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Multimorbidity in Older Adults

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Multimorbidity, the coexistence of 2 or more chronic conditions, has become prevalent among older adults as mortality rates have declined and the population has aged. We examined population-based administrative claims data indicating specific health service delivery to nearly 31 million Medicare fee-for-service beneficiaries for 15 prevalent chronic conditions. A total of 67% had multimorbidity, which increased with age, from 50% for persons under age 65 years to 62% for those aged 65–74 years and 81.5% for those aged ≥85 years. A systematic review identified 16 other prevalence studies conducted in community samples that included older adults, with median prevalence of 63% and a mode of 67%. Prevalence differences between studies are probably due to methodological biases; no studies were comparable. Key methodological issues arise from elements of the case definition, including type and number of chronic conditions included, ascertainment methods, and source population. Standardized methods for measuring multimorbidity are needed to enable public health surveillance and prevention. Multimorbidity is associated with elevated risk of death, disability, poor functional status, poor quality of life, and adverse drug events. Additional research is needed to develop an understanding of causal pathways and to further develop and test potential clinical and population interventions targeting multimorbidity.

aged; chronic disease; comorbidity; prevalence

INTRODUCTION

Multimorbidity, the coexistence of 2 or more chronic conditions, has become widely prevalent through the third phase of the epidemiologic transition, which is characterized by a decline in mortality rates combined with an aging population (1). Recognizing the importance of multiple chronic conditions, primary care practitioners have adopted a patient-centered focus on multimorbidity, and researchers are increasingly interested in understanding the phenomenon. In developed countries, the prevalence of multimorbidity in the older population and its impact on health-care expenditures have led health agencies to begin to address the problem and explore ways to improve health and function (2).

Comorbidity, the conceptual predecessor of multimorbidity, was originally defined by Feinstein as "any distinct additional clinical entity that has existed or may occur during the course of a patient who has the index disease under study" (3, pp. 456–457). This initial disease-centered approach to research might have led to a predominant focus on the uncomplicated "index" disease and resulted in a paucity of information about the complex and all-too-common multimorbid patient.

The purpose of the present review was to examine several questions related to multimorbidity and comorbidity: 1) What is the prevalence of multimorbidity in older adults, particularly those living in the community? 2) How does multimorbidity affect health outcomes? 3) What are the implications of multimorbidity for public health and medicine? We examined population-based data on an extremely large sample of US Medicare enrollees and conducted a systematic literature review to address the first question, and we conducted a survey of the literature to address the second and third questions.

MATERIALS AND METHODS

We defined multimorbidity as the presence of 2 or more chronic conditions, consistent with the US Department of Health and Human Services framework (4). We limited prevalence studies to those reporting results for community samples, and we excluded samples sourced solely from care settings or limited to younger age groups.

Table 1. Percentage of Medicare Beneficiaries With Selected Chronic Conditions, by Age and the Presence of Comorbidity, United States, 2008[a]

Chronic Condition	Prevalence, %		% With Comorbidity
	Overall	Age ≥65 Years	
Hypertension	56.2	59.6	93.5
Hyperlipidemia	42.8	45.4	94.9
Ischemic heart disease	32.0	34.5	96.1
Diabetes	26.6	26.9	95.1
Arthritis	20.8	22.2	93.6
Heart failure	16.8	18.0	98.7
Depression	13.1	10.7	90.0
Chronic kidney disease	12.7	13.1	98.1
Osteoporosis	12.4	13.9	92.4
Alzheimer's disease	11.0	12.6	94.0
Chronic obstructive pulmonary disease	10.9	11.1	96.6
Atrial fibrillation	7.7	8.9	97.9
Cancer[b]	6.5	7.4	91.3
Asthma	4.5	4.0	95.4
Stroke	4.3	4.6	98.5

Abbreviation: CMS, Centers for Medicare and Medicaid Services.

[a] Data were obtained from CMS administrative claims data, January–December 2008, accessed from the CMS Chronic Condition Data Warehouse (5). Adapted from *Chronic Conditions Among Medicare Beneficiaries, Chartbook, 2011 Edition* (6) data tables.

