges, burden, and cost have positioned complexity as an important health issue. Complex chronic conditions are now being discussed by clinicians, researchers, and policy-makers around such issues as quantification, payment schemes, transitions, management models, clinical practice, and improved patient experience. We conducted a scoping review of the literature for definitions and descriptions of complexity. We provide an overview of complex chronic conditions, and what is known about complexity, and describe variations in how it is understood. We developed a Complexity Framework from these findings to guide our approach to understanding patient complexity. It is critical to use common vernacular and conceptualization of complexity to improve service and outcomes for patients with complex chronic conditions. Many questions still persist about how to develop this work with a health and social care lens; our framework offers a foundation to structure thinking about complex patients. Further insight into patient complexity can inform treatment models and goals of care, and identify required services and barriers to the management of complexity.

Journal of Comorbidity 2012;2:1–9

Keywords: chronic conditions, complexity, multimorbidity, holistic health, biopsychosocial model

Introduction

Compared with a century ago, when the most prevalent illnesses were infectious [1], 50% of the general population in developed nations now live with chronic conditions [2]. Recent acknowledgement that many patients have multiple conditions, often compounded with psychosocial challenges (i.e. complexity) [3], and that cost of care for them is very high, has positioned patient complexity in focus within healthcare policy, practice, and research.

Patients with chronic conditions cost the healthcare system billions of dollars annually [4], a finding that has been found internationally [5]. For example, medical care costs in Canada for people with chronic conditions account for 42% of total direct medical care expenditures, and 65% of indirect costs [1]. Among the indirect costs are the burden and cost to informal and family caregivers, who have contributed a value estimated at
$25 billion in Canada (i.e. the cost of replacing informal caregiving with paid professionals) [6]. Another Canadian study estimated the cost to the system for those with chronic disease to be approximately double that of caring for those without a given condition [7]. Although we approached this issue with a Canadian focus, the implications are much broader. The present and projected cost estimates of providing care for these patients in the current healthcare system infrastructure have been cited as unsustainable [8].

Beyond cost is the concern about healthcare quality. In an international study of patient experience, those with multiple conditions reported poorer quality and overall dissatisfaction with their care compared with single-condition counterparts [9]. It is widely acknowledged that an acute care model is inappropriate for chronic conditions [10, 11]. As stated by Kane [12]: “Although demographic and epidemiological studies clearly show that we are firmly in the era of chronic disease, we persist in acting as though we are still treating primarily acute illnesses.” Coordination of care is cited as integral to high-quality care [13], but it is extremely challenging to organize care for people with complex chronic conditions due to the number of care providers involved [14].

Over the past 10 years, models of chronic healthcare, such as the Chronic Care Model [15] and the Expanded Chronic Care Model [16], have identified care coordination as an integral component. However, it is unclear to what extent these models have been applied to and/or successful in the management of complex patients.

The objective of this paper is to contribute to our understanding of complexity by performing a structured scoping review of descriptions and definitions of complexity in the literature. Three broad types of descriptions of complex chronic conditions were identified and are described: multimorbidty (i.e. two or more concurrent health conditions), healthcare resource utilization, and psychosocial vulnerabilities. These perspectives and the findings of the scoping review were synthesized via investigator consensus into a unifying, high-level complexity framework to aid in approaching the many questions that remain about providing optimal care for complex patients.

The state of the literature on complexity

Methods

A scoping review was conducted to investigate the fundamental question of what patient complexity is, and how it is currently understood in the context of providing health services and/or outcomes. Relevant databases (i.e. MEDLINE, EMBASE, Social Work Abstracts, PsycINFO, Scholars Portal, PubMed, Google Scholar) were searched in July of 2010. The following key terms were used: comorbidity, multiple comorbidity, chronic disease, multimorbidity, polypharmacy, pluripathology, complex chronic disease, complex chronic illness, complex chronic disability. The above terms were searched in combination with: care delivery, care model, chronic care model, care management, care coordination, social care, care delivery model, social care, health service, social service, health care. The above search terms were selected to capture variations in spelling conventions or hyphenation (e.g. co-morbidity). Relevant references were hand searched, and principal authors contacted where appropriate. The search was limited to adults (aged 19 years or older), English articles, and research involving humans. Included articles focused on populations with two or more chronic conditions and some aspect of healthcare delivery. Articles were excluded if they focused on pediatric subjects, single-disease groups, or medical education. Abstracts were reviewed by one investigator for linkages between chronic disease, care or individual characteristics, and acknowledgement of case or care complexity. Articles that were unclear if they met the criteria for inclusion based on the abstract were reviewed in their entirety. The findings were classified into five broad health dimensions that emerged from the review. Health dimensions represented by this review include medical/physical health, mental health, demographics, social capital, and health and social experience.

Results

The search returned 1,669 articles, 127 of which were considered relevant as assessed by the inclusion/exclusion criteria. Table 1 summarizes the breadth of the findings from the scoping review.

