

COMPASS Expansion Workgroup

Expanding the Scope of the COMPASS Program

June 2015

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Executive Summary

Overview

Care of Mental, Physical, and Substance Use Syndromes (COMPASS) is a collaborative care management model designed to improve treatment outcomes for patients with multiple chronic conditions (MCC), but is currently limited to treating depression, diabetes and cardiovascular disease. The program is funded through a three-year demonstration grant from the Center for Medicare and Medicaid Innovation (CMMI).¹

Two health systems associated with the Michigan Center for Clinical Systems Improvement (Mi-CCSI) implemented COMPASS in 20 practices beginning in 2012. Fifteen other health delivery systems across the U.S. have also implemented the program, while the multi-condition treatment model on which COMPASS is based, known as TEAMcare, has been disseminated in more than 20 sites in the U.S., India and Canada.

The program is funded through a three-year Health Care Innovation Award (HCIA) from the Center for Medicare and Medicaid Innovation (CMMI) to the Institute for Clinical Systems Improvement (ICSI). Mi-CCSI, a participant subcontractor to ICSI in the project, was awarded funding related to the main program to convene a study group of physicians and other health care professionals to evaluate the feasibility of expanding the COMPASS model to a larger set of chronic conditions and patients. This report details the discussions, findings and recommendations of that team, which met five times over the past four months.

Healthcare leaders and institutions throughout the country recognize that the care of patients with MCC is inadequate and enormously costly. The COMPASS model addresses various clinical care gaps that complex patients experience, while helping systems of care achieve the triple aim of improved outcomes, lowering costs of care and improving the quality of care. COMPASS may also assist in improving quality of caring, an important consideration given increasing levels of burnout among primary care providers and staff.

While the COMPASS program shows great promise in improving care and reducing costs, it cannot be sustained with its current clinical focus. This report aims to address a primary question that COMPASS consortium partners are asking: *Can COMPASS scale to become an established part of patient care for an operationally meaningful proportion of healthcare populations with MCC?*

The analysis presented here was conducted by the awardee. Findings might or might not be consistent with or confirmed by the findings of the independent evaluation contractor.

¹ The COMPASS project described was supported by Grant Number 1C1CMS331048 from the Department of Health and Human Services, Centers for Medicare & Medicaid Services. The contents of this publication are solely the responsibility of the authors and do not necessarily represent the official views of the U.S. Department of Health and Human Services or any of its agencies. Michigan Center for Clinical Systems Improvement (Mi-CCSI) is a sub-awardee of this grant.

Key findings and recommendations

Health condition considerations

- The COMPASS Expansion Workgroup concluded that COMPASS constitutes the foundation of a generalizable model for patients with MCC. Specifically, the workgroup concluded that a primary care physician working in a team could provide relevant and timely guidance to care teams for a significant segment of patients, including those with common behavioral health conditions such as depression and anxiety. Key to impact is a clear focus on treatment targets based on individual patient circumstances.
- Chronic conditions recommended for potential inclusion in the program included the Medicare roster of chronic conditions (see list later in report), with two exceptions:
 - Inclusion of anxiety and substance abuse, and
 - Exclusion of cancer (A heterogeneous disease category that requires highly individualized treatment regimens. Note: There may be some patients who ultimately are included.)
- Two related approaches for expanding criteria are recommended:
 - 1) **Opt-out:** All chronic patients are included as a starting point (with the above exception), excluding conditions on the basis of key considerations such as prevalence, adequate evidence and available specialty expertise.
 - 2) **Opt-in:** Specific conditions are included in a bottom up approach with systems using the set of criteria suggested below.
 - Both approaches are required as provider systems will likely add conditions and populations over a period of time as process, people and resources are available and health systems “learn” how to address complex patient needs.
 - In essence, the opt-out approach defines the long-term future of a multi-morbid model; the opt-in approach is a tactical tool to add specific conditions.

Criteria considerations

- The COMPASS Expansion Workgroup determined that, at a minimum, healthcare systems may need to consider the following to include specific conditions:
 - **Population:** Prevalence and cost of multi-morbid populations to help establish priorities
 - **Evidence base:** Whether there is enough literature to support collaborative or team-based care (evidence is still quite immature in this area)
 - **Clinical:** Factors such as diagnostic specificity, specific targets for monitoring and monitoring tool availability
- In addition to the prevailing focus on chronic conditions, healthcare systems may also consider patient characteristics such as social and behavioral complexity as a way of expanding criteria for inclusion. In addition to establishing criteria for inclusion of such characteristics, health systems will need to institute associated clinical guidelines. (This area was not widely explored in workgroup meetings.)
- Health systems that include new conditions will benefit from engaging specialists to assist in the development of guidelines, individualized patient care plans that include patient specific goals and criteria for systematic case review (e.g. clinical monitoring for treatment-to-target) or referral.
- While treatment of co-morbid medical illnesses without diagnosed behavioral conditions was seen as a viable option for consideration, the workgroup concluded that a behavioral focus remains the critical element of the model with respect to treatment guidance and health behavior considerations.

Logistical and cost considerations

- Even with efforts to expand the number of conditions and patients who may benefit from COMPASS, patient volumes will remain small and deployment may require the resources and sophistication of relatively large systems of care that are more highly organized. To address costs and resource challenges, health systems may need to consider innovative ways to deploy key parts of the model including evolving technology and dynamic deployment of teams.
- Health systems will need to improve data management and evaluation to provide meaningful feedback to teams regarding clinical and process measures. Having actionable and reportable external data is also seen as critical to long-term success.
- The COMPASS Expansion Workgroup recognized the investment and support requirements for successful deployment of the model. In West Michigan, per practice cost of implementation was estimated by Mi-CCSI at \$20,000-\$25,000. Operating costs may be as high as \$7.50 per member per month (PMPM) for a mixed population of Medicare, Medicaid and Commercial patients.
- While model savings have not been calculated by the analytical team within the COMPASS consortium nationally, savings of nearly \$600 annually were modeled in the TEAMcare trial published in 2010. Trend reductions of 2-3% over a 3-year period (0.5% to 1% per year) are likely to be required to achieve an ROI.

Charter

Convene a group of physicians, nurse care managers, nurse care management leaders, and administrative staff to evaluate the expansion of the COMPASS model to include a broader set of medical conditions. Develop a set of criteria and considerations to assist providers and payers in exploring how to generalize the existing model of care.

COMPASS: An Overview

COMPASS is a collaborative care management model (CCMM) designed to create, in a primary care setting, a system to treat adult patients who have depression along with poorly controlled diabetes and/or cardiovascular disease. Implementation of the model primarily focuses on Medicare and Medicaid patients who meet these criteria, but commercial patients were enrolled in the model as well. Practices implementing COMPASS also have the option of adding systematic screening and brief intervention for risky substance use.

COMPASS was implemented in seven states in a consortium led by the Institute for Clinical Systems Improvement (ICSI). Partners include Community Health Plan of Washington, Kaiser Permanente Colorado and Southern California, Mayo Clinic Health System, Michigan Center for Clinical Systems Improvement, Mount Auburn Cambridge Independent Practice Association and the Pittsburgh Regional Health Initiative. HealthPartners Institute for Research and Evaluation and the AIMS Center at the University of Washington are providing technical assistance (patient registry, model implementation, evaluation).

COMPASS was designed by integrating proven CCMMs and transitions of care models using best practices observed in both. These include: IMPACT and DIAMOND (Depression Improvement Across Minnesota, Offering a New Direction) for depression; TEAMcare, for depression, diabetes and cardiovascular disease and SBIRT (brief intervention) for risky substance use. CCMM elements common to these programs that make the COMPASS model applicable to patients with multiple conditions include:

1. Thorough initial evaluation, including screening for relevant co-morbidities, measuring condition severity, and supporting patient self-management to control key disease parameters, including PHQ-9, HbA1C, SBP and LDL
2. A registry for care monitoring of both individual patients and population/panel management
3. Treatment-to-target and treatment intensification when there is a lack of clinical improvement
4. Prevention of avoidable hospital and emergency department admissions and readmissions
5. A care manager to monitor condition status, provide self-management support, refer to community resources, coordinate care, communicate recommendations by the physician consultant(s) about medication changes to the primary care physician and provide proactive follow-up
6. Expert physician consultant(s) with clearly defined roles to provide a weekly review of inadequately responding cases with the care manager and suggest treatment changes to improve depression and glycemic, lipid and blood pressure control, or further evaluation to the primary care physician (this model element is referred to as “systematic case review” or SCR)
7. Aggregate data evaluation and quality improvement²

² https://www.icsi.org/_asset/9w2qfz/COMPASS-White-Paper-5-8-2014.pdf

Why undertake this exploration?