[b] Cancer sites included the breast, colon, lung, and prostate.

Medicare population

The Centers for Medicare and Medicaid Services developed a database of administrative claims data for 100% of Medicare beneficiaries who were continuously enrolled in fee-for-service coverage in Medicare Parts A and B for the entire year of 2008. The presence of each of 15 chronic conditions (listed in Table 1) was identified through claims data on the basis of evidence of treatment or service delivery for each condition. "Cancer" included breast, colon, lung, and prostate cancer. A complete description of the methodology, including attribution of chronic conditions, can be found at the Chronic Condition Data Warehouse website (5). The number of chronic conditions was counted for each person and grouped in various ways for analysis. Figures and tables were adapted from the summary data for the Centers for Medicare and Medicaid Services' *Chronic Conditions Among Medicare Beneficiaries, Chartbook, 2011 Edition* (6) or from summary analysis (Kimberly Lochner, Centers for Medicare and Medicaid Services, personal communication, 2012).

Systematic review

We searched for articles that described the prevalence of multimorbidity in studies conducted in the general population. Using Medical Subject Headings and keywords, we conducted an electronic literature search of the PubMed database for English-language articles published between 1980 and May 2012. The complete search (shown in the Appendix) was conducted, and then articles on nonhuman and nonelderly studies were excluded. We included some papers identified through manual searching and some citations from other reviews and those recommended by selected experts, including unpublished manuscripts. We reviewed the abstracts to exclude articles that were not eligible. This review excluded studies conducted only in health-care settings, such as primary care offices or inpatient hospitals; studies without older adults aged ≥65 years; and studies that did not report the overall or age-specific prevalence of multimorbidity. Studies with sample sizes under 500 were excluded as well. Articles were not subjected to quality assessment. We reviewed the full text of retrieved papers. We extracted data on prevalence by age group for groupings above 59 years from articles that met all inclusion criteria.

RESULTS

Medicare population

A total of 30,923,846 persons were enrolled in Medicare fee-for-service continuously during 2008, of whom 16.5% were under 65 years of age and were eligible because of disability or end-stage renal disease. The most prevalent chronic conditions were hypertension, hyperlipidemia, and ischemic heart disease (Table 1). The least prevalent chronic conditions were atrial fibrillation, cancer, asthma, and stroke, each occurring in less than 10% of the population. Among persons with the 15 "index" conditions of interest, the vast majority had at least 1 other comorbid condition, ranging from 90% for those with depression to 98.7% for those with heart failure.

In 2008, 33% of Medicare beneficiaries had 0 or 1 chronic condition, whereas 67% had multimorbidity (2 or more chronic conditions), and the prevalence of multiple chronic conditions increased with age (Figure 1). The prevalences of 4, 5, and 6 or more chronic conditions increased with age, and this was most pronounced for 6 or more conditions (Figure 1). The most prevalent combination of 2 chronic conditions was hypertension and hyperlipidemia, and the most prevalent combination of 3 conditions was hypertension, hyperlipidemia, and ischemic heart disease; both combinations would be predicted from the individual prevalence rates.

In 2008, 67% of Medicare beneficiaries had multimorbidity, and its prevalence increased with age, from 62% between 65 and 74 years of age to 81.5% at ≥85 years of age (Table 2). Within each age group, women had a higher prevalence of multimorbidity than men, most prominently in the youngest age group and less so above age 85 years.

Prevalence of multimorbidity

Through the article selection process (Figure 2), we identified 17 studies on the prevalence of multimorbidity. The