In exploring the literature on patient complexity, we found evidence that chronic conditions can be complex due to interconnections with many other dimensions, including, but not limited to: medical/physical challenges, such as functional impairment [10, 17–20], chronic symptoms (e.g. pain) [80], challenges in the application of clinical practice guidelines (CPGs) [10, 24–28], multimorbidity [29–42], and polypharmacy [21–23]; mental health challenges, such as depression [43, 44], psychological distress [45–47], cognitive impairment [51, 52], and substance use [53, 54]; social health issues including caregiver strain [64], poor social support [66, 67], relationship strain and lack of leisure time [63]; experiential challenges including poor quality of life [31], difficulty navigating services [78] and the need for a care manager [79], lack of access to providers [78, 79], heavy utilization of services [17, 47, 67, 69], and higher healthcare costs [1, 7, 47, 70–74]; and demographic characteristics...
including advanced age [55–58] and frailty [18, 22, 59],
gender [40, 47], poverty [40, 47, 65], ethnic disparities
[60, 61], and lower level of education [62].

In reviewing the breadth of the literature on patient
complexity, it became apparent that there are three
broad types of descriptions of complexity: multimorbi-
dity, resource utilization, and psychosocial complexity.
The following sections provide an overview of these
perspectives.

### Complexity due to multimorbidity

Many patients experience two or more chronic condi-
tions simultaneously (i.e. multimorbidity). Complexity
may be associated with multimorbidity in many cases
though it is not a necessary cause. In the literature on
patient complexity, multimorbidity reigns as the most
investigated description. There are several terms that
have been used synonymously for this phenomenon,
including: comorbidity, polypathology, pluripathology,
multimorbidity, and multiple chronic conditions [81].

In 2010, an e-book across the international clinical and
research community from the Observatory of Innovative
Practices for Complex Chronic Diseases Management
(OPIMEC) [81] was published to raise awareness about
multiple chronic conditions’ prevention and manage-
ment due to the growing recognition of such patients.

An international population-based survey estimated
that multimorbidity affects approximately 20–30% of
chronically ill patients [2]. In primary care practices,
multimorbidity is more prevalent [82] than in the gen-
eral population, which may be attributable to their
relatively better health status, differences in access and
use of services, or unmet need. Multimorbidity in pri-
mary care patients aged 65 years and older has been
estimated to be as high as 97–98%, while for younger
and middle-aged patients, estimates are in the order
of 69% and 93–95%, respectively [29, 40, 82]. In the
Netherlands, the number of patients with multimorbi-
dity in primary care has doubled since the mid-1980s, and
the proportion of patients with four or more chronic
diseases has tripled [40].

Comparing estimates of multimorbidity is difficult
due to variations in how the concept is defined and
studied [83]. The number and type of diseases, setting,
health registry characteristics, and patient demograph-
ics affect estimates of multimorbidity prevalence and
incidence [84]. A recent systematic review of multimor-
bidity prevalence studies revealed that variation in study
methodologies and findings yields dramatically different
prevalence estimates, with the largest differences between
studies’ estimates being up to 59% and 92% for the gen-
eral population and primary care, respectively [29, 40, 82].

### Table 1
Examples of elements of complexity classified by health dimensions identified via scoping review.

| Dimension                        | Example                                      | Sources                                      |
|----------------------------------|----------------------------------------------|----------------------------------------------|
| Medical/physical health          | Loss of physical functioning                 | [10, 17–20]                                 |
|                                  | Polypharmacy                                 | [21–23]                                     |
|                                  | Limited application of clinical practice guidelnes | [10, 24–28]                                 |
|                                  | Multimorbidity                               | [29–42]                                     |
| Mental health                    | Psychological distress                        | [43–47]                                     |
|                                  | Psychiatric illness (e.g. depression)        | [41, 43, 48–50]                             |
|                                  | Cognitive impairment                         | [51, 52]                                    |
|                                  | Addictions/substance use                     | [53, 54]                                    |
| Demographics                     | Older age                                    | [55–58]                                     |
|                                  | Frailty                                      | [22, 59]                                    |
|                                  | Female gender                                | [40, 47]                                    |
|                                  | Ethnic disparities                           | [60, 61]                                    |
|                                  | Lower education                              | [62]                                        |
| Social capital                   | Negatively affected relationships            | [63]                                        |
|                                  | Caregiver strain and burnout                 | [64]                                        |
|                                  | Low socio-economic status and poverty        | [40, 47, 65]                                |
|                                  | Poor social support                          | [66, 67]                                    |
| Health and social experiences    | Heavy utilization of healthcare resources    | [17, 47, 68, 69]                            |
|                                  | Costly care                                  | [1, 7, 47, 71–74]                           |
|                                  | Self-management challenges                   | [23, 69, 75–77]                             |
|                                  | Poor quality of life                         | [31]                                        |
|                                  | Difficulty with healthcare system navigation | [78, 79]                                    |
terms of the multiplicity of physical, mental health, and social issues, or in terms of complex or extensive care. Measurements of multimorbidity tend to be simple or weighted counts of diagnoses [86]. Mercer and colleagues assert that defining complexity solely as two or more conditions underestimates the intricacy of these patients [34]. An alternative measure, the Cumulative Illness Rating Scale (CIRS), rates body systems on pathophysiologic severity as opposed to counting diagnoses. The CIRS has been adapted into an electronic assessment (eCIRS) in primary care to quantify multimorbidity [87]. De Groot and colleagues [88] critically evaluated the reliability and validity of 13 common measures of comorbidity and concluded that, in terms of capturing mortality, disease severity, type and severity of comorbidities, and functional impairment, several measures were appropriate for clinical research. As is self-evident, such measures focus predominantly on medical complexity.