The unique focus on multiple conditions in COMPASS is a clinical innovation that has been tested or implemented in one form or another for 10 years. While its clinical trial investigators expected the model would be applicable to most conditions, a narrow set was adopted initially to test its efficacy, with all patients having a diagnosis of moderate to severe depression. The clinical trial results were positive and published in several journals, including:

- New England Journal of Medicine (<http://www.nejm.org/doi/full/10.1056/NEJMoa1003955>)
- Archives of General Psychiatry (<http://archpsyc.jamanetwork.com/article.aspx?articleid=1151490>)

As compared to usual care, this multi-condition collaborative care intervention in patients with depression and diabetes resulted in:

- Greater overall 12-month improvements in depression, HbA1c, LDL, and blood pressure
- More adjustments of antidepressants, insulin, and antihypertensive medications
- Greater satisfaction with care for depression, diabetes, & coronary heart disease
- \$594 lower outpatient costs per patient at 24 months

COMPASS is an elaboration on the original work, testing whether its implementation can be adapted in varying clinical systems of care. Through May 31, 2015, the eighteen medical groups participating in the ICSI-led COMPASS initiative had enrolled nearly 4,000 patients into this team-based model, which treats patients with uncontrolled depression and uncontrolled diabetes and/or heart disease. The outcomes thus far include:

- **Depression outcomes:** For patients enrolled >4 months, 60% have shown a significant improvement in their depressive symptoms (achieving a PHQ-9 target goal of improvement by at least five points or a PHQ-9 under 10), compared to the goal of 40%. For a subset of patients with follow-up PHQ-9 testing on or after 120 days, the depression improvement increased to 67%. In this same population, 27% are now in remission.
- **Diabetes outcomes:** For patients enrolled >4 months, the percentage with HbA1c in control (HbA1c < 8%) has improved from 27% to 45% (relative improvement of 67%). For a subset of 1,351 diabetes patients with follow-up lab testing on or after 120 days, 54% had HbA1c in control (an absolute improvement of 27% over baseline).
- **Hypertension outcomes:** For patients enrolled for >4 months, 632 patients were identified with uncontrolled BP at baseline, and 60% have achieved control (BP < 140/90) at 120 days compared to the goal of 20%. For a subset of 489 patients with follow-up BP on or after 120 days, 72% had BP in control.

COMPASS partners struggled with patient recruitment to varying degrees because of the immaturity of recruitment approaches, the required sub-set of clinical inclusion criteria and misperceptions regarding how many patients would ultimately fit the criteria. In fact, this led the workgroup to the conclusion that patient/condition inclusion will need to be defined generally, letting the assessment process narrow the population to those patients who will benefit from enrollment. (See discussion in Financial Considerations Section later in the document for more on patient population numbers to sustain models of care.)

It was against this backdrop that the COMPASS Expansion Workgroup met to consider how conditions or populations could be addressed in a COMPASS-like model, either as is or in enhanced or varying configurations. Questions that the team wrestled with were:

- What criteria should care systems consider in adding a condition to the COMPASS model?
- What conditions should systems consider in deploying multi-disciplinary teams?
- What conditions or characteristics are qualification criteria for enrollment in a multi-morbid model?

- Should social complexity be considered in identifying populations to manage? And if so, how?
- Should having a behavioral health diagnosis be a requirement for enrollment in this model? Or could/should patients with medical only conditions be considered?
- Instead of a strict focus on managing behavioral health per se, are “health behaviors” also a significant enough focus of this model to justify a behavioral focus in patients recruited for medical condition and not behavioral conditions?
- Should other professional and/or clinical staff beyond the core (case managers and case reviewers) be included in systematic case review to an expanded set of conditions or populations? If so, which ones and how might they be included?
- Should conditions be evaluated one at a time and each one considered as a candidate for addition to the model? Or should all chronic conditions be candidate conditions for management to be sorted out through further assessment with consideration of local population characteristics and resources?
- How will added conditions be evaluated for efficacy as they are added to the inclusion criteria?

The COMPASS Expansion Workgroup

The COMPASS Expansion Workgroup was drawn from primary and specialty care physicians, nurses, care management leaders, and health plan physicians familiar with or who had implemented the model along with other physicians who had no previous affiliation with the project. A co-investigator of the original TEAMcare model clinical trial, who has also been involved with national training and dissemination of the program, also attended meetings and assisted in developing agendas and focusing the discussion. The list of participants and their organizational affiliation is found below:

Name and credentials	Title	Organization	Workgroup Role
Philip Baty, MD	Family Physician	Mercy Health Physician Partners	PCP Physician Advisor
William Beecroft, MD	Medical Director, Behavioral Health	Blue Care Network	Payer Physician Advisor
Gregory Gadbois, MD	Medical director, Network Innovation & Education	Priority Health	Payer Physician Advisor
Philip Gorelick, MD	Medical Director Hauenstein Neurosciences & Professor, Translational Science and Molecular Medicine, MSU College of Human Medicine	Mercy Health Hauenstein Neurosciences Center	Specialty Physician Advisor
Michael Klinkman, MD	Professor, Family Medicine	University of Michigan	PCP Physician Advisor
Thomas Platt, MD	Chief Medical Officer	Cherry Health	PCP Physician Advisor
Deborah Schaefer, RN	Director of Care Management	Spectrum Health	CM Clinical Advisor
Angela Smith-Hietikko, LMSW	Behavioral Health Director, Social Work/Health Plan Liaison	Priority Health	SW Clinical Advisor
Kiran Taylor, MD	Chief, SHMG Division of Psychiatry	Spectrum Health	BH Physician Advisor
Burt VanderLaan, MD	Medical Director for Network Effectiveness	Priority Health	Payer Physician Advisor
Susan Viviano, RN	Director of Medical Management	Mercy Health Physician Partners	CM Clinical Advisor
Claire Neely, MD	Chief Medical Officer	ICSI	COMPASS Advisor
Paul Ciechanowski, MD, MPH	CEO	SamePage, Inc.	Physician/Advisor Facilitator
Steve Williams	Executive Director	Mi-CCSI	Workgroup Facilitator
Sue Vos, RN	Program Director	Mi-CCSI	Clinical Advisor
Amy Wales	Administrative Coordinator	Mi-CCSI	Support

Objectives, Focus, Scope

Objective: To establish criteria, considerations or methods to expand COMPASS to include conditions beyond those currently addressed by this model.

Focus: Criteria and frameworks that will help guide the inclusion of an expanded patient base for the program.

Scope

- Focus on criteria and process for inclusion of additional conditions
- Research the literature to determine which conditions are most likely to benefit from COMPASS-like care
- Develop a final report to ICSI/CMMI on findings, methods, challenges and opportunities
- Note: Patient characteristics (such as social determinants or other behavioral manifestations) are a potentially important consideration in developing care strategies, patient assessment, and enrollment and targeting populations. While members of the team understood the enormous significance of patient characteristics, a decision was made to focus primarily on chronic conditions as a way of expanding the program, since there is great heterogeneity in assessing patient characteristics as a way of operationalizing a means for expansion.

Definition of Multiple Chronic Conditions

NQF defines multi-morbidity as persons with multiple chronic conditions, i.e. persons with two or more concurrent chronic conditions that collectively have an adverse effect on health status, function, or quality of life and that require complex healthcare management, decision-making or coordination.

Assessment of the quality of care³ provided to the MCC population should consider persons with two or more concurrent chronic conditions that require ongoing clinical, behavioral⁴ or developmental care from members of the healthcare team and act together to significantly increase the complexity of management and coordination of care—including but not limited to potential interactions between conditions and treatments. This description is taken from NQF material, but is broadly applicable to the COMPASS model and infers that many conditions are candidates for multi-disciplinary team (MDT) review and input. (There are no qualifiers as to number or kinds of conditions.)

Alternatively, the Agency for Healthcare Research and Quality (AHRQ) defines a complex patient as having two or more chronic conditions that may influence the care of other conditions through limitations of life expectancy, interactions between drug therapies, or direct contraindications to therapy for one condition by other conditions. This definition moves toward capturing the ongoing interaction and complexity of concurrent chronic conditions and how these interactions impact care; however, it does not capture health status considerations such as function or quality of life.⁵

³ Quality of care is defined by the Institute of Medicine (IOM) six aims: safe, timely, effective, efficient, equitable, and patient-centered.

⁴ Behavioral includes mental health and substance use illness

⁵ Multiple Chronic Conditions Measurement Framework, NQF, May 2012

In each of the definitions, it is clear that both AHRQ and NQF are “inclusive” of all chronic conditions and in the end, the COMPASS Expansion Workgroup returned repeatedly to the framework that all conditions will need to be addressed in clinical models for them to be generalizable and sustainable.