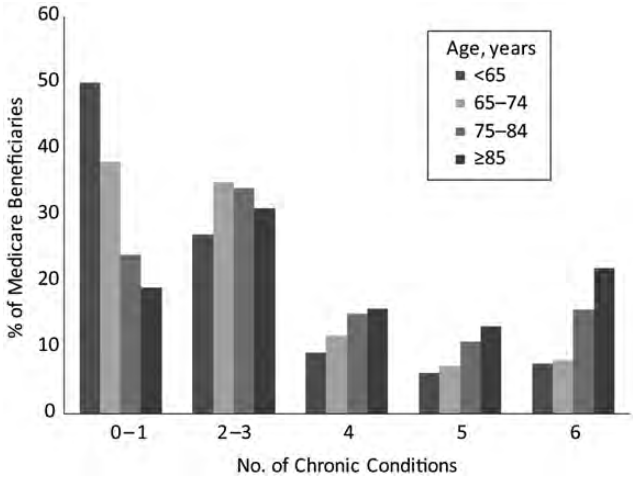

Figure 1. Percentage of the US population enrolled in the Medicare program, by number of chronic conditions and age group, 2008. Data were obtained from Centers for Medicare and Medicaid Services (CMS) administrative claims data, January–December 2008, accessed from the CMS Chronic Condition Data Warehouse (5). The graph was adapted from *Chronic Conditions Among Medicare Beneficiaries, Chartbook, 2011 Edition* (6).

final sample of prevalence studies contained national rates reported from the United States, Australia, Canada, Ireland, Israel, and Spain and regional or local rates from many European nations (Table 3) (7–22). The sample sizes of studies ranged from approximately 1,000 to nearly 31 million, with the largest sample sizes being from Medicare claims databases. Study methods included the use of national samples, claims databases, and recruited geographic cohorts. Most studies relied on a self-reported diagnosis from a health professional or used diagnostic codes or use of medications from administrative claims data, but a few used direct clinical assessments or mixed methods. The number of chronic conditions considered ranged from 7 to more than 30.

Age-specific and overall prevalence rates extracted from the articles are summarized in Table 3. The prevalence of multimorbidity in the reviewed studies ranged from 13% (10) to 83% (age ≥75 years) (16), with a median of 63% and a mode of 67%. The prevalence rates were lower for studies that included fewer than 10 chronic conditions (Table 3). The prevalence rates were higher in studies that included a greater proportion of persons over age 75 years (data not shown).

DISCUSSION

The prevalence of multimorbidity is greater than 60% worldwide and is probably greater than 80% among persons aged ≥85 years. The differences in prevalence rates between the studies were probably due to methodological differences rather than true differences; no 2 studies used the same methods, so there is no comparability. Key methodological issues included the type and number

Table 2. Percentage of Medicare Beneficiaries With Multimorbidity (≥2 of 15 Selected Chronic Conditions[a]), by Age and Gender, United States, 2008[b]

Age, years	Prevalence, %		
	Men	Women	Overall
<65	45.7	55.4	50.3
65–74	59.9	63.9	62.0
75–84	73.4	77.4	75.7
≥85	79.5	82.3	81.5

Abbreviation: CMS, Centers for Medicare and Medicaid Services.
[a] A complete list of chronic conditions is given in Table 1.
[b] Data were obtained from CMS administrative claims data, January–December 2008, accessed from the CMS Chronic Condition Data Warehouse (5). Adapted from *Chronic Conditions Among Medicare Beneficiaries, Chartbook, 2011 Edition* (6) data tables or from summary analysis (Kimberly Lochner, CMS, personal communication, 2012).

of chronic conditions included in the case definition of multimorbidity, how they were measured, the number of diseases defining multimorbidity, and the source population. The reported prevalence of multimorbidity was lower in studies that considered fewer than 10 chronic conditions. This sample of studies was not large enough to delineate other relations with methodological factors. Among older adults with any of the 15 index conditions, more than 90% had comorbid conditions from this set of conditions. Because the Medicare population under 65 years of age is eligible for the program largely because of disability, the multimorbidity prevalence rate in this age group is probably biased. The results for persons aged ≥65 years, however, are representative of the entire US population inasmuch as they come from a sample of more than 30 million adults enrolled in fee-for-service Medicare. The prevalence rates of individual chronic conditions, which are based on ascertainment from billing data, are generally consistent with other studies that have used such data. They tend to be higher than the rates reported in studies that used clinical methods; for example, the prevalence of heart failure in this study was 18% in the older adults, versus 5%–15% in national data from the United States (23).

