Review Article

The global burden of multiple chronic conditions: A narrative review

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ABSTRACT

Globally, approximately one in three of all adults suffer from multiple chronic conditions (MCCs). This review provides a comprehensive overview of the resulting epidemiological, economic and patient burden.

There is no agreed taxonomy for MCCs, with several terms used interchangeably and no agreed definition, resulting in up to three-fold variation in prevalence rates: from 16% to 58% in UK studies, 26% in US studies and 9.4% in Urban South Asians.

Certain conditions cluster together more frequently than expected, with associations of up to three-fold, e.g. depression associated with stroke and with Alzheimer's disease, and communicable conditions such as TB and HIV/AIDS associated with diabetes and CVD, respectively. Clusters are important as they may be highly amenable to large improvements in health and cost outcomes through relatively simple shifts in healthcare delivery.

Healthcare expenditures greatly increase, sometimes exponentially, with each additional chronic condition with greater specialist physician access, emergency department presentations and hospital admissions. The patient burden includes a deterioration of quality of life, out of pocket expenses, medication adherence, inability to work, symptom control and a high toll on carers. This high burden from MCCs is further projected to increase.

Recommendations for interventions include reaching consensus on the taxonomy of MCC, greater emphasis on MCCs research, primary prevention to achieve compression of morbidity, a shift of health systems and policies towards a multiple-condition framework, changes in healthcare payment mechanisms to facilitate this change and shifts in health and epidemiological databases to include MCCs.

1. Introduction

1.1. Investment in noncommunicable disease

Three in five global deaths are attributed to four major non-communicable diseases (NCDs) – cardiovascular disease, cancer, chronic lung diseases and diabetes (Wang et al., 2016). The increasing burden of NCDs, which fall disproportionately on low-income countries (LICs), has made prevention and management of NCDs a global priority. In 2011, the United Nations convened a High-Level Meeting on NCDs, calling for whole-of-society, whole-of-government and multi stakeholder action to prevent and control NCDs (United Nations, 2011). The 66th annual World Health Assembly endorsed the World Health Organization (WHO) Action Plan for the prevention and control of NCDs 2013–2020 (World Health Organization, 2013). A report by the National Academy of Medicine focuses on strategies to better serve high need patients including those with more than one chronic condition (National Academy of Medicine, 2017).

One in three adults lives with more than one chronic condition, or multiple chronic conditions (MCC) and accrue a disproportionate health and cost burden (Marengoni et al., 2011). This figure is closer to three out of four in older adults living in developed countries and is predicted to rise dramatically (Buttorff et al., 2017), with the proportion of patients with four+ diseases almost doubling between 2015 and 2035 in the UK (Kingston et al., 2018). Yet the area of MCCs remains grossly understudied.

The purpose of this review is to provide an overview of the available evidence base on the health, economic and patient burden from MCC.

2. Methods

2.1. Data sources and availability

Data used for the report include searches conducted in the academic literature and ‘snowballing’ to identify other referenced articles and reports. A review of English language literature through May 15, 2017...
Prevalence estimates for MCC are highly heterogeneous with methodological differences, including the number of chronic conditions included in the count, leading to estimates that vary up to three-fold (Fortin et al., 2012). Most US-based studies use a list of 20 chronic conditions and symptoms such as depression and low back pain also included in the count, leading to estimates that vary up to three-fold (Fortin et al., 2012). In low-income countries (LIC) and middle-income countries (MIC), the top diseases similarly include IHD, stroke, diabetes and depression, but also communicable diseases such as diarrhea, HIV and malaria, and road traffic injuries.

Fig. 1 illustrates the global burden of chronic disease as measured by DALYs from 1990 to 2015. The shift over the last 25 years highlights the reduction in DALYs due to IHD, resulting from an increase in the prevalence of IHD but a reduction in mortality.