The team also agreed that a somewhat “wider” definition of behavioral health should be included as an important element of multi-morbid models. The proposal was to include patients who had 1) mental health diagnoses 2) substance use issues 3) health behaviors that inhibited self-care and 4) social determinants. While COMPASS and this project do not fully address these issues, the team expressed a view that future models must.

How COMPASS addresses multi-morbidity

While there are several key elements to the COMPASS intervention, two process elements are believed to be the important to its success: 1) behavioral health integration through use of a multi-disciplinary team and 2) treat-to-target for both behavioral and medical conditions (which leads often to treatment intensification or modification in rapid cycles).

There are several reasons the model has focused on these elements:

1. Untreated depression in individuals with multiple conditions can lead to significant total cost of care increases (e.g. depression in those with diabetes can double the total costs of care).
2. The model can be put into practice in diverse types of provider systems including those that are parts of broader non-integrated or loosely integrated networks.
3. Behavioral and medical conditions benefit from treat-to-target and treatment intensification as a remedy for clinical inertia (lack of treatment intensification), which is one of the main reasons outcomes are not met in treating populations of individuals with multiple conditions.

Importantly, COMPASS addresses population-based treatment of patients rather than the visit-based one the health care system has operated for decades. It would seem logical that such a model that shows promise for patients with depression and diabetes or heart disease could address other patient populations, with or without classical depression. In fact, in a number of the COMPASS locations deploying the model and organizations implementing the TEAMcare program, other conditions are often addressed since patients sometimes have diagnoses that are outside the study criteria and, in essence, “come along for the ride.” Anxiety is one that has been cited, but there are others (e.g. sleep apnea, obesity, and kidney disease).

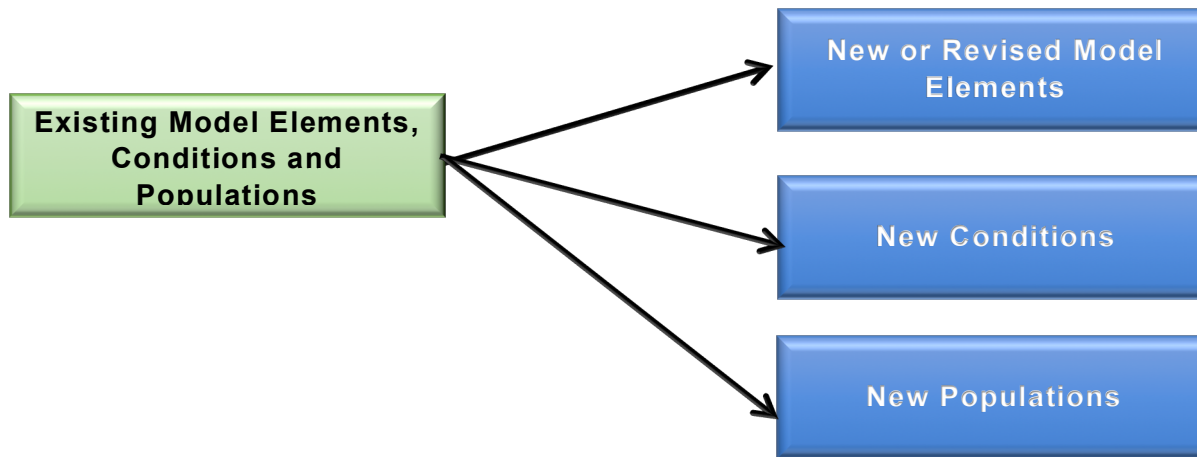
In other conditions, the evidence regarding collaborative care is less clear, but enough studies have demonstrated efficacy across a number of conditions that it is logical to consider applying similar practices and techniques to patients with a wide set of chronic conditions. These include COPD, CKD, CHF, chronic pain and arthritis among others. In a model termed Guided Care, no conditions were excluded from the model, which focused on complex patients who scored high on predictive modeling scales.⁶ That model demonstrated broad clinical improvement. In a

⁶ Guided Care: A New Frontier for Adults With Chronic Conditions, Sherry L. Aliotta, BSN, RN, CCM et al

Cochrane Review report published in 2011, several collaborative care studies showed meaningful clinical improvements over a wide range of conditions. (See summary table below; appendix includes a more comprehensive table of the studies included in the meta-analysis).

Framework for discussions

In considering whether and/or how to add patient populations or conditions to the existing COMPASS infrastructure, the following illuminates the categories in which the group made its evaluation:



The Workgroup focused on how delivery systems or other health care stakeholders would approach decision-making around expanding the reach of COMPASS.

The following principles of integrated healthcare for depression were considered in thinking about treating individuals with multiple conditions:

Principles of Effective Integrated Health Care (AIMS Center, University of Washington, 2013)

1. Patient-Centered Team Care / Collaborative Care
 - Primary care and behavioral health providers collaborate effectively using **shared care plans**.
2. Population-Based Care
 - Care team shares a defined group of **patients tracked in a registry** to ensure no one “falls through the cracks.” Practices track and reach out to patients who are not improving and mental health specialists provide caseload-focused consultation, not just ad-hoc advice.
3. Measurement-Based Treatment to Target

- Each patient's treatment plan clearly articulates **personal goals and clinical outcomes** that are routinely measured. Treatments are actively changed if patients are not improving as expected until the clinical goals are achieved.
4. Evidence-Based Care
 - Patients are offered treatments for which there is **credible research evidence to support their efficacy** in treating the target condition.
 5. Accountable Care
 - Providers are **accountable and reimbursed for quality of care and clinical outcomes**, not just the volume of care provided.

These principles were limited, in the cited document, to collaborative care for depression, but would seem to apply to any condition. With respect to the fourth principle, while there may not be a number of studies that provide evidence for patients with different constellations of conditions, it suffices in carrying out the collaborative care process that evidence-based treatments for each condition are used.

One of the encouraging elements of COMPASS is its reliance on true collaboration among a multi-disciplinary team of providers to focus on all of the factors that impact a patient's care and overall well-being. Clearly nearly any chronic condition or set of conditions managed in such a way has the potential to improve with the attention focused by these model elements. Whether these models are cost effective; however, only time will tell. A generalized implementation of the model elements to a larger subset of patients such that it could be seen an essential component of a provider system of care will allow this approach to be fully evaluated.

Note: Team discussions focused on how conditions or sets of conditions might be included in the model. Team members recognized the importance that social determinants play on health outcomes and how patients with significant social complexity vs. medical/behavioral could be addressed. However, the team did not focus significantly on this issue.

The Cochrane Review

The literature is replete with examples of how various forms of collaborative care models or team-based care are improving results in clinical trials and pilot projects. Following is a summary table of a Cochrane review of the major studies that demonstrated improved clinical results for patients over a long period of time. (An expanded version of the table is found in Appendix 3.) Included in this meta-analysis is the original clinical trial upon which COMPASS is based (Katon et al, 2010.)⁷ In many of the studies cited, several additional conditions (beyond those included in COMPASS – depression, diabetes and heart disease) were included.

Table 1—Cochrane Review Summary

Principal author, year	Population included in study
Bognor 2008	Aged >50, depression and hypertension (n=64)
Boult 2011	Aged >65, multiple conditions and high service use (n=904)
Hogg 2008	Aged >50, at least two conditions of many and at risk of experiencing adverse outcome (n=241)
Katon 2010	Depression and diabetes or heart disease , or both (n=214)
Krska 2001	Aged >65, at least two conditions of several (n=332)
Sommers 2000	Aged >65, at least two conditions of several (n=543)
Eakin 2007	Multi-morbidity defined as at least two conditions (n=175) (data for multi-morbidity group from authors)
Gitlin 2006	Aged >70, multiple conditions of several and reported difficulties with activities of daily living (n=319)
Hochhalter 2010	Aged >65, at least two of seven chronic conditions (n=79)
Lorig 1999	Aged >40, at least two of heart disease, lung disease, arthritis, or stroke (n=536) (patient subgroup with comorbidities)

COMPASS Expansion Workgroup felt that if other RCTs or studies showed clinical improvement in either very intense care management models (deploying nurses to follow patients closely as Guided Care has done) or with a deep focus on patient self-management that COMPASS in its current or evolved form could address many of these patients that met similar profiles. These studies would indicate that focusing on organizational design (such as SCR) and self-management support lead to the most meaningful clinical improvements.

⁷ Interventions for improving outcomes in patients with multi-morbidity in primary care and community settings, The Cochrane Collaboration. 2012.