The present review encompassed 17 population samples, including 5 that were more recent than a recent review by Fortin et al. (24). Fortin et al. incorporated only 13 population-based estimates, 2 of which did not meet our criteria. Although Fortin et al. rated articles for quality, all studies were rated as good, and apparently no studies were excluded on the basis of the quality assessment. Nevertheless, similar methodological concerns were observed, and similar conclusions were drawn.

Definition of multimorbidity

The underlying concept of a disease or health condition is that of a deviation from the normal state, with a dependency on basic science and convention to meet this criterion.

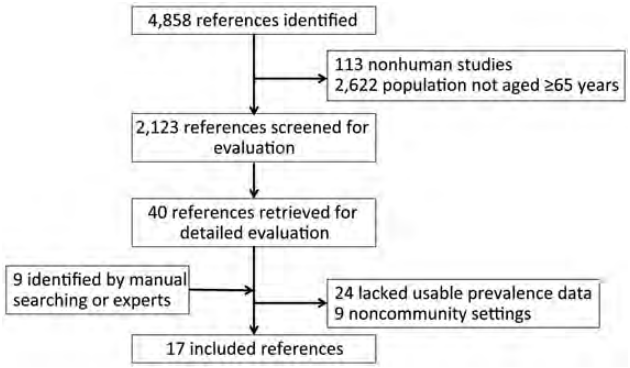

Figure 2. Number of references identified at each stage of a systematic review of multimorbidity among older adults.

For example, hypertension and hyperlipidemia are known risk factors for ischemic heart disease that were recognized as diseases at different times, and their definitions evolved differently. Chronicity is based on expected or actual duration of the condition. More recently, debate has arisen over whether to consider obesity a chronic condition, and, as a practical matter, its inclusion would considerably modify the prevalence of multimorbidity, especially in younger populations. Obesity was not included in the reviewed studies. The choice of how many chronic conditions to include, together with their individual prevalence rates, most strongly drives the prevalence of multimorbidity. Some authors recommend a minimum number, such as 12, but do not specify whether the choice should be based on prevalence or health burden (24). Although inclusion of a long list of less common conditions might increase the prevalence of multimorbidity, it would increase the complexity of the methods. Geriatric conditions, such as incontinence and falling, should be considered for inclusion in future multimorbidity research because they have routinely been omitted from the studies reviewed here.

Comorbidity recognizes timing factors in that the index condition came first, whereas multimorbidity requires only concurrent occurrence. Another factor related to timing is the concept of duration or chronicity, which is also somewhat arbitrary. Usual definitions of chronic disease require a typical course lasting 1 year at a minimum. Some studies, focusing on patient complexity, have not excluded acute illness. However, inclusion of acute illness is undesirable because it inflates multimorbidity rates unnecessarily. Other definitions that recognize complexity also address disease severity or its typical impact on health outcomes.

The validity and reliability of the method used to ascertain a chronic condition affect the measured prevalence of multimorbidity. Few studies used clinical examination at the time of measurement, and most relied on self-report (on a questionnaire) of a clinician's diagnosis or the submission of a bill that included diagnostic codes of interest. The latter methods have well-known strengths and limitations but are generally acceptable for measuring population-level data. Claims data rely on service delivery and accurate coding of the reason for treatment. However, treating multimorbidity in intervention studies and clinical practice requires highly accurate case-finding and should incorporate clinical assessment. Although some authors recommend use of multiple sources based on logic, the method is not tested and requires procedures for resolving disagreement between sources. One study used medication prescribed for specific chronic conditions as a marker for the illness, and this could have led to misclassification due to off-label drug prescriptions and omission of treatment for some persons for various reasons.

The choice of 2 or more chronic conditions as a definition of multimorbidity, though preferred by the US Department of Health and Human Services in its framework, is not universally accepted. The cutpoint of 3 or more was reported in a few of the articles examined in the present review. Some authors prefer to use an organ system or domain approach to reduce overlap, and it might be easier to summarize diagnostic codes and measure prevalence with such an approach. Although the use of multiple case definitions has some appeal, further research is needed to understand the strengths and weaknesses of these options.