Fig. 2 demonstrates the burden of chronic disease by country-level income group in 2015. The combined burden of chronic diseases is greatest in LIC and largely attributed to the burden of HIV/AIDS. While the socioeconomic status (SES) of a country’s population can explain the variation in HIV/AIDS and IHD, this is not the case for other conditions such as low back pain, depression, and arthritis, which are relatively homogenous between countries with differing SES.

Various indices have been used to assess the number and severity of chronic diseases. Perhaps the most well-known of these is the Charlson Comorbidities Index and its adaptations, originally established to predict mortality in hospital patients (Yurvich et al., 2015). Other indices have been derived from medical data, medication groups, diagnoses groups (Starfield et al., 2005), or organ systems (e.g., Chronic Disease Score) (Ionescu-Ittu et al., 2007). However, the Charlson Comorbidity Index and other available measures are not widely or consistently used in reporting MCC (McPhail, 2016).

### 3. Observations

#### 3.1. Epidemiology of chronic conditions

The top conditions contributing to mortality and morbidity combined using disability adjusted life years (DALYs) in high-income countries (HIC) include ischemic heart disease (IHD), stroke, lung cancer, depression, diabetes and, back and neck pain (GBD, 2015). In low-income countries (LIC) and middle-income countries (MIC), the top diseases similarly include IHD, stroke, diabetes and depression, but also communicable diseases such as diarrhea, HIV and malaria, and road traffic injuries.

Fig. 1 Change Over Time for Age-standardized DALYs (rate per 100,000) for Leading Chronic Conditions (1990–2015) (GBD, 2015).
(Centers for Medicare and Medicaid Services, 2015), while some reviews include 40 diseases and up to 140 conditions (Salisbury et al., 2011; Barnett et al., 2012). UK prevalence estimates for MCC range from 16% (17 chronic conditions considered) to 58% (114 chronic conditions considered) (Salisbury et al., 2011). When including 10 physical chronic conditions, approximately 25.5% of the United States population were reported to have MCC, and the prevalence increases to 50% of adults 45 to 65 years, and up to 81% of adults older than 65 years (Ward et al., 2014). For adults over 50 years, rates of MCC vary from 45% in China to 71% in Russia (Garin et al., 2015).  

3.1.2. Future projections of MCC  
As populations age, the time people live with disability and chronic disease is increasing such that MCC prevalence rates are closer to three quarters of older adults in developed countries (Divo et al., 2014). A simulation model of UK primary care patients predicts a dramatic rise such that patients with four or more diseases will almost double between 2015 and 2035 (Kingston et al., 2018). Furthermore, two-thirds of those with four or more diseases are predicted to have poor mental (dementia, depression, cognitive impairment no dementia) (Kingston et al., 2018). The majority of gains in life expectancy (3.6 years in men, 2.9 years in women) will be spent with four or more diseases (2.4 out of 3.6 years or 65.9% in men; 2.5 out of 2.9 years or 85.2% in women), due to increased prevalence of, rather than longer survival with, MCC (Kingston et al., 2018).  

3.2. Global prevalence of MCC by chronic disease type  
Fig. 3 shows that the highest proportion of MCC is observed with chronic kidney disease (CKD) (82.1% have a secondary condition, in particular heart failure and diabetes) (Schneider et al., 2009). For diabetes, depression, and cancer, individuals were more likely to only have the primary condition.  

3.3. MCC and demographics  
In the US, women aged 18–64 are more likely than men to have MCC (Buttorff et al., 2017), to have two diseases (14.5% vs. 13.0%) and
three diseases (12.6% vs. 10.7%), but this may be attributed to a greater tendency for female health-seeking behavior (Ward et al., 2014). For those under age 45, there is considerable heterogeneity as to the primary chronic condition, but this diminishes for those aged over 45. More than half of those with cancer, COPD, or arthritis who are under 45 had MCC (Buttorff et al., 2017).