Considerations in adding conditions to the COMPASS model

The COMPASS Expansion Workgroup assembled to review conditions that might qualify for inclusion in a COMPASS-like, collaborative care model include all of the Medicare-defined chronic conditions listed below*:

Table 2—Chronic Condition List

Alzheimer's/dementia	Diabetes	Team additions
Arthritis (including rheumatoid and osteoarthritis)	Heart failure	Anxiety
Asthma	Hyperlipidemia	Substance abuse
Atrial fibrillation	Hypertension	
Cancer (breast, colorectal, lung, and prostate)	Ischemic heart disease	
Chronic kidney disease	Osteoporosis	
COPD	Stroke/Transient ischemic attack	
Depression		
* http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/CC_Main.html		

In reviewing the criteria for including additional conditions, the COMPASS Expansion Workgroup defined three potential domains to apply to patients for inclusion:

Level	Definition
Populations	Those populations of patients with co-morbid conditions that reach a prevalence and cost threshold; those thresholds could vary by region but should be defined by the delivery system, payer or other entity determining eligibility for model inclusion
Evidence basis	Is there a defining study or set of clinical trials and agreed upon framework for approaching a population of patients? Or is there evidence that can be assembled to create an agreed upon framework for diagnosis, treatment and on-going care?
Clinical considerations	A short list of clinical criteria that a population should meet before considering inclusion, such as diagnostic specificity, screening methods available, monitoring tools available, available treatment algorithms and treatment target specificity.

A fuller explanation of these follows:

Populations

It is important to distinguish patient selection from population identification. This confusion was present often in the team discussions when reviewing which criteria to consider for model inclusion. It is one thing to define a population (any patient with two or more conditions from a defined list). It is quite another to choose specific patients from any given population for enrollment. The COMPASS Expansion Workgroup focused on the former, rather than the latter, but used specific conditions, if not patients, to develop the criteria. In essence, testing the logic of the inclusion criteria by ranking conditions using the criteria developed. (For more on the approach to specific conditions, see [Appendix 1.](#))

This first gate level that the team considered is relatively straightforward: Medicare defines the list of chronic conditions (those included above) as well as the most common and costly dyads and triads of patients with those conditions. (These are included on page 22.) It is clear from examining the costs that any Medicare patient with two or more chronic conditions uses far more resources than the global cost average. Thus, even patients with the two most common co-morbid conditions—hypertension and hyperlipidemia—are 30% more costly to treat than the broad Medicare per capita cost (\$14,000 vs \$11,000; 2012 data)

A population is perhaps an appropriate target for collaborative care if the other considerations are met. While the workgroup did not consider all of dyad permutations, COPD, osteoarthritis and chronic heart failure were considered as potential conditions and used as examples of how to apply criteria to conditions to determine whether they would be candidates for COMPASS or a COMPASS-like model.

Evidence-base

Despite the lack of gold standard evidence on effective interventions there are a scattering of studies that demonstrate the effectiveness of teams in addressing complex patients. The aforementioned Cochrane review is one example but there are others.⁸ In more recent initiatives to create an evidence base there is certainly more awareness that researchers need to focus on patients with MCC and/or social complexity. HHS and others are calling for significant research into interventions that will address complex patients, but results are likely years in the future.⁹

Clinical criteria

Among the workgroup's discussions, there was some consideration of diagnostic uncertainties that might be characteristic of conditions such as heart failure, rheumatoid arthritis or COPD. The group assumed that recruitment of patients with various conditions will depend on updated registries or referrals where diagnoses have been ascertained. Each provider system will likely develop its own criteria for model inclusion as ThedaCare in Wisconsin did in a recently deployed model for identifying and addressing complex patients.¹⁰

⁸ Chronic Obstructive Pulmonary Disease Model of Care. Perth: Health Networks Branch, Department of Health, Western Australia; 2012; Multidisciplinary Team Care May Slow the Rate of Decline in Renal Function, Elizabeth A. Bayliss, et al, 2011.

⁹ 2008 R21 Exploratory and Developmental Grants on Multiple Chronic Conditions: Updated 2014. February 2014. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.ahrq.gov/professionals/prevention-chronic-care/decision/mcc/mccrn-18grants.html>

¹⁰ Improving Complex Disease Management through Multi-Specialty Care Teams, Thedacare Accountable Care Organization, Mark B. McClellan, Health Care Innovation and Value Initiative, The Brookings Institution, et al; 2015

The workgroup generally agreed to include the following criteria for the “opt in” approach:

1. Diagnostic specificity and ease
2. Screening methods available, accepted
3. Monitoring tools available, accepted
4. Available, evidence-based, treatment algorithms
5. Treatment target specificity

Thus, any condition that might be added to the model should ideally meet these criteria. To test the relevance and ease of use of these criteria, the physicians who are part of the workgroup evaluated various conditions. Below is the summary result: (six respondents)

Table 3—Criteria Survey

	Conditions										
Clinical criteria	CHF	COPD	CKD	IHD	A-Fib	Cancer	Asthma	Osteoarthritis	Osteoporosis	Stroke	Alzheimer's
Diagnostic specificity and ease	2.3	2.3	2.8	2.7	3.0	1.5	2.3	2.0	2.3	3.0	1.7
Screening methods available, accepted	2.0	2.7	2.9	2.2	2.1	1.7	2.2	1.7	2.7	2.3	2.0
Monitoring tools available, accepted	2.2	2.3	2.6	2.3	2.8	0.9	2.2	1.3	1.3	1.7	2.0
Available treatment algorithms	2.8	2.4	2.1	2.6	2.8	1.1	2.9	2.3	3.0	2.3	1.7
Treatment target specificity	2.2	2.2	1.8	2.1	2.4	1.1	2.3	1.7	2.0	2.0	1.3
(Rounded) Totals	11	12	12	13	12	6	12	9	11	11	9
Notes: COMPASS eligible conditions omitted. Rheumatoid arthritis omitted (low prevalence)											
Table key: 1=lowest level of agreement; 3 highest											

With a few exceptions, physicians rated the criteria in a similar and consistent way. Cancer received the lowest rating with osteoarthritis and Alzheimer's falling below the double digit threshold. The exclusion of cancer from the criteria was described earlier in the key findings and recommendations section.) In the case of OA and dementia, treatment targets and the lack of diagnostic and screening specificity were rated low.

Opt out—including all conditions as a starting point

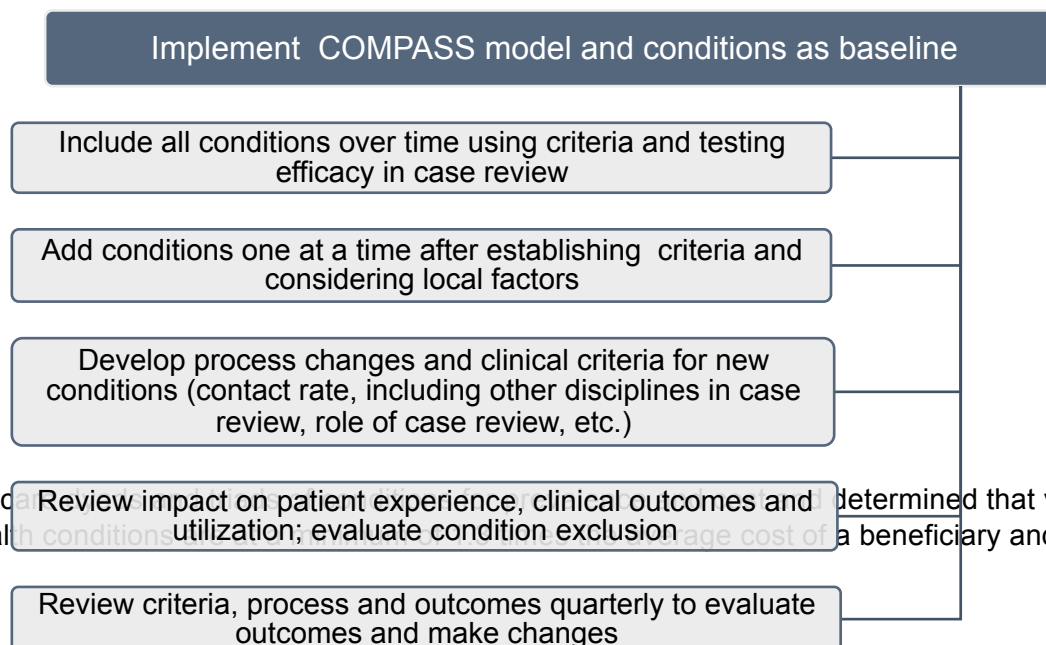
After discussing a number of individual conditions for inclusion, the workgroup settled on a more expansive model for including conditions that it termed “opt out.” Simply put, the team felt that the most logical starting place for condition consideration was to include all of the Medicare

chronic diseases. Thus, all patients with diagnosed heart failure and COPD might be included in a registry report for further screening. SCR teams would then have to decide if only those with out-of-scope clinical values would be considered for referral to SCR, where those in control might still be included in “routine” care management and not collaborative care. A further consideration may be whether to include those with advanced long-term disease where primarily functional improvements might be made but where the potential for medical improvements may be more modest. For example, in the screening process, nurse care managers or other SCR team members may determine that one patient with significantly advanced heart failure or COPD may, in fact, be triaged to complex care management or for palliative care, but not be included for enrollment in SCR, while another patient with newly diagnosed CHF and controlled COPD may indeed be included. This gets to the issue of risk level.