A standardized case definition for multimorbidity is desirable for surveillance and public health analysis. Using a standardized definition and conducting studies in multiple source populations would improve understanding of other methodological issues regarding the differences between large regional or national samples.

Source population

We chose a general community population for maximum potential comparability. However, differences in the rates of institutionalization could influence differences in multimorbidity prevalence between communities because institutionalized elders are likely to be highly multimorbid. Using a national health-care program such as Medicare as the frame probably ensures inclusion of persons who are institutionalized for part or all of the year. Many excluded studies used health-care setting as a base, most commonly the person's primary care practice. This probably excluded disease-free persons who were not seeking health care. Britt et al. (16) used a primary care sample but adjusted their estimates on the basis of survey results indicating the proportion of persons who did not receive any care. Furthermore, care-based samples might overrepresent the multimorbid patients, who have frequent need for service or highly complex care. This could be an advantage for certain projects that aim to better understand or intervene in the care of the complex patient.

The concepts of comorbidity and multimorbidity have strengths and limitations, which roughly correspond to clinical and public health applications, respectively. The concept of comorbidity has clinical utility in identifying specific combinations that could require an alternative diagnostic or therapeutic approach. Ideally, clinical guidelines should deal with common comorbid conditions. The concept of multimorbidity could be useful for public health surveillance, the identification of common risk factors, and systems-based approaches to treatment and prevention.

Table 3. Prevalence of Multimorbidity in the General Population and Study Sample and Related Characteristics

First Author, Year (Reference No.)	Country	No. of Persons	Age, years	Data Source	No. of Conditions Considered	Prevalence of Multimorbidity, %
Verbrugge, 1989 (7)	United States	16,148	≥55	National sample survey; self-report	13	63.1
Hoffman, 1996 (8)	United States	34,459	All	National sample survey; self-report	All chronic conditions classified by ICD-9 codes	69 (age ≥65 years)
Fuchs, 1998 (9)	Israel	1,487	75–94	Community survey; self-report	14	64.5
Menotti, 2001 (10)	Finland, the Netherlands, Italy	716 (Finland), 887 (the Netherlands), 682 (Italy)	Men 65–84	Geographically recruited cohorts; clinical examination	7	23.3 (Finland), 13.1 (the Netherlands), 15.3 (Italy)
Wolff, 2002 (11)	United States	1,217,103	≥65	Medicare claims data; sample	23 groups	65
Partnership for Solutions, 2004 (12)	United States	NR	All	National sample survey; self-report	All chronic conditions classified by ICD-9 codes	67 (age ≥65 years)
Rapoport, 2004 (13)	Canada	17,244	>20	National sample survey; self-report	22	54.7 (age 60–79 years), 64 (age ≥80 years)
Naughton, 2006 (14)	Ireland	316,928	≥70	National pharmacy claims database; drug dispensing	9	60.4
Broemeling, 2008 (15)	Canada	NR	≥12	National sample survey; self-report	7	35 (age 60–79 years), 48 (age ≥80 years)
Britt, 2008 (16)	Australia	9,156	All	National sample of 305 general practitioners	8 domains + cancer	75 (age 65–74 years), 83 (age ≥75 years)
Nagel, 2008 (17)	Germany	13,781	50–75	Geographically recruited cohort; self-report	13 groups	67.3
Marengoni, 2008 (18)	Sweden	1,099	77–100	Geographically recruited cohort; clinical assessment	30	55
Schram, 2008 (19)	The Netherlands	2,463 (LASA), 3,550 (Rotterdam), 599 (Leiden)	55–94 (LASA), ≥65 (Rotterdam), 85 (Leiden)	Geographically recruited cohort; self-report and clinical examination, varying by site	12 (LASA), 15 (Rotterdam), 13 (Leiden)	56 (LASA), 72 (Rotterdam), 67 (Leiden)
Schneider, 2009 (20)	United States	1,649,574	All	Medicare claims data; sample	6	20
Loza, 2009 (21)	Spain	2,192	>20	National sample survey; self-report	All diseases	30
Centers for Medicare and Medicaid Services, 2011 (present report)	United States	30,923,846	All	Medicare claims data; all fee-for-service	15	62 (age 65–74 years), 76 (age 75–84 years), 81 (age ≥85 years)
Kirchberger, 2012 (22)	Germany	4,127	65–94	Geographically recruited cohort; self-report	13	58.6

Abbreviations: ICD-9, *International Classification of Diseases*, Ninth Revision; LASA, Longitudinal Aging Study Amsterdam; NR, not reported.