Globally, the relationship between SES and MCC is dependent on both geography and age. Fig. 4 reports prevalence ratios of MCC across SES groups and age from the World Health Survey (Afshar et al., 2015). Among adults under 55 years, there is a strong negative relationship between SES and MCC in most regions, which is most pronounced in Western Europe and Eastern Europe and Central Asia. This relationship does not hold for adults over 55 years, with no or only weak relationships seen in all regions, other than South East Asia where a positive relationship between SES and MCC is seen (Afshar et al., 2015). This is consistent with other studies in India that reported greater chronic disease (obesity, CVD and MCC) in higher SES groups (Subramanian et al., 2013; Arokiasamy & Uttamacharya, 2015). This geographical and age pattern may reflect the distribution of key risk factors for chronic diseases such as unhealthy diet, physical inactivity, tobacco use and alcohol consumption among SES groups, which are higher in wealthier populations in developing countries and lower income groups in developed countries.

### 3.3.1. Chronic disease clusters

There is a paucity of published comprehensive research on clusters of chronic conditions and their impact on patients, health systems and healthcare costs. One systematic review examining clusters included 39 studies and > 70,000,000 patients in 12 countries (Violan et al., 2014). Only three of the included studies used all chronic health conditions, remaining studies selected a variable number of conditions, which ranged between 5 and 335. The review provides a useful summary of MCC clusters, but the authors stated limitations due to heterogeneity in study design, sampling design (primary care sample vs. general population), age (as MCC is highly associated with age), and the definition used for MCC (Violan et al., 2014).

Table 1 provides a summary of available evidence for chronic disease clusters for the leading global chronic diseases (by DALYs) and their relationship with other chronic diseases. The most strongly associated clusters include Alzheimer’s disease and stroke (relative risk of 5.5) (Tatemichi et al., 1994), depressive disorders and stroke (relative risk of 3.2) (Huang et al., 2010), CVD and stroke alongside depression (odds ratio of 1.43) (van der Kooy et al., 2007), alongside long-term communicable diseases in developing countries such as TB and Diabetes (relative risk of 3.11) (Baker et al., 2012; Jeon & Murray, 2008), and HIV/AIDS and CVD (relative risk of 1.6–2.0) (Islam et al., 2012). Other conditions that cluster together strongly include TB and COPD, CVD and asthma, depressive disorders and low back pain, depressive disorders and Alzheimer’s disease, diabetes and depressive disorders, breast cancer and CVD, diabetes and osteoarthritis, and COPD and depressive disorders.

Existing studies have concentrated on disease combinations or chronic disease risk factors, with limited consideration of the potential impact of clustering of certain conditions. Clustering can occur by virtue of high prevalence rates, shared risk factors or due to causation of one condition by another. An alternate categorization of clusters is by concordance (shared risk factors or disease pathways) and discordance (seemingly unrelated conditions). It is important to distinguish between these categories in particular for the prediction and prevention of subsequent chronic conditions. The treatment and management of clusters of conditions may also be impacted upon by whether they are concordant vs. discordant. For example, medications for one condition (e.g., TB) might exacerbate another chronic condition (e.g., diabetes) or increase risks associated with the disease, particularly if the conditions are discordant (Magnan et al., 2015).

By tackling clusters rather than individual diseases, interventions and systems can tackle difficulties faced by patients including medication design, approaches to screening and detection, and care.
3.3.2. Tuberculosis and diabetes

A systematic review of 13 observational studies demonstrated DM is associated with more than a three-fold increased risk of developing TB (Baker et al., 2012; Jeon & Murray, 2008). Subgroup analyses revealed that this relationship was significantly stronger in non-North American countries. The mechanism of the increased risk is unclear as is whether the higher risk is due to reactivation of dormant TB or the acquiring of new infections. Some cross-sectional studies have shown a positive correlation between the presence of latent TB and diabetes (Hensel et al., 2016; Magee et al., 2015). Whether the latent TB is more likely to reactivate has not yet been reported. Furthermore, TB patients who have diabetes are less responsive to anti-TB medication (Baker et al., 2012).