The COMPASS Expansion Workgroup wrestled with the concept of risk levels in patients and discussed extensively which level or levels would receive the most value in a MM model. If a patient was so complex that no amount of oversight or intervention would lead to clinical improvement and cost savings, it was a consensus view that the COMPASS model and program may not be a good fit for such an individual. On the other hand, those considered “rising risk” where complications had not yet fully manifested or where the limits of available treatments had not yet been reached, so that clinical improvements and cost avoidance were possible, these patients—with the same set of conditions—were thought to be the best candidates for inclusion. That said, there is still much to learn about appropriate risk levels for inclusion in the model.

As the workgroup considered how best to illustrate the opt-out approach, it developed the following flow chart that demonstrates the thinking on adding conditions over time and evaluating the impact of adding conditions, changing processes and reviewing data regarding outcomes. The flow of implementation might look something like this:

Implementation flow: Adding conditions over time



The workgroup reviewed the Medical and Behavioral Health conditions and determined that virtually all patients with two or more medical or behavioral health conditions are in the program and many are 2-3 or more times

that average. However, some of most costly patients represent a very small subset. These include stroke patients with other conditions. See the charts below for examples.

Five most prevalent dyads of conditions and cost/Source: Medicare Chartbook, 2012*

Dyads	Prevalence (%)	Per Capita (\$)*
High cholesterol & high blood pressure	52.9	\$13,825
High cholesterol & ischemic heart disease	36.2	\$20,529
High cholesterol & diabetes	32.3	\$18,010
High cholesterol & arthritis	31.1	\$18,043
Ischemic heart disease & high blood pressure	29.6	\$18,308

* compare with broad Medicare per capita cost of \$11,000 - 2012 data.

Five most costly dyads of conditions and cost/Source: Medicare Chartbook, 2012*

Dyads	Prevalence (%)	Per Capita (\$)*
Stroke and chronic kidney disease	2.0	\$51,715
Stroke and COPD	1.4	\$49,025
Stroke and heart failure	2.3	\$47,568
Stroke and asthma	0.4	\$46,913
COPD and Chronic kidney disease	4.9	\$45,011

* compare with broad Medicare per capita cost of \$11,000 - 2012 data.

Case example: Durham Clinic

The inclusion of all conditions was explored extensively in meeting #3, highlighted by a presentation by Tom Platt, the medical director of a Grand-Rapids FQHC (Cherry Health). Dr. Platt described a standalone clinic that was established inside the core operations of the FQHC that included a multi-disciplinary team of medical and behavioral clinicians and others called the Durham Clinic. The clinic is heavily based on Wagner's Chronic Care Model and the deployment of health coaches in the practice. In this model, any patient with a chronic condition is eligible for enrollment. In this discussion the team agreed that many primary care physicians can effectively provide input and guidance for most chronic patients in systematic case review. Dr. Platt agreed and provides that kind of insight and guidance.

The issue of whether a primary care provider, in the context of the SCR treatment model, can provide meaningful input for complex patients with any set of conditions was discussed extensively. While there will be occasions when PCPs find themselves out of their depth, the workgroup concluded that a PCP could indeed provide this kind of guidance for most patients most of the time. There are other models of oversight in team-based care, such as the PACE program, where this practice is also prevalent and where a team of providers discusses patient approaches, behavioral health and social complexity continually for all patients and conditions.¹¹ Health plans have also performed systematic case review of a different sort for years, addressing complex or non-improving, complex and/or high cost patients in a regular review session with nurse care managers.

Use of Specialists

Because specific evidence may be lacking for particular patients with various combinations of conditions, one of the considerations for systems implementing a comprehensive model of care to patients with MCC is the availability of particular specialists and their willingness to engage with primary care providers in developing algorithms and guidance such that an SCR team working with a care team could provide most of the care and oversight of patients. This specialist might also provide guidance as to what should trigger a phone call or even a referral, just as a small proportion of patients getting collaborative care treatment for depression will see a psychiatrist. In some instances it was thought that one or more specialties or other provider types would attend or support SCR in various ways:

1. If there is sufficient patient volume to justify, specialists could attend selected sessions of SCR (this was seen as fairly unlikely)
2. Be available on an as needed basis for phone or virtual guidance to the team

Logistics and scheduling will prove to be major hurdles for this involvement, but development of specialty input on a dynamic, asynchronous and regular basis is seen as a likely and welcome development.

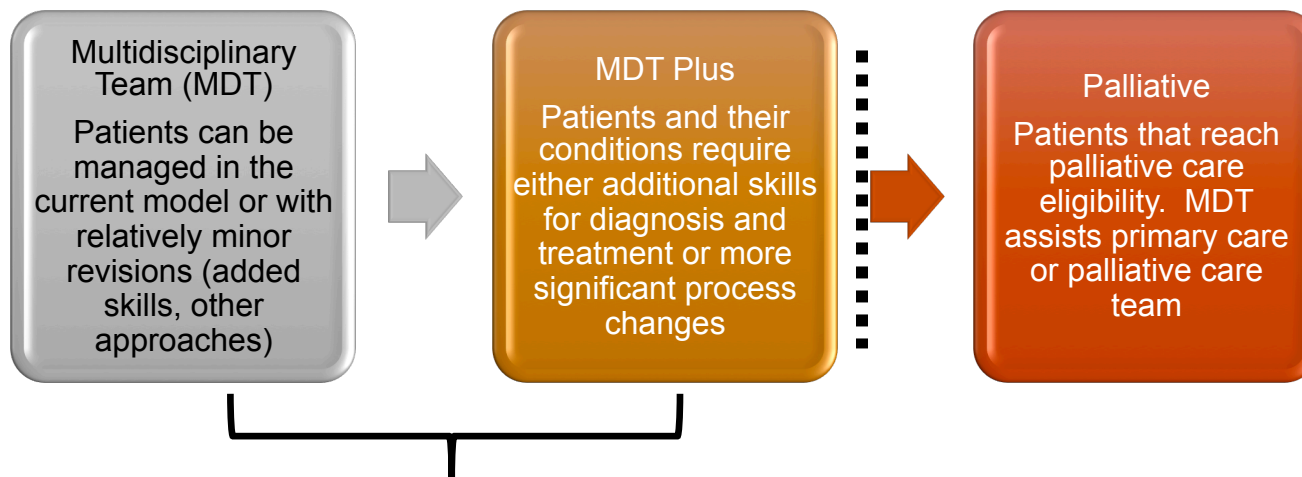
¹¹ www.medicare.gov/your-medicare-costs/help-paying-costs/pace/pace.html

COMPASS strategic evolution

Below are examples of how to think about an evolved model of collaborative care in the context of COMPASS. The Workgroup discussed these in the context of COMPASS today and an expanded version of COMPASS, with both being part of a continuum of care that addresses: rising risk patients who have developed multiple chronic conditions, those whose conditions or circumstances were more complex, and ultimately patients for whom there was no longer expected improvements in outcomes and only marginal improvements in quality of life. While the model might or might not address palliative care patients, it might be a gateway through which these patients would pass.

Figure 1

In a generalizable model, COMPASS would become the management platform for patients with newly manifested MCC combinations of either all chronic conditions or a subset based on prevalence, cost and population considerations or system capabilities (existing specialty or other provider assets that will vary from system to system). As patients became more complex or reach a stage where prevention is no longer the driving imperative, the focus of the team would shift and may evolve to include, episodically, personnel with other skill sets (such as select specialty providers, social workers or patient navigators as needed). Ultimately patients may migrate toward palliative care. It is unlikely that the MCC model would address patients that graduated to this level of support but the team would provide comprehensive clinical and other critical data to the provider or team engaged in providing supportive care. The figure demonstrates a deepening complexity of patients over time.