Despite the occurrence of multimorbidity, healthcare and research continue to be organized mainly according to specific conditions. There are systemic contributors to this, including the training of physicians in disease-focused paradigms and the reliance on specialist practitioners; however, we chose to omit these issues in this article. Rooted in evidence, CPGs and other medical evidence predominantly address single conditions and rarely refer to or suggest a course of action for patients with multimorbidity [89–91]. Boyd and colleagues illustrated that following CPGs for an older patient with five conditions results in a complicated regimen of 12 medications at 19 doses per day, 14 non-pharmacological treatment activities, and any number of medication–diet–disease interactions [26]. Potential interactions are one way that multimorbidity may be complex. Clinicians must draw more on clinical expertise and patient preferences than CPGs to meet complex patients’ needs [28]. It is evident that caring for patients with multimorbidity is challenging for patients and practitioners, in terms of decision-making around treatment course, regimen manageability, and risk–benefit analysis.

Complexity in terms of healthcare utilization

A system-oriented description of complexity in chronic conditions is from the perspective of healthcare resource consumption. A study of high users of healthcare by Reid and colleagues found that the 5% who use the most resources, including primary care, specialist encounters, and inpatient days, are characterized by multiple, complex health issues [47]. The Kaiser Permanente Chronic Conditions Management pyramid is one model that recognizes this heterogeneity in the chronically ill population; differentiating non-complex from complex patients (i.e. multiple chronic conditions, risk of decline, fluctuating or poorly managed conditions) [92]. The Kaiser model indicates that patients at the top of the pyramid are the most complex, as defined by historical healthcare use and disease registries, and thus targets intensive case management to these complex patients [92]. There are a number of adaptations of the Kaiser model, including the UK’s National Health Services Health and Social Care Long Term Conditions Model. In the Kaiser model, aside from health history, little is known about the characteristics of these patients that make them complex.

Resource use is commonly estimated via case–mix indices. These indicators are the product of an algorithm that stratifies patients into relatively homogeneous clusters. An example is the Johns Hopkins Adjusted Clinical Groups (ACG) methodology, which quantifies morbidity using diagnostic codes and groups patients by age, gender, and expected consumption of healthcare resources and short-term clinical outcomes (see [93]).

Complex chronic conditions typically necessitate ongoing clinical management, are associated with poor health outcomes, greater utilization of healthcare services, and higher cost [74]. However, the question must be raised if high healthcare resource use is indicative of a complex patient. The potential circularity of resource utilization equating to complexity, and care need, has been summed up by Wade: “If complexity is defined operationally as equivalent to needing or using more resources, then obviously more complex cases will need or use more resources!” [3]. Alternatively, patient need may be underestimated where services or professionals (e.g. home care, psychologists) are not available or service provision is inadequately documented. Thus, caution must be exerted when relying solely on resource utilization to indicate complexity.

Complexity due to psychosocial factors

It is well established that chronic illness is not just about the disease, but intersects with the broader socioeconomic context. An estimated 75% of the factors that influence health lie outside of the healthcare system [94]; for instance, poverty and social exclusion are key chronic condition risk factors. Health inequities are closely tied to health status and wellbeing [95], and chronic conditions can force individuals into poverty due to the extensive cost of treatment [96]. A study of primary care physician’s ratings of complexity for patients in their practices revealed that over 25% of patients were considered complex by their physicians, with socioeconomic and behavioral factors driving complexity ratings more than medical diagnoses [97]. It is increasingly evident that any conceptualization of complexity is incomplete without consideration of social and environmental factors.
Psychosocial complexity tends to refer to one or some combination of social isolation, psychiatric illness, socio-demographic vulnerability, or other social and/or psychological difficulties [98]. This may include persistent distress or fear that is not adequately addressed and complicates medical management [98]. Nardi and colleagues [22] analyzed complex internal medicine patients, and suggest two key variables that load onto the construct of complexity: disability in physical function and frailty (i.e. a condition with a high risk of negative outcome and worsening quality of life commonly associated with disability and socioeconomic issues).

In response to psychosocial complexity, Safford and colleagues [99] developed a model including population-level determinants of health (i.e. socioeconomic, culture, behavior, and environment). Their Vector Model of Complexity depicts each determinant as a vector influencing the direction (i.e. increase or decrease) and magnitude of a patient’s complexity. The interconnectedness of the determinants is outlined, whereby a disturbance of any one affects the entire balance [99]. The Vector Model may account for some of the key challenges practitioners face with complex patients, such as why the same treatment plan is poorly adhered to or differentially effective for different patients (i.e. the treatment is not sufficiently individualized with a shared vision of realistic outcomes). The need for CPGs to include guidance on tailoring treatment plans is emphasized [99], an idea central to collaborative care (e.g. [63]). A shortcoming of this potentially useful model is the application of mathematical vectors to mathematically devoid determinants of health, thus, yielding the angles between vectors meaningless for quantification of complexity [100].