The association between TB and diabetes is bi-directional; that is, patients with TB are also at higher risk of developing glycemic dysfunction and diabetes. The biological mechanism for this remains unclear and it may be the anti-TB medication, rather than the TB itself, that causes glycemic dysfunction.

3.3.3. TB and COPD

A systematic review of studies evaluating TB and COPD suggests the two chronic diseases occur together more frequently than by chance alone. COPD patients have a 3-fold higher risk of developing TB (Sarkar et al., 2017) and COPD is an independent risk factor for developing TB (hazard ratio = 2.47) (Lee et al., 2013). This could be due to their common risk factors of smoking, low SES, biomass fuel exposure and vitamin D deficiency (Sarkar et al., 2017).

3.3.4. Depression and chronic diseases

One study that examined the clustering of depression with other chronic diseases in a sample of adults aged 50–74 years (Pruchno et al., 2016) reported that as the number of chronic diseases increase, so do depressive symptoms. The prevalence of depressive symptoms was 10.5% with zero conditions, 14.4% with one condition, 20.8% with two conditions, 30.1% with three conditions, 37.3% with four conditions and 58.3% with five conditions (Pruchno et al., 2016). Research from the World Health Survey demonstrated that the prevalence of depression in respondents with chronic diseases was higher than in those without chronic diseases (Moussavi et al., 2007). Respondents with depression had the lowest health scores among chronic disease conditions. Furthermore, the decrement in health score from the combination of diabetes and depression was significantly greater than the sum of the two conditions separately (Moussavi et al., 2007).

3.3.5. HIV/AIDS and CVD

While the introduction of antiretroviral therapy (ART) has reduced the risk of HIV-related mortality worldwide, it has increased the risk of CVD among HIV patients. A meta-analysis of studies examining the relationship reported a substantially increased pooled relative risk (RR) of CVD of 1.61 (95% CI: 1.43–1.81) for HIV patients compared to HIV-uninfected people (Islam et al., 2012). HIV patients on ART treatment have an increased risk of CVD compared to both individuals with HIV who are not being treated (RR = 1.52; 95% CI: 1.35–1.70) and HIV-uninfected people (RR = 2.0; 95% CI: 1.70–2.37). The CVD risk also depends on the duration of ART; CVD risk may be higher after initiating ART, which may be mediated by an increase in dyslipidemia, a reduction in insulin sensitivity and increased body fat redistribution (Hemkens & Bucher, 2014).

3.3.6. Diabetes and stroke

While the increased risk of stroke among diabetics is well reported, the magnitude of risk varies by study population. One study comparing risk of stroke in diabetes patients between two cohort studies of different populations found that Japanese American men in the Honolulu Heart Program had a relative risk of stroke of 1.9 (95%CI: 1.5–2.4) whereas American men in the Framingham study had a higher relative risk of stroke.
risk of stroke of 3.1 (95% CI: 1.6–5.8) (Rodriguez et al., 2002). This difference in risk could not be explained by differing risk factor profiles alone.

3.4. The financial burden of MCC

MCC is associated with substantial increases in healthcare costs and resource utilization (McPhail et al., 2015) attributable to elevated use of primary care and specialist physician services, greater medication use, emergency department presentations and hospital admissions (both frequency of admissions and bed days) (McPhail et al., 2015).

Older age, undesirable lifestyle factors, and low SES have been consistently associated with the development of MCC (McPhail et al., 2015). Three important and interrelated challenges for contemporary healthcare policy include (Barnett et al., 2012):

- The aging nature of population demographics,
- Development of chronic diseases at younger ages,
- And socioeconomic inequalities in the distribution of MCC and its effects.

The scarcity of robust economic evaluations in the field represents a considerable challenge for resource allocation decision-making intended to reduce the burden of MCC. Although the literature is sparse, one systematic review and several published studies are summarized below.