Model addresses only first two boxes; the dotted line is meant to suggest a handoff, yet to be determined when, how and to whom

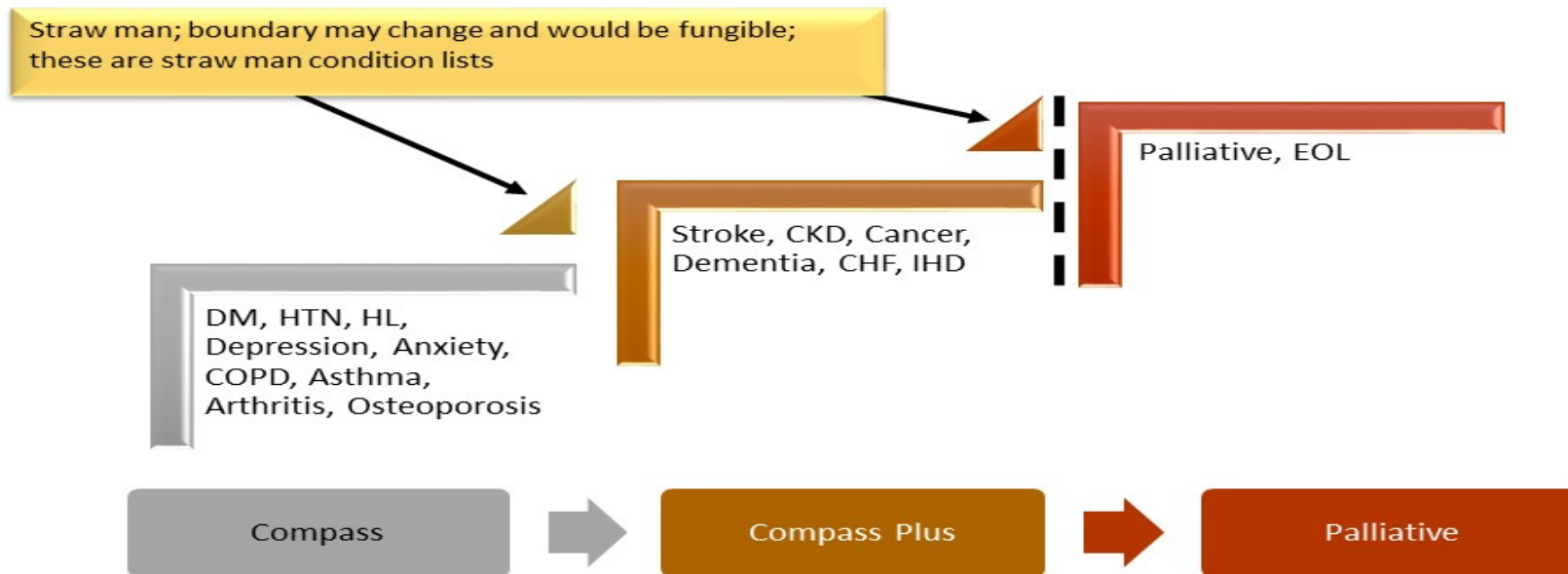
Figure 2

Putting this flow into a COMPASS model might look like this with the goals in each step of the model over time.



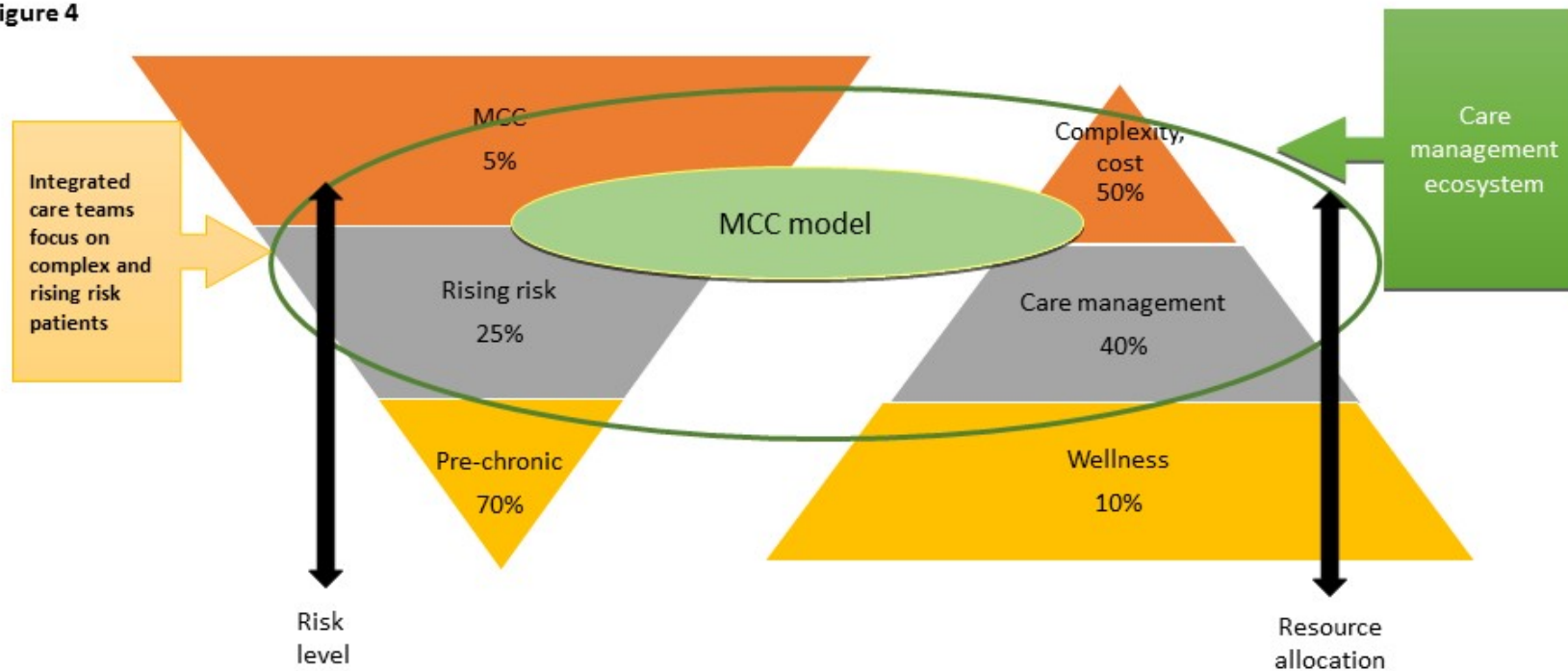
Figure 3

In considering the additional conditions to the model, this represents a suggested set of conditions that might be added to COMPASS on an “as is” basis with other conditions addressed in a somewhat reconfigured model that we called COMPASS plus.



As suggested above, the workgroup wrestled with the risk level of the potential populations and whether the model would provide benefit to individuals with higher levels of risk and complexity, particularly in considering whether SCR in its current or revised format could or should address other conditions. It was determined that the “rising risk” category were likely most appropriate to address in SCR as these patients are able to work with their care team and improve their outcomes with assistance from the clinical team and others. Those who were more frail and complex medically with advanced progression of chronic conditions were considered to be less likely to benefit from the model. Assessing complexity and progression along any chronic condition trajectory will be important for ascertaining which patients in a population will most benefit from COMPASS. Furthermore, screening for activation or other patient characteristics (social complexity, behavioral health, financial barriers) may also be important factors to consider when addressing the appropriateness and benefit of COMPASS. See Figure 4 of a graphic presentation of how a MCC model “fits” into a global clinical model that must, of necessity, deal with all risk levels in an assigned or attributed population.

Figure 4



Thus in adding patient types or general categories of conditions, systems will need to address a number of questions:

- Which conditions will respond to the model? Or its corollary, are there conditions that will not respond or are inappropriate to include? (i.e. dementia or schizophrenia)
- Which patients will respond and engage?
- Should patients be screened formally for social complexity and which of these patients ultimately included for enrollment?
- What is the role of the team in linking complex patients to community resources?
- What risk level is most appropriate for inclusion?
- Are there various levels of risk that may be included?
- If so, how might the model need to evolve to address these populations?
- Should patients be included if they have only medical conditions?
- Should a quality of life or activities of daily living standard be added to clinical and cost measures to determine impact of the model?

However these questions are answered, there will be an imperative to study the results for interventions for various conditions. This is likely to require sophisticated aggregation of data and collaboration among multiple providers and payers because of the small numbers of patients and the complexity of their conditions and circumstances. Projects like COMPASS are going to have to be run continually for a number of years into

the future with new measure sets (total cost of care, for example, comparing intervention populations vs. non-intervention) if systems are going to sustain these interventions.

Case review variations

In its deliberations, the workgroup discussed several possibilities related to how systematic case review might evolve over time. One thought was to have the case review team address complex patients as part of a comprehensive assessment process, providing input on a care plan but taking no role in following the patient at that time. It was the consensus of the group that the model may indeed change as provider systems were able to demonstrate improvements in care planning, treatment intensification and medication guidance.