In the same vein, there are few clinical measures that tap into biopsychosocial definitions of complexity. Of interest, the INTERMED Complexity Assessment Grid systematizes a biopsychosocial approach to ascertain case complexity [101]. The INTERMED was developed to operationalize the biopsychosocial model and identify characteristics that pose obstacles to care, using a combination of psychometric and clinimetric theories to maintain the reliability and validity, and relevance and brevity, respectively, of each approach [101]. The tool makes it possible to identify the need for multidisciplinary intervention for patients who may respond poorly to conventional biomedical interventions [101], and has been successful in identifying clusters of complex patients [102] and improving health outcomes for patients (e.g. [103, 104, 105, 106, 107]). Although the tool has been applied to several patient populations in a variety of settings, including the adoption of an adapted version by the Case Management Society of America, it has not yet seen system-level uptake.

**Synthesis into a Complexity Framework**

Although they tend to be reported in separate bodies of literature, it appears that multimorbidity, resource use, and psychosocial vulnerability are closely intertwined in understanding complex patients [32]. There are many possible permutations of these factors, thus, a high degree of uniqueness among complex patients; a challenge to the healthcare system that draws largely on the application of rules to homogenous patient groups. As a synthesis to our review process and to consolidate thinking, we developed a high-level framework to guide our own research development and approach to complexity (Figure 1). Existing models were drawn upon for their contributions to understanding complex patients.

The scoping review informed the development of this framework via thematic analysis of the literature and investigator consensus reached through discussion. The framework is centered on the top of the Kaiser Permanente Chronic Conditions Management diagram, with the triangle in our framework representing the 1–5% most complex chronically ill patients identified in the Kaiser model. The Kaiser model identifies patients at the top of the pyramid as the most resource intensive, yet there is little understanding what personal or experiential characteristics make them a high-risk population. In an effort to fill this gap in understanding, the framework broadly synthesizes the scoping review findings around the question: What needs to be considered to gain an understanding of patients with complex chronic conditions? Thus, the framework includes the five health dimensions detailed

---

**Figure 1** The Complexity Framework showing five health dimensions.
in Table 1, and examples of the types of granular elements are provided for illustrative purposes.

Our Complexity Framework builds on past descriptions of complexity, synthesizing a number of perspectives, literature, and adding a unifying, high-level approach. Considering the framework dimensions concurrently offers a systematic and holistic perspective with which to understand patient challenges, goals, and care need in research that can ultimately inform policies to support clinicians in caring for complex patients. Our search results are limited in scope by the terms we used. Broadening the search to include other terms, such as disability and frailty, could provide further insight into these factors and their relation to patient complexity. Further research is required to validate the framework, and we are beginning by using it to guide our program of research to test the hypothesis that these dimensions are salient for inpatients receiving post-acute complex care and rehabilitation, and for outpatients at other points in the continuum of care in a Canadian context. In addition to our conceptualization of patient complexity, there are systemic and structural issues that add another layer of complexity that may manifest as care-regimen complexity, healthcare system navigation challenges, or complex networks of healthcare providers. The framework should stimulate further thought, discussion, and empirical study of complexity and bring together experts and decision makers at the organizational and regulatory levels to proactively address complexity in healthcare settings.

In this paper, we describe three dominant general understandings of complexity, and synthesize the literature in a complexity conceptual framework. Key questions remain around how a holistic and systematic understanding of complexity could inform the development of treatment models and required skill mix for clinicians who provide care to patients with complex chronic conditions. It also remains unknown if such an approach can provide a better understanding of patient goals of care and identify the resources and programs required. Answering such questions will help to identify barriers to the effective management of complexity.

Acknowledgements

The authors wish to acknowledge the clinical staff at Bridgepoint Health for providing valuable insight about patient complexity and chronic disease management addressed in this paper. Martin Fortin is supported by the Canadian Institutes of Health Research (CIHR) and partners (CIHR Applied Health Services and Policy Research Chair on Chronic Diseases in Primary Care/Canadian Institutes of Health Research-Institute of Health Services and Policy Research, Canadian Health Services Research Foundation, and Centre de santé et de services sociaux de Chicoutimi).

Conflicts of interest

The authors declare that they have no conflicts of interest.

Funding

None declared.