The question arises: How useful is multimorbidity as a concept for future studies? Considerable research has indicated a link between multimorbidity and health-service utilization, including hospitalization and total costs of health care (11, 25). Although rooted in the medical model of disease, multimorbidity, as examined in this review, omits the geriatric syndromes, which are important clinical entities that are chronic and prevalent and impact the health of the older population (26). The ascertainment of geriatric syndromes, such as incontinence or falls, is considerably less complete in health-care records and billing systems and would likely require clinical assessment or patient self-report methods.

In addition, the concept of frailty deserves consideration in comparison with multimorbidity as an overall marker for risk of poor health outcomes in the older population. Bergman et al. described the central feature of frailty as "increased vulnerability to stressors due to impairments in multiple, inter-related systems that lead to decline in homeostatic reserve and resiliency" (27, pp. 731–732). Unfortunately, the complex relation between frailty and chronic disease is not well understood and has been difficult to characterize. Ultimately, the two concepts could be distinct, which would help explain why some persons with frailty have no adverse outcomes, some frail persons have no chronic conditions, and some persons with a single chronic condition are frail and vulnerable to poor outcomes. Among the proposed operational definitions of frailty, one approach bridges multimorbidity, early disability, and the geriatric syndromes through the "accumulation of multiple deficits" (28, 29). This approach includes many potential deficits, including at least 10 chronic conditions, and has been shown to be predictive of death. If this approach to frailty measurement proves successful, it would suggest that multimorbidity might be a part of the overall concept of frailty. This would have profound implications for risk assessment, treatment, and prevention of multimorbidity.

RISK FACTORS FOR MULTIMORBIDITY

Despite the prevalence of multimorbidity, little work has focused on elucidating its causes. A systematic review covering 1993–1997 found only 4 articles on the causes of multimorbidity, with a focus on genetic links to combinations that occurred more frequently than would be expected by chance (30). The present review identified 2 recent articles that assessed socioeconomic risk factors for multimorbidity (17, 31). Childhood financial hardship and lifetime earnings were associated with multimorbidity, with the latter exerting a modest protective effect (31). Lower educational level was associated with multimorbidity, and the relation was explained partly by body mass index (weight (kg)/height $(m)^2$) (17). Identification of risk factors or underlying causes would be quite helpful in developing multimorbidity prevention strategies.

The leading chronic-condition causes of death can be attributed to 4 major underlying risk factors: tobacco use, unhealthy dietary patterns, alcohol consumption, and physical inactivity (32, 33). A substantial body of evidence demonstrates how these factors lead to various individual chronic conditions, although they have been studied infrequently in relation to multimorbidity. The 4 risk factors themselves cluster in the population (34), which creates both a challenge and an opportunity in terms of multimorbidity prevention. Chronic disease prevention activities likely to have the greatest population impact include tobacco control, salt reduction, and the use of multidrug regimens for secondary prevention of cardiovascular disease (35).

More research is needed on the etiology of multimorbidity, particularly on shared risk factors and combinations of conditions that occur more frequently than would be expected by chance. Identification of multimorbidity clusters that occur more frequently than would be expected by chance alone could serve as a source for testing whether there is a common underlying factor. Clinical and community prevention trials should examine multimorbidity as a secondary composite outcome.

HEALTH OUTCOMES OF MULTIMORBIDITY

Epidemiologic studies have demonstrated that multimorbidity, defined by the number of chronic conditions, is associated with an increased risk of death, disability, poor functional status, poor quality of life, adverse drug events, and other adverse outcomes. Gijsen et al. reviewed 78 articles about the consequences of comorbidity published between 1993 and 1997, concluded that "comorbidity in general does affect health outcomes" (30, p. 670), and noted substantial evidence for mortality, functional status, and quality of life.