Additionally, the team expressed interest in various ways to involve skills in the team (social workers for some patients with medical and select behavioral health conditions or health behavior challenges). Variations might include direct attendance, phone or virtual connection to the team or other novel ways to engage other staff. Technology was also thought to be an important future consideration to connect physicians or other skills to case review on an “as needed” basis. This might apply to various specialists for particularly difficult conditions or sets of conditions where higher level expertise is required.

Importantly, it was thought that establishing systematic case review as a core process component for addressing patients with MCC forms a foundation for various approaches to patient complexity that will unfold as systems and personnel learn how to address patient complexity over time.

Financial considerations

The other major consideration for model sustainability is financial. If a system invests heavily in a greatly expanded MCC model for its population, what investments are required to develop and sustain it? From the payment group that is discussing this within the COMPASS Consortium, it is pretty clear that fee for service will not be able to pay adequately for the components of a robust MCC model. Operating a COMPASS-like team or teams will cost an estimated \$1,500-\$2,000 per patient in the first year, with a much smaller payment required in the second year to account for recidivism or worsening of symptoms or functioning. (These figures are a preliminary and early evaluation of the first year cost.)

In addition to the on-going costs, systems will need to invest significantly in first year deployment. An estimate for a small set of practices or clinics and patients is more than \$300,000. In a population of 100,000 patients, it was estimated the annual operating costs at more than \$8 million for an estimated 5% of the projected patient base included in an expanded model.

In a model developed at Mi-CCSI (included below on page 30,) the per member per month costs of operating an all-condition model were more than \$7 in addition to other primary care billing. It obviously does not contain any risk for a primary care system, only the costs of operating a clinical system of care for all or many chronic conditions. If payers, including government program funders, were to pay based on an enrolled case, this method could limit the outlays initially until the model had proven effective Triple Aim goal achievement. Such a case rate, as demonstrated below would require about \$2,000 in the first year. A second year “maintenance” rate of \$400-\$600 might be required to follow a patient, though not in all cases. Thereafter, patients would be managed in the medical home. The model would likely need to achieve a three-year trend reduction among these patients of 10-15% or 3.5 to 5% per year, assuming the cost of a co-morbid patient is approximately \$20,000 in annual expense. (See Medicare Dyad table above for some of these costs.) This would seem reasonable for many patients. (\$2,000 to \$3,000 in savings during the initial 2-3 years to break even.)

The problem with all payment methods that do not pay a defined amount is that it is difficult for health systems to predict how many patients will be enrolled in a model of care. COMPASS proved challenging in this regard and gave rise to efforts like this one to expand the model to become more generalizable. While shared savings has been used to various effect by Medicare and others, it would seem that perhaps a shared “cost” approach might be worth considering in investing in new models of care. In this way, payers and providers could share the cost of the investment in systems, process and people making it more likely that providers will move forward “in advance” of any pay for performance or shared savings.

Using a net present value (NPV) approach might also be useful in this way as a conceptual framework for “investments” in systems of care that pay future dividends through lower ER, specialty procedures and hospital utilization that lag initial investments by 1-3 years. Further explorations of NPV were not completed by the workgroup but the footnote below directs the reader to an analysis using NPV for wellness programs for employers that is similar to the problem presented in pre-funding infrastructure costs for future savings.¹² Whether payers will find this compelling or even allowed in the funding models is not known.

In some way though it is imperative to find a longer term and more widely distributed method to test innovations like COMPASS.

¹² How to Present the Business Case for Healthcare Quality to Employers, Sean Nicholson, et al, November 2005

Table 4—Financial Model

Caseloads for care managers=100 patients (conservative estimate; may be closer to 125)									
Practice size=4 physicians	100000	Require CCM	Pts requiring CM	Reduction factor*	Adjusted Pts	CM FTEs	Cost/FTE	PMPM	Totals
Commercial	63,000	3%	1890	40%	1134	11	\$90,000		
Medicare	22,000	23%	5060		3036	30			
Medicaid	12,000	5%	600		360	4			
Uninsured	3,000	3%	90	60%	54	1			
Total	100000	8%	7640	Est'd pts	4584	46			
Care Management Costs					FTE	Comp	CM	\$3.44	\$4,125,600
CM	Management	Management ratio of 10:1			4.58	125,000	Mgmt	\$0.48	\$573,000
* Reduction factor includes patient refusal, benefit plan limits, patient cost, etc.							Total CM		\$4,698,600
Physician added expense				Hours/mo	Cost/phys/mo	Cost/FTE			
Huddles, conferences, other duties				11.3	\$1,413	\$16,950	Phys Totals	\$0.57	\$678,000
Information services and support (deployed over multiple practices; FTE estimate is per practice site)									
IT, registry development, deployment, refinement, reporting, analysis, support							4 FTEs	\$0.27	320,000
Complex Case Review									
							Complex Case Review	\$1.35	1,623,500
							Subtotal FTE	\$6.10	\$7,320,100
Other costs	Facility, overhead						20% of FTE	\$1.22	\$1,464,020
							Grand Total	\$7.32	8,784,120
							Case rate/patient		\$1,916

Our example above calls for a minimum of 100,000 patients as a base to support the infrastructure, technology, clinical depth and financial resources required to develop, implement and operate a model for complex patients. This base also assumes a more generalized set of conditions and patients to be managed. That base was also chosen to support nearly two full time equivalent positions (system-wide) for the PCP consultant and psychiatrist. While it may be likely that multiple physicians occupy these roles (perhaps each PCP consultant providing half-time support to the role) the model will not survive long term if the team roles are considered a small part of a professional's position. It was also chosen because only systems with the requisite resources will have the wherewithal to initially engage in this work because so much of it is new requiring significant experimentation and refinement. Because multi-morbid models have not been implemented generally in the US, there are few studies or experience to draw on as to the optimal size of the population or medical group considering implementation. In the experience of many of the initial ACOs developed for Medicare, it is our opinion that many were too small to support the infrastructure required to deploy

models to care for complex patients. This may be one factor in the underperformance of the smaller organizations. In a recent evaluation of California ACOs that appeared June 2, 2015 in Health Affairs, Steve Shortell and Richard Scheffler write this:

“Recent Medicare legislation requires only 5,000 enrollees to be in the shared savings program, however many are much larger than this particularly on the commercial side. The Dartmouth-Berkeley National Survey of Accountable Care Organizations (NSACO) has identified some ACOs with upwards of 100,000 enrollees or more, bringing to light the consideration of economies of scale in an organization. The more people an organization has under the risk-bearing contracts, the greater the incentive for the organization to invest in infrastructure support such as Electronic Health Records (EHRs) and patient activation and engagement training for providers.”¹³ In the same article, the authors posit this:

“There are several ongoing challenges to creating more integrated systems of care such as those represented by ACOs. Not the least among these is that creating integrated systems of care is difficult work requiring considerable resource investments (the cost of integration) in increasing EHR functionality, workflow redesign, and developing partnerships with others.”

Much of this same thinking is likely to be applicable to models to care for complex patients. In point of fact, many of the ACOs are looking at deploying just such models for their complex patients. Scale may be compelling as systems consider deployment of multi-morbid models.

While it is important to understand what the model may require to “scale” generally, we have also provided a regional model approach to bring the generalized thinking to a more specific level. Generally, a “unit” or “pod” consisting of 1 FTE nurse case manager time (i.e. several nurses may make up this FTE) can address the needs of an estimated 125 patients annually. This requires 2 hours of psychiatrist case reviewer time and 2 hours of primary care provider case reviewer time per week. Assuming a 0.5 FTE minimum commitment from each of the case reviewers (20 hours) to make this position sustainable, 10 pods would ideally be covered simultaneously, i.e. 1,250 patients annually. Assuming that 5% of a population with an average insurance mix (60% commercial or exchange-based, 22% Medicare, 12% Medicaid and the remainder with no insurance) were enrolled in the program, this would require at a minimum 25,000 total patients in a care sub-system. Assuming that there are narrow inclusion criteria, however, a much larger denominator is required or more inclusive criteria for inclusion are required.

The challenge of financial and operational support is summarized below by Chad Boulton, et al, in a meta-analysis published in 2009 that found various evidence to support the Institute of Medicine’s “Retooling for an Aging America” Report.

“Few of the models of comprehensive care described in this report have been adopted widely in clinical practice in the United States. Factors that influence a model’s “real world” adoption include not only its effectiveness, but also its operational and financial complexity and its fit with potentially adopting organizations’ prevailing cultures. Operational barriers to widespread dissemination include difficulty in “scaling up” a model for use throughout large systems of care, requirements for collaboration between stakeholders within and between organizations, and lack technical assistance from model developers.