3.4.1.1. Determining costs from multiple chronic conditions. The cost drivers of excess utilization, patterns of usage, physician access, medication use, bed utilization, out of pocket healthcare costs and cost effectiveness of interventions for MCC are summarized below and in Table 2.

3.5. Cost

Most studies to date have asserted a positive association between MCC and healthcare utilization outcomes (including physician visits, hospitalizations, use of medications) and healthcare cost outcomes (including medication, out of pocket, total healthcare expenditures) (Lehnert et al., 2011; Paed et al., 2009). In fact, several studies have reported a near exponential relationship, in which expenditures approximately doubled with each additional CC (Schneider et al., 2009; Wolff et al., 2002). This finding suggests costs for MCC are not simply additive but there is an interaction resulting in costs increasing exponentially, and this should be taken into account in reporting of costs from chronic disease.

3.6. Patterns of usage

MCC has been associated with higher levels of health resource utilization, including medications, primary care and outpatient specialist services, as well as emergency department presentations and hospitalizations (McPhail et al., 2016). For adults 65–69 years old in the US in 1999, data show the odds of incurring a hospital admission for an adverse event increase with the number of chronic conditions (Wolff et al., 2002). Both for ambulatory care sensitive conditions (OR: 1 = 7.49, 2 = 18.10, 3 = 36.43, ≥4 = 98.52) and preventable complications (1 = 6.02, 2 = 13.60, 3 = 29.17, ≥4 = 91.35) (Wolff et al., 2002). The greater use of non-emergency care for preventable conditions suggests some of the access utilization is avoidable.

There is considerable variation in the magnitude of increases in healthcare utilization (HCU) reported between studies, health systems and data sources from which study findings were derived. In terms of HCU, all evidence points to more complex in- and outpatient-care scenarios, with disproportionately higher use of services by specialists (Wolff et al., 2002), seeing a multitude of physicians (Anderson, 2010) and confronting them with more problems at each encounter (Beasley et al., 2004). In addition, MCC patients use significantly more prescription medications and have higher prescription drug expenditures (Mueller et al., 1997; Sambamoorthi et al., 2003).

Age and living arrangements (e.g. living alone) are positively associated with hospital use (Landi et al., 2004; Rapoport et al., 2004; Shelton et al., 2000; Librero et al., 1999; Condelius et al., 2008), and female gender and supplementary insurance are associated with an increased use of prescription medications (Sambamoorthi et al., 2003; Lawson et al., 2013), independent of the number of chronic conditions (CCs).

3.7. Physician access

Older adults with MCC utilize between two and five times more physician appointments than peers without chronic diseases (Xakellis, 2005; Paed et al., 2009; Schneider et al., 2009). A Canadian study reported 51% greater use of physician services for each additional chronic disease (Rapoport et al., 2004). People with MCC are also more likely to see a specialist physician for a CC that would fall within the scope of primary care service (Starfield et al., 2005).

3.8. Medication use

Several studies have found patients with three or more CCs had prescription medication costs that were 6.6 times greater than peers without CCs, and 2.1 times greater than peers with one or two comorbidities (Moxey et al., 2002). Amongst US Medicare beneficiaries, patients with five or more CCs used an additional eight prescriptions for each additional comorbidity during their last year of life (Fahlman et al., 2006).

3.9. Bed utilization

Greater emergency department presentations and hospital admissions are also reported. One US study found older patients with three or more CCs utilized 25 times more hospital bed-days during 14.6 times more hospital admissions than peers without any CCs (Schneider et al., 2009).

3.10. Out of pocket healthcare costs

Individual patients are also impacted by the elevated costs of MCC if they are responsible for healthcare usage costs (Smith et al., 2012). For example, the out-of-pocket expenses (OOPEx) are twice as high for older adults with MCC than those without MCC and the elderly and low-income families are disproportionately affected (Rogowski et al., 1997).