Death or survival time is an important patient outcome, but for older persons with multiple chronic conditions, it might not be the primary consideration in terms of patient preference. Gijsen et al. (30) found 35 studies of the relation of multimorbidity to all-cause death among regional cohorts, registries, or hospital inpatients; the methods varied, and duration of follow-up ranged from 30 days to 22 years. Nearly all of the studies demonstrated a relation of multimorbidity to mortality rate. Comorbidity index or a simple disease count was significantly related to mortality rate in 12 of 14 studies, and some of the studies adjusted for important clinical variables. The findings were not completely consistent for specific disease combinations, although samples were small for most combinations.

Functional status includes aspects of physical and cognitive function and daily activities of life. Some researchers have combined functional status with other measures, such as aspects of quality of life, self-rated or self-perceived health, general life satisfaction, and many additional concepts, including emotion, sleep and rest, energy, and vitality. Researchers have taken 2 broad approaches to quality-of-life measurement: generic measures and disease-specific measures. In addition, some researchers have focused on problems in defined patient groups or areas of function.

Gijsen et al. (30) identified 24 articles, 6 prospective and 18 cross-sectional, about the relation of multimorbidity to functional status and quality-of-life outcomes. The weight of the evidence supported a relation between multimorbidity count or a comorbidity index and poor outcomes, although evidence for specific combinations varied. Among persons with diabetes mellitus, parkinsonism, and respiratory

diseases, having another comorbid disease increased the risk of poor outcomes. Verbrugge et al. (7) reported specific combinations associated with higher risk of disability. Specific examples included stroke with diabetes mellitus, osteoporosis, or hip fracture; visual impairment with osteoporosis; and heart disease with cancer. Tinetti et al. (36) reported specific combinations that prospectively led to more than additive risk of functional impairment, including heart failure with chronic obstructive pulmonary disease, as well as depression with heart failure, osteoarthritis, or cognitive impairment.

Fortin et al. (37) reported the results of a systematic review of the relation of multimorbidity to quality-of-life outcomes that was based on 30 published articles, only 2 of which overlapped with the review by Gijsen et al. (30). The studies were predominantly cross-sectional, and 25 of them used tools from the Medical Outcomes Study, such as the Short Form 36. There was methodological heterogeneity in terms of multimorbidity measurement and population sources. Overall, an inverse relation was observed between the number of medical conditions and quality of life in the physical domains. Among persons with 4 or more conditions, Fortin et al. (37) reported an inverse relation with social and psychological dimensions of quality of life as well. More recent large, national, cross-sectional studies of multimorbidity and quality of life have confirmed the general findings and identified subtle effects of multimorbidity on positive affect (38, 39).

Universal health outcomes that transcend individual disease outcomes are needed for further research and clinical care of multimorbidity. The National Institute on Aging convened an expert panel to evaluate the potential for such outcome measures. The panel concluded that a 2-stage outcome measurement would be optimal: 1) a composite measure such as the Short Form 36 or an instrument from the National Institutes of Health Patient-Reported Outcomes Measurement Information System (PROMIS), along with a performance measure such as gait speed, and 2) selective use of short follow-on measures targeted toward symptom burden, depression, anxiety, and daily activities (40). Routine assessment of persons with multimorbidity for their subsequent clinical outcomes could facilitate system-based care improvement and clinical effectiveness research.

TREATMENT AND SELF-MANAGEMENT OF MULTIMORBIDITY

Although primary prevention of multimorbidity might be possible by targeting common risk factors such as smoking or diet, proving the benefit would require trials with large sample sizes and long follow-up. Interventions targeting multimorbidity have focused rather on treatment of prevalent cases, either through changes in health-care delivery or through patient-oriented education or self-management support.