References

1 Mirolla M. The cost of chronic disease in Canada: Executive summary. Ottawa, ON: The Chronic Disease Prevention Alliance of Canada; 2004.
2 Schoen C, Osborn R, Doty MM, Bishop M, Peugh J, Murukutla N. Toward higher-performance health systems: adults’ health care experiences in seven countries, 2007. Health Aff (Millwood) 2007;26(6):w717–34.
3 Smith SM, O'Dowd T. Chronic diseases: what happens when they come in multiples? Br J Gen Pract 2007;57(537):268–70.
4 Ontario Health Quality Council. OHQC 2008 Report on Ontario’s Health System. In: Q Monitor Report; 2008. pp. 1–111. Available from: http://www.hqontario.ca/pdfs/ohqc_2008_report_-_english.pdf [last accessed Sept 19, 2012].
5 World Health Organization. Preventing chronic diseases: a vital investment: WHO Global Report. World Health Organization; 2005. Available from: http://www.who.int/chp/chronic_disease_report/full_report.pdf [last accessed Sept 19, 2012].
6 Hollander MJ, Liu G, Chappell NL. Who cares and how much? The imputed economic contribution to the Canadian healthcare system of middle-aged and older unpaid caregivers providing care to the elderly. Healthc Q 2009;12(2):42–9.
7 Finlayson G, Ekuma O, Yogendra M, Burland E, Forget E. The Additional Cost of Chronic Disease in Manitoba. Manitoba Centre for Health Policy; April 2010.
8 Ontario Association of Community Care Access Centres, Ontario Federation of Community Mental Health and Addiction Programs, Ontario Hospital Association. Ideas and Opportunities for Bending the Health Care Cost Curve: Advice for the Government of Ontario; 2010.
9 Burgers JS, Voerman GE, Grol R, Faber MJ, Schneider EC. Quality and coordination of care for patients with multiple conditions: results from an international survey of patient experience. Eval Health Prof 2010;33(3):343–64.
10 Fries JF. The compression of morbidity. Milbank Q 2005;83(4):801–23.
11 Sylvia ML, Griswold M, Dunbar L, Boyd CM, Park M, Boult C. Guided care: cost and utilization outcomes in a pilot study. Dis Manag 2008;11(1):29–36.
12 Kane RL. The chronic care paradox. J Aging Soc Policy 2000;11(2–3):107–14.
13 Berry-Millett R, Bodenheimer T. Care management of patients with complex health care needs. Synth Prog Res Synth Rep 2009;19: pp: 52372.
14 Vogeli C, Shields AE, Lee TA, Gibson TB, Marnder WD, Weiss KB, et al. Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs. J Gen Intern Med 2007;22(Suppl 3):391–5.
15 Wagner EH. Chronic disease management: what will it take to improve care for chronic illness? Eff Clin Pract 1998;1(1):2–4.
16 Barr VJ, Robinson S, Marin-Link B, Underhill L, Dotts A, Raven-dale D, et al. The expanded Chronic Care Model: an integration of concepts and strategies from population health promotion and the Chronic Care Model. Hosp Q 2003;7(1):73–82.

17 Upshur RE, Tracy S. Chronicity and complexity: is what’s good for the diseases always good for the patients? Can Fam Physician 2008;54(12):1655–8.

18 Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care. J Gerontol A Biol Sci Med Sci 2004;59(3):255–63.

19 Rijken M, van Kerkhof M, Dekker J, Schellevis FG. Comorbidity of chronic diseases: effects of disease pairs on physical and mental functioning. Qual Life Res 2005;14(1):45–55.

20 Bayliss EA, Bayliss MS, Ware JE, Jr., Steiner JM. Predicting declines in physical function in persons with multiple chronic medical conditions: what we can learn from the medical problem list. Health Qual Life Outcomes 2004;2:47.

21 Tinetti ME, Bogardus ST Jr., Agostoni JV. Potential pitfalls of disease-specific guidelines for patients with multiple conditions. N Engl J Med 2004;351(27):2870–4.

22 Nardi R, Scannelli G, Corrao S, Iori I, Mathieu G, Cataldi Amatrian R. Co-morbidity does not reflect complexity in internal medicine patients. Eur J Intern Med 2007;18(5):359–68.

23 Noël PH, Parchman ML, Williams JW Jr., Cornell JE, Shuko L, Zeber JE, et al. The challenges of multimorbidity from the patient perspective. J Gen Intern Med 2007;22(Suppl 3):419–24.

24 Bernabe-Usset_Wittel M, Jafadi A, Moreno-Gavino L, Hernandez-Quiles C, Toscano F, Casam P, et al. Peeking through the cracks: an assessment of the prevalence, clinical characteristics and health-related quality of life (HRQoL) of people with polypathology in a hospital setting. Arch Gerontol Geriatr 2010;51(2):185–91.

25 Mutasingwa DR, Ge H, Upshur RE. How applicable are clinical practice guidelines to elderly patients with comorbidities? Can Fam Physician 2011;57(7):e253–62.

26 Boyd CM, Darer J, Boutl C, Fried LP, Boutl L, Wu AW. Clinical practice guidelines and quality of care for older patients with multiple comorbid diseases: implications for pay for performance. JAMA 2005;294(6):716–24.

27 Nardi R, Scannelli G. Complexity in the care of elderly patients and polypharmacy. Eur J Intern Med 2008;19(4):304.

28 Upshur RE. Looking for rules in a world of exceptions: reflections on evidence-based practice. Perspect Biol Med 2005;48(4):477–89.

29 Fortin M, Bravo G, Hudon C, Vanasse A, Lapointe L. Prevalence of multimorbidity among adults seen in family practice. Ann Fam Med 2008;6(3):223–8.

30 Fortin M, Lapointe L, Hudon C, Vanasse A. Multimorbidity is common to family practice: is it commonly researched? Can Fam Physician 2005;51:244–5.