3.11. Cost effectiveness of interventions for MCC

The largest study, a Cochrane systematic review, examined the effect of primary care and community interventions for MCC patients and reported that cost savings were plausible for interventions related to pharmaceutical use and risk factor prevention but the cost-effectiveness of interventions was not reported (Smith et al., 2012). The authors postulated cost savings were plausible based on favorable intervention effects related to pharmaceutical use and reductions in chronic disease risk factors, but this cost effectiveness was not specifically reported. The paucity of cost-effectiveness data to inform allocation decisions related to MCC remains a concern.

3.12. Geographical variation in healthcare cost

The impact of MCC on healthcare costs and resources will likely differ across health systems, geographical regions, disease
3.13. Clusters of diseases

Existing studies have concentrated on disease combinations or chronic disease risk factors, with limited consideration of the potential impact of intervening in concordant versus discordant clustering of disease combinations (Damery et al., 2015; Hsieh et al., 2015; Katon et al., 2012; Panagioti et al., 2014; Candrilli et al., 2015; Tonelli et al., 2015).

3.13.1. Impact of MCC on patients and families

The impact of having MCC on the patient and caregivers remains underexamined but important considerations include their ability to work, remain productive lead independent lives, and further financial constraints due to out-of-pocket healthcare costs. Patients report compounded effects such as adhering to medication and self-care (Hajat & Kishore, 2018).

Research has indicated that MCC is associated with poorer physical function and functional decline, with on average 50% risk of functional decline with each additional condition (Kadam et al., 2007; Marengoni et al., 2009).
3.13.2. Unmet needs & challenges

Despite the increasing burden of MCCs across the world, intervention funding and political action are non-commensurate with major disparities between the burden of disease and the funding allocated (Dieleman et al., 2014), particularly in LICs and MICs. For example, in 2010, HIV/AIDS accounted for 3.7% of the burden of disease in LICs and MICs, whereas NCDs accounted for 49.8% of the burden. The development assistance allocated for health was just 2.3% for NCDs and 45.9% for HIV/AIDS (Dieleman et al., 2014).

Future projections suggest much of the life-expectancy gains will be spent with disability due to chronic conditions, such that the compression of morbidity, that is delaying the onset of chronic disease as far as possible, becomes increasingly pertinent (Fries et al., 1984). As a large proportion of chronic conditions contributing to MCC are amenable to prevention through lifestyle behavior change, compression of morbidity can only be achieved through early intervention through primary prevention of chronic conditions.

Unfortunately, traditional health systems and major disease programs rarely address the chronic diseases that occur together, instead taking a single-disease framework. For example, reports indicate physicians underestimate the presence of depression in cancer patients because oncology visits are focused only on physiologic treatment and symptom management (Passik et al., 1998). The shift from a single-disease focus to a broad consideration of other diseases was the result of a successful, multidisciplinary application of behavioral and social science that must be applied to all areas of health and medicine (Holland, 2002).

The literature on cost effectiveness of interventions that tackle more than one chronic condition is sparse and studies that exist highlight methodological problems with designing such studies (Smith et al., 2012). Regarding primary prevention, long-term or lifetime modeling of potential attainment of health and cost benefits are required to demonstrate tangible health benefits and reductions in health service utilization for MCC interventions (Drummond & McGuire, 2001; Weinstein et al., 2003).

Unfortunately, long-term modeling may also come with untenable levels of uncertainty such as determining how long lifestyle behavior change interventions will last (Lefèvre et al., 2014). Studies examining secondary prevention would require many years of ongoing intervention (and follow-up) among large samples before benefits can be directly observed such as the outcomes of myocardial infarction or stroke (Li et al., 2008; Lindström et al., 2013; Diabetes Prevention Program Research Group, 2015).