Smith et al. (41) reviewed the effectiveness of interventions designed to improve outcomes in patients with multimorbidity, in either primary care settings or community settings. They identified 10 studies, of which 8 enrolled persons with multimorbidity and 2 enrolled persons with depression and specific comorbid conditions. Six studies altered the delivery of care (case management, care coordination, or multidisciplinary team skill improvement), and 4 used patient-oriented behavioral interventions. The results were mixed, but the authors concluded that the interventions which focused on specific behavioral risk factors, medication management, or functional ability were more likely to improve health outcomes. The single effective patient-oriented intervention lowered mortality rate with a focus on functional difficulty and fall prevention. One common thread in these studies was interprofessional collaboration. Sustainability was enhanced by integrating interventions into existing health-care systems. The authors suggested that chronic disease management, though based on a single-disease paradigm, likely was evaluated in persons with multimorbidity, albeit ones selected to exclude the sickest individuals (41). This suggests that disease management programs might provide another platform for building potentially effective multimorbidity interventions.

More integrated approaches to treatment of multimorbidity should be evaluated for their effectiveness in important health outcomes. Starting studies in persons with specific combinations of multimorbidity and subsequently testing promising interventions in wider cohorts of patients with multimorbidity could be a fruitful research strategy.

POLICY IMPLICATIONS: CLINICAL AND SOCIETAL

The high prevalence of multimorbidity and comorbidity in older populations demonstrates tremendous heterogeneity and has profound clinical ramifications. The need for complex clinical care to deal with the individual conditions as well as with multimorbidity has urgent societal consequences. In particular, multimorbidity consumes considerable societal resources and demands the development of novel systems approaches. Polypharmacy and inadequate care guidelines are 2 examples of how multimorbidity exposes the vulnerability of older adults to suboptimal health care.

The prevalence of multiple chronic conditions that require pharmacotherapy drives polypharmacy, particularly among older adults, and has considerable potential for adverse drug effects and drug-disease interactions. Lindblad et al. defined drug-disease interaction as "exacerbations by medications of pre-existing diseases, conditions or syndromes" (42, p. 1134). An expert panel that evaluated drug-disease interactions for clinical importance in the older population identified 28 such combinations with a prevalence of at least 15% (42). The health impact of the problem has not been quantified, but it substantially contributes to the adverse outcomes described for the multimorbid population.

Guidelines for chronic disease treatment frequently omit consideration of multimorbidity, despite the potential for significant health effects. With the observed comorbidity prevalence of >90% among Medicare beneficiaries, adapting guidelines to better address common comorbidities seems imperative. Because guidelines drive care in certain settings, they also can form the basis for the evaluation of

quality of care. Consequently, the omission of multimorbidity from guidelines can have far-reaching and adverse implications.

Setting clinical priorities can be difficult for persons with multimorbidity and the clinicians who care for them. When faced with competing outcomes in clinical decision-making, older persons with multimorbidity are able to prioritize by using universal health outcomes (43). Achieving concordance between multimorbid patients and their health-care providers is possible but can be impaired by poor health status or competing demands, such as financial issues (44).

CONCLUSIONS

Agreement on a definition of multimorbidity could lead to refinements in research and treatment and the ability to make substantial progress on health improvements for the older population. Routine measurement and reporting would enable the tracking of progress against multimorbidity and foster a public health approach. Much more work is needed to develop an understanding of causal pathways and to propose potential clinical or population interventions targeting multimorbidity. Recognizing and focusing on multimorbidity will require methods that embrace complexity and patient-centeredness and that complement disease-specific and reductionist approaches. Such efforts ultimately might reduce morbidity and increase life span.

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APPENDIX

PubMed Search Strategy

((((((((((comorbidity[MeSH Terms]) OR co-morbidity)) AND study, prevalence[MeSH Terms])) AND ((chronic disease[MeSH Terms]) OR population))) OR (((((((multimorbidity) OR multi-morbidity) OR multiple diseases)) AND Prevalence[MeSH Terms])) AND ((chronic disease[MeSH Terms]) OR population)))) AND English[Language])) AND (“1980/01/01”[Date - Publication] : “3000”[Date - Publication])