31 Fortin M, Lapointe L, Hudon C, Vanasse A, Nettu AL, Meliss D. Multimorbidity and quality of life in primary care: a systematic review. Health Qual Life Outcomes 2004;2:51.

32 Fortin M, Soubhi H, Hudon C, Bayliss EA, van den Akker M. Multimorbidity’s many challenges. BMJ 2007;334(7602):1016–7.

33 Laux G, Kuehlein T, Rosemann T, Szecsenyi J. Co- and multimorbidity patterns in primary care based on episodes of care: results from the German CONTENT project. BMC Health Serv Res 2008;8:14.

34 Mercer SW, Smith SM, Wyke S, O’Dowd T, Watt GC. Multimorbidity in primary care: developing the research agenda. Fam Pract 2009;26(2):79–80.

35 Min LC, Wenger NS, Fung C, Chang JT, Ganz DA, Higashi T, et al. Multimorbidity is associated with better quality of care among vulnerable elders. Med Care 2007;45(6):480–8.

36 Salisbury C, Johnson L, Purdy S, Valderas JM, Montgomery AA. Epidemiology and impact of multimorbidity in primary care: a retrospective cohort study. Br J Gen Pract 2011;61(582):12–21.

37 Schafer I, von Leitner EC, Schon G, Koller D, Hansen H, Kolenko T, et al. Multimorbidity patterns in the elderly: a new approach of disease clustering identifies complex interrelations between chronic conditions. PLoS One 2010;5(12):e15941.

38 Smith S, Soubhi H, Fortin M, Hudon C, O’Dowd T. Interventions to improve outcomes in patients with multimorbidity in primary care and community settings. Cochrane Database Syst Rev 2007;Protocols 2007;2:CD006560.

39 Smith SM, Ferede A, O’Dowd T. Multimorbidity in younger deprived patients: an exploratory study of research and service implications in general practice. BMC Fam Pract 2008;9:6.

40 Uijen AA, van de Lisdonk EH. Multimorbidity in primary care: prevalence and trend over the last 20 years. Eur J Gen Pract 2008;14(Suppl 1):26–32.

41 Valderas JM, Starfield B, Roland M. Multimorbidity’s many challenges: a research priority in the UK. BMJ 2007;334(7604):1128.

42 van den Akker M, Buntinx F, Metsemakers JF, Roos S, Kottnerus JA. Multimorbidity in general practice: prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases. J Clin Epidemiol 1998;51(5):367–75.

43 Harpole LH, Williams JY, Jr., Olsen MK, Stechuchak KM, Oddone E, Callahan CM, et al. Improving depression outcomes in older adults with comorbid medical illness. Gen Hosp Psychiatry 2005;27(1):4–12.

44 Moussavi S, Chatterji S, Verdes E, Tandon A, Patel V, Ustun B. Depression, chronic diseases, and decrements in health: results from the World Health Surveys. Lancet 2007;370(9590):851–8.

45 Fortin M, Bravo G, Hudon C, Lapointe L, Dubois MF, Almirall J. Psychological distress and multimorbidity in primary care. Ann Fam Med 2006;4(5):417–22.

46 Fortin M, Hudon C, Bayliss EA, Soubhi H, Lapointe L. Caring for body and soul: the importance of recognizing and managing psychological distress in persons with multimorbidity. Int J Psychiatry Med 2007;37(1):1–9.

47 Reid R, Evans R, Barer M, Sheps S, Kerluke K, McGrail K, et al. Consumptive consumption: characterizing high users of physician services in one Canadian province. J Health Serv Res Policy 2003;8(4):215–24.

48 Clarke DM. Depression and physical illness: more complex than simple comorbidity. Med J Aust 2009;190(Suppl 7):S52–3.

49 Clarke DM, Currie KC. Depression, anxiety and their relationship with chronic diseases: a review of the epidemiology, risk and treatment evidence. Med J Aust 2009;190(Suppl 7):S54–60.

50 Gunn JM, Aytong DR, Dennis K, Pallant JF, Chondros P, Herrem HE, et al. The association between chronic illness, multimorbidity and depressive symptoms in an Australian primary care cohort. Soc Psychiatry Psychiatr Epidemiol 2010;45(2):175–84.

51 Blaum CS, Ostfled MB, Liang J. Low cognitive performance, comorbid disease, and task-specific disability: findings from a nationally representative survey. J Gerontol A Biol Sci Med Sci 2002;57(8):M523–31.

52 Bruce DG, Casey GP, Grange V, Clarneett R, Almeda OP, Foster JK, et al. Cognitive impairments, physical disability and depressive symptoms in older diabetic patients: the Fremantle Cognition in Diabetes Study. Diabetes Res Clin Pract 2003;61(1):59–67.

53 Dickey B, Normand SL, Weiss RD, Drake RE, Arzeni H. Medical morbidity, mental illness, and substance use disorders. Psychiatr Serv 2002;53(7):861–7.

54 Donald M, Dower J, Kavanagh D. Integrated versus non-integrated management and care for clients with co-occurring mental health and substance use disorders: a qualitative systematic review of randomised controlled trials. Soc Sci Med 2005;60(6):1371–83.
Kadam UT, Croft PR. Clinical multimorbidity and physical function in older adults: a record and health status linkage study in general practice. Fam Pract 2007;24(5):412–9.