“Financial barriers to dissemination are also significant. Some models generate savings by avoiding costs, but this is often difficult for adopting organizations to track. Other models operated and funded by one organization produce savings for another. A dearth of experts in providing

¹³ Accountable Care Organizations Taking Hold And Improving Health Care In California, Stephen Shortell and Richard Scheffler, Health Affairs Blog, June 2, 2015; <http://healthaffairs.org/blog/2015/06/02/accountable-care-organizations-taking-hold-and-improving-health-care-in-california/>

chronic care is another formidable obstacle. It should come as no surprise that dissemination of successful models has been limited! The Medicare program will play a critical role in facilitating or discouraging the dissemination of successful new models of care for older adults with chronic conditions.”

Discussion: Toward a learning and sustainable model

However the financial questions are answered, there will be an imperative to develop and study the results of interventions for various conditions well into the future. This is likely to require sophisticated aggregation of data and collaboration among multiple providers and payers because of the small numbers of patients and the complexity of their conditions and circumstances. Projects like COMPASS may need to be run continually for a number of years into the future with new measure sets (e.g. total cost of care, comparing intervention populations vs. non-intervention) if systems are going to develop and sustain meaningful and cost effective interventions.

When collaborative care models are examined in the literature and in studies, they seem (though not universally) to improve clinical and patient-reported results significantly and many are shown as cost effective. In a meta-analysis in Psychosomatic Medicine in 2013, the authors concluded:

“Over 600 articles were identified of which 67 were selected for annotated review. The results reported in these articles indicate that collaborative care interventions for psychiatric disorders have been consistently successful in improving key outcomes in both research and clinical intervention studies; cost analyses also suggest that this model is cost effective. Conclusions: Collaborative care models for psychiatric disorders are likely to serve an increasingly large role in healthcare given their effect on patient and population outcomes and their focus on integration of care.”¹⁴

It would seem a virtual certainty that provider systems and payers will need to collaborate on expanding MCC models since no one system (unless very large) will serve enough patients to evaluate clinical and financial results, quality of life and other measures. This is particularly true in early stages of development. While provider systems are quite experienced in considering new evidence or treatment options for single conditions or exacerbations and incorporating them, few if any are capable currently of the sophistication and skills necessary to develop and evaluate adequately the multiple combinations of chronic patients and which interventions will improve clinical care and economic results.

The literature does point to some natural groupings of conditions in patients which would ease the burden of pattern analysis for some patients.¹⁵ But these combinations are still not well understood and the development of interventions to address them is immature. Geriatricians have been urging more research and development on co-and multi-morbidity for years, decrying the lack of scientific and practical approaches to assist systems in developing sound approaches to complex patients.¹⁶ HHS has recognized this lack of cohesive policy and evidentiary approaches and has convened academic centers to address this gap.¹⁷

¹⁴ Collaborative Care Models for Treatment of Psychiatric Disorders in Medical Settings, J. Huffman, et al, 2013 Academy of Psychosomatic Medicine.

¹⁵ Patterns of Chronic Multi-morbidity in the Elderly Population, Alessandra Marengoni, MD, PhD, et al; J AmGeriatr Soc, 57:225–230, 2009.

¹⁶ Report of the National Institute on Aging Task Force on Comorbidity, Rosemary Yancik, et al, Journal of Gerontology: Medical Sciences, 2007, Vol. 62A, No.

3.

¹⁷ <http://www.hhs.gov/ash/initiatives/mcc/>

“...research is needed to improve treatment guidelines for patients with MCC. The prospect may seem daunting, as the myriad combinations of MCC will magnify the complexity of guidelines. To wit, Sorace et al showed that a cohort of over 32 million Medicare beneficiaries exhibited [more than] 2 million disease combinations. A focus on patient-centered outcomes, facilitated by the judicious use of electronic health records and decision aids to facilitate shared decision-making, may help manage the increased complexity that is likely to result from evidence-based treatment guidelines for patients with MCC. Further, Yoon et al offer helpful guidance on where to start. They suggest that research resources be allocated to both the most common combinations of conditions and also the most costly. Efforts related to those conditions should focus on prevention, guidelines for joint management of comorbid conditions, and case management of high utilization and high-cost patients.”

In a 2014 special issue of Medical Care, researchers from the Multiple Chronic Conditions (MCC) Research Network, funded by the Agency for Healthcare Research and Quality (AHRQ), shared a number of findings and suggested topics for future research on persons with MCC. Included below is a quote from that overview:

“...health system issues remain a challenge for patients with MCC. Innovative healthcare delivery models have been developed and implemented in recent years to promote team-based care, care coordination, self-management support, integration of primary and specialty care, and integration of care with community resources.... A number of articles in this issue show, however, that these innovations are not equally reaching all patients with MCC. Further efforts are required to develop successful models of coordinated care that can reach these most vulnerable populations.”¹⁸

Other issues that must be addressed include determining whether behavioral and social complexity should occupy the lion’s share of attention in patients with multi-morbidity given their central role in high cost and clinical challenges. In another quote from the special issue of Medical Care authors posit that behavioral health may need to occupy a prominent place in any MCC models of the future:

“A cross-cutting issue in several papers was that of behavioral health or the coexistence of behavioral and physical health conditions. Patients with behavioral health comorbidities are particularly vulnerable. Strategies to address the needs of these most complex patients can potentially benefit all patients with MCC.”¹⁹

Extrapolation from other studies will also challenge conventional treatment regimens. In one example: “Lee et al assessed the use of beta-blockers after acute myocardial infarction in older adults with both cardiovascular and pulmonary conditions. Current American Heart Association/American College of Cardiology guidelines recommend that beta-blockers be used for 3 years after a myocardial infarction or acute coronary syndrome. The authors found that, contrary to earlier studies showing that beta-blockers helped patients who were younger with or without MCC, they neither helped nor harmed older adults with both cardiovascular and pulmonary conditions. These findings challenge the current practice of extrapolating results from younger and healthier populations to older persons with MCC.”

Research and development is going on across the globe on the issues related to MCC and some of the more advanced thinking is found in Europe, Canada, Australia and the UK. We can learn from them.

Appendix 1—Specific condition considerations

¹⁸ Research on Multiple Chronic Conditions Where We Are and Where We Need to Go, Mary E. Tinetti, MD, et al, Medical Care Volume 52, March 2014

¹⁹ IBID

The following pages provide examples and citations from the literature to address how population, prevalence and clinical criteria might be applied to assess and qualify specific conditions. This is not a systematic “how-to” approach, but more of an example of the types of information a health system might want to collect in evaluating conditions for inclusion for their particular circumstances into an expanded COMPASS model. Each of these were developed using the context of multi-morbidity.

COPD

Comorbidities, prevalence and costs (Medicare data)

Comorbidity with COPD	% Prevalence	Cost
Stroke	1.4	\$49,025
Chronic kidney disease	4.9	\$45,011
Hypertension	13.6	\$27,384
Hyperlipidemia	10.2	\$27,077
Ischemic heart	9.4	\$31,054
Source: Medicare Chartbook, 2012		

Population level evaluation

While prevalence is lower than for some chronic conditions, COPD is thought to be somewhat underdiagnosed, at least in its early stages.²⁰ CDC reports prevalence rates were stable between 1998 and 2009.²¹ Nationally the prevalence rate is 6.3% with a range between 4-9% depending on state-by-state variability. COPD is, in advanced stages, a complex condition to manage. Co-occurring conditions complicate the management of the condition, including depression and anxiety, heart failure and other cardiovascular complications, osteoporosis, metabolic syndrome and lung cancer among others.²²

²⁰ American Thoracic Society/European Respiratory Society Task Force. Standards for the diagnosis and management of patients with COPD [online]. Version 1.2. New York: American Thoracic Society. 2004.

²¹ Chronic Obstructive Pulmonary Disease Among Adults Aged 18 and Over in the United States, 1998–2009, Lara J. Akinbami, M.D.; and Xiang Liu, M.Sc.

²² <http://www.goldcopd.org/>

Evidence, literature base

“...chronic care programs that...transform practice organizational culture have greater impact than those requiring the patients to do all the changing. Collaborative multidisciplinary care teams within a practice and care coordination with inpatient, emergency, and specialty services beyond primary care practice walls are particularly important for improving COPD management.

“The optimal care of the patient with chronic obstructive pulmonary disease (COPD) requires an individualized, patient-centered approach that recognizes and treats all aspects of the disease, addresses the systemic effects and comorbidities, and integrates medical care among healthcare professionals and