4. Opportunities for action and intervention

The opportunity to reduce the burden of MCC lies with healthcare providers, the pharmaceutical industry, policy makers, the digital health industry, and the broader public health community. There have been some promising advances in tackling MCC, particularly in the field of high technology solutions. The emerging solutions and models target issues of MCC burden, functional health, quality of life and health care costs. However, many other opportunities exist, including measures for prevention, health systems and professionals, and smarter and tailored development of medication and patient support systems.

Public health prevention of chronic conditions may be the most impactful in terms of cost and health outcomes. Distinguishing between modifiable and non-modifiable risk factors is critical for developing effective interventions that prevent the onset of disease. Beyond prevention, healthcare systems should develop models of care and systems that facilitate cross-condition management. For example, using symptom-based care guidelines in resource-poor settings can empower non-physician prescribing and be an effective strategy for simultaneously managing communicable and NCDs (Fairall et al., 2005). Further, patients with few concordant chronic conditions should be targeted as potential patients at risk of suboptimal care, since these patients are often earlier in their disease progression. Empowering and educating physicians can improve patient health, given the impact physician-patient relationships, including time, rapport, communication and trust, can have on patients care and personal health (Hajat & Yach, 2015).

Efforts to increase adherence to medication among those with chronic diseases could improve health and reduce healthcare costs (Berg et al., 1992). For example, fixed-dose combination medicine, which combines multiple medications into a single pill, can simplify treatment regimens and increase adherence (Bangalore et al., 2007). Other technology providing adherence data to patients and their caregivers can improve adherence (Frias et al., 2017). Technological innovations provide the tools to support on-demand physician care in areas with physician shortages low resources (Eccles, 2012). Artificial intelligence provides opportunities to maximize care for patients with MCC by predicting drug receptivity, adherence and interactions, while using data repositories to provide personalized care and targeted disease management (Mukherjee, 2017).

5. Conclusions

Existing data suggest that between 16–57% of adults in developed countries suffer from more than one chronic condition. Developing countries now need to deal with the double burden of long-term communicable conditions alongside NCDs, with clustering and causality between common conditions. From the relatively sparse evidence-base, MCC has been shown to be associated with substantially greater increases in healthcare costs and different patterns of resource utilization. The increasing proportion of older adults in the population, increasing proportion of younger adults with MCC who will live to advanced ages, together with the predicted increase in prevalence of those living with MCC, all have worrying implications for policy and healthcare funding. Compression of morbidity through prevention of chronic disease would be the most impactful approach and requires lifetime lifestyle behavior change.

There are substantial gaps in the knowledge base, such as taxonomy, availability and consistency of data, and economic evaluations of interventions. Furthermore, the major sources of data don’t directly report on or tackle MCC and the evidence increasingly provides strong justification for a shift in this approach. The concerns of patients with MCC, such as the presence of chronic pain and the inability to remain in work, are not yet widely recognized or reported.

Prominent findings include the sharp rise in healthcare costs with each additional chronic condition, in addition to clustering of chronic conditions, which further increase and complicate the health and cost burden from MCC. Both of these attributes should be taken into account for health system design in moving away from a single-disease framework towards a patient-centered model that deals with several chronic conditions. An innovative approach to existing health system payment models would help to facilitate this shift.

Clinical practice guidelines, which primarily focus on single diseases, fail to consider how MCC should be managed, particularly among older adults. Guiding principles for older adults with MCC proposed by the American Geriatrics Society offer new directions for clinicians to provide more appropriate care (Boyd et al., 2012). Incorporating patient preferences into medical decision-making, framing medical decisions in the context of risks, burdens, benefits, and prognosis, considering treatment complexity and feasibility and prioritizing treatments with high benefit and little harm can enhance quality of life and promote patient-centered health outcomes among patients with MCC.

Interventions for MCC are lacking. A few initiatives promise to be impactful, including measures to increase medication adherence (such as fixed dose combination medication) and multi-condition management (such as patient-based guidelines). There is a need for healthcare providers to rethink and test new models of healthcare provision to
prepare for future escalating costs of managing MCC in aging populations.

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