Karlamangla A, Tinetti M, Gurinik J, Studenski S, Wele T, Reuben D. Comorbidity in older adults: nosology of impairment, diseases, and conditions. J Gerontol A Biol Sci Med Sci 2007;62(3):296–300.

van den Akker M, Buntinx F, Metsemakers JF, Knottnerus JA. Marginal impact of psychosocial factors on multimorbidity: results of an explorative nested case-control study. Soc Sci Med 2000;50(11):1679–93.

Schoenberg NE, Leach C, Edwards W. “It’s a toss up between my hearing, my heart, and my hip”: prioritizing and accommodating multiple morbidities by vulnerable older adults. J Health Care Poor Underserved 2009;20(1):134–51.

Phillips-Harris C. Case management: high-intensity care for frail patients with complex needs. Geriatrics 1998;53(2):62–4.

Sarkar J, Lux LM, Bruce S, Young TK. Ethnic and regional differences in prevalence and correlates of chronic diseases and risk factors in northern Canada. Prev Chronic Dis 2010;7(1):A13.

Schiefel MA, Ashworth M. Inequalities in health due to ethnicity and social deprivation – an analysis of primary care data from one inner-city area over a three year period. Report to the National Audit Office. UK National Audit Office; 2010. Available from: http://www.nao.org.uk [last accessed Sept 19, 2012].

Jackson GL, Weinberger M, Hamilton NS, Edelman D. Racial/ethnic and educational-level differences in diabetes care experiences in primary care. Prim Care Diabetes 2008;2(1):39–44.

Noël PH, Fruch BC, Larme AC, Pugh JA. Collaborative care needs and preferences of primary care patients with multimorbidity. Health Expect 2005;8(1):54–63.

Canadian Institute for Health Information. Supporting Informal Caregivers: The Heart of Home Care. In Analysis in Brief: 2010.

Schofield MA. Ashworth M. Inequalities in health due to ethnicity and social deprivation – an analysis of primary care data from one inner-city area over a three year period. Report to the National Audit Office. UK National Audit Office; 2010. Available from: http://www.nao.org.uk [last accessed Sept 19, 2012].

Jackson GL, Weinberger M, Hamilton NS, Edelman D. Racial/ethnic and educational-level differences in diabetes care experiences in primary care. Prim Care Diabetes 2008;2(1):39–44.

Schofield MA, Ashworth M. Inequalities in health due to ethnicity and social deprivation – an analysis of primary care data from one inner-city area over a three year period. Report to the National Audit Office. UK National Audit Office; 2010. Available from: http://www.nao.org.uk [last accessed Sept 19, 2012].

Mercer SW, Watt GC. The inverse care law: clinical primary care and conditions in deprived and affluent areas of Scotland. Ann Fam Med 2007;5(6):503–10.

Hough ES, Brumitt GA, Templin TN. Social support, demands of work, and chronic conditions in working women. J Occup Health Psychol 1999;4(3):290–303.

Bayliss EA, Bosworth HB, Noel PH, Wolf JL, Damush TM, McIver L. Supporting self-management for patients with complex medical needs: recommendations of a working group. Chronic Illn 2007;3(2):167–75.

Bayliss EA, Ellis JL, Steiner JE. Barriers to self-management and quality-of-life outcomes in seniors with multimorbidities. Ann Fam Med 2007;5(3):395–402.

Jowsey T, Jean YH, Dugdale P, Glasgow NJ, Kljakovic M, Usherwood T. Challenges for co-morbid chronic illness care and policy in Australia: a qualitative study. Aust New Zealand Health Policy 2009;6:22.

Bayliss EA, Edwards AE, Steiner JE; Main DS. Processes of care desired by elderly patients with multimorbidities. Fam Pract 2008;25(4):297–93.

Butchart A, Kerr EA, Heisler M, Piette JD, Krein SL. Experience and management of chronic pain among patients with other complex chronic conditions. Clin J Pain 2009;25(4):293–8.

Jadad AR, Cabrera A, Martos F, Smuth R, Lyons RF, editors. When people live with multiple chronic diseases: a collaborative approach to an emerging global challenge. Granada: Andalucian School of Public Health; 2010. Available from: http://www.opumec.org/equipos/when-people-live-with-multiple-chronic-diseases/ [last accessed Sept 19, 2012].

Fortin M, Hudon C, Haggerty J, Akker M, Almurray J. Prevalence estimates of multimorbidity: a comparative study of two sources. BMC Health Serv Res 2010;10:111.

van den Akker M, Buntinx F; Roos S, Knottnerus JA. Problems in determining occurrence rates of multimorbidity. J Clin Epidemiol 2001;54(7):675–9.

Schram MT, Frijters D, van de Lisdonk EH, Poitras ME, Almirall J, de Waal MW, et al. Setting and registry characteristics affect the prevalence and nature of multimorbidity in the elderly. J Clin Epidemiol 2008;61(11):1104–12.

Fortin M, Steward M, Poitras ME, Almurray J, Maddocks H. A systematic review of prevalence studies on multimorbidity: toward a more uniform methodology. Ann Fam Med 2012;10(2):142–51.

Kerr EA, Heisler M, Krein SL, Kabete M, Langa KM, Weir D, et al. Beyond comorbidity counts: how do comorbidity type and severity influence diabetes patients’ treatment priorities and self-management? J Gen Intern Med 2007;22(12):1635–40.

Fortin M, Steenbakkers K, Hudon C, Poitras ME, Almurray J, van den Akker M. The electronic Cumulative Illness Rating Scale: A reliable and valid tool to assess multi-morbidity in primary care. J Eval Clin Pract 2011;17(6):1089–93.

de Groot V, Beckerman H, Lankhorst GJ, Bouter LM. How to measure comorbidity: a critical review of available methods. J Clin Epidemiol 2003;56:221–9.

Lugtenberg M, Burgers JS, Clancy C, Westert GP, Schneider EC. Current guidelines have limited applicability to patients with comorbid conditions: a systematic analysis of evidence-based guidelines. PLoS One 2011;6(10):e25087.

Fortin M, Contant E, Savard C, Hudon C, Poitras ME, Almurray J. Canadian guidelines for clinical practice: an analysis of their quality and relevance to the care of adults with comorbidity. BMC Fam Pract 2011;12:74.
91 Vitry AI, Zhang Y. Quality of Australian clinical guidelines and relevance to the care of older people with multiple comorbid conditions. Med J Aust 2008;189(7):360–5.
92 Porter M, Kellogg M. Kaiser Permanente: An Integrated Health Care Experience. Revista de Innovación Sanitaria y Atención Integrada 2008;1(1):1–8.
93 Starfield B, Weiner J, Mumford L, Steinwachs D. Ambulatory care groups: a categorization of diagnoses for research and management. Health Serv Res 1991;26(1):53–74.
94 Keon WJ, Pepin L. Population Health Policy: Issues and Options. Fourth Report of the Subcommittee on Population Health of the Standing Senate Committee on Social Affairs, Science and Technology; 2008. Available from: http://www.parl.gc.ca/Content/SEN/Committee/392/soci/rep/rep10apr08-e.pdf [last accessed Sept 19, 2012].
95 Braveman P, Gruskin S. Defining equity in health. J Epidemiol Community Health 2003;57(4):254–58.
96 World Health Organization. FACT FILE: 10 facts on noncommunicable diseases. 2011. Available from: http://www.who.int/features/factfiles/noncommunicable_diseases/facts/en/index.html [last accessed Apr 2, 2012].
97 Grant RW, Ashburner JM, Hong CC, Chang Y, Barry MJ, Atlas SJ. Defining patient complexity from the primary care physician’s perspective: a cohort study. Ann Intern Med 2011;155(12):797–804.
98 Conly J, Glassford J, Guebert N, Lapin J, Schulz K, Barrington G. Medical Access to Service Project – Calgary Zone, Phase 2 – Outcome Assessment – Final Report. Calgary: Alberta Health Services. 2009. Available from: http://www.departmentofmedicine.com/MAS/documents/mas_final_sept1_2009.pdf [last accessed Sept 19, 2012].
99 Safford MM, Allison JJ, Kiefe CI. Patient complexity: more than comorbidity, the vector model of complexity. J Gen Intern Med 2007;22(Suppl 3):382–90.
100 Braithwaite RS, Concato J. Vector model of complexity. J Gen Intern Med 2008;23(6):895.
101 de Jonge P, Huyse FJ, Sloets JP, Sollner W, Stiefel FC. Operationalization of biopsychosocial case complexity in general health care: the INTERMED project. Aust N Z J Psychiatry 2005;39(9):795–9.
102 de Jonge P, Latour C, Huyse FJ. Interrater reliability of the INTERMED in a heterogeneous somatic population. J Psychosom Res 2002;52(1):25–7.
103 de Jonge P, Stiefel F. Internal consistency of the INTERMED in patients with somatic diseases. J Psychosom Res 2003;54(5):497–9.
104 Fischer CJ, Stiefel FC, De Jonge P, Guex P, Troendle A, Bollard C, et al. Case complexity and clinical outcome in diabetes mellitus. A prospective study using the INTERMED. Diabetes Metab 2000;26(4):295–302.
105 Hoogervorst EL, de Jonge P, Jelles B, Huyse FJ, Heeres I, van der Ploeg HM, et al. The INTERMED: a screening instrument to identify multiple sclerosis patients in need of multidisciplinary treatment. J Neurol Neurosurg Psychiatry 2003;74(1):20–4.
106 Luthi F, Stiefel F, Gobelet C, Rivier G, Deriaz O. Rehabilitation outcomes for orthopaedic trauma individuals as measured by the INTERMED. Disabil Rehabil 2011;33(25–26):2544–52.
107 Scerri M, de Goumoens P, Frisch C, Van Melle G, Stiefel F, So A. The INTERMED questionnaire for predicting return to work after a multidisciplinary rehabilitation program for chronic low back pain. Joint Bone Spine 2008;73(6):736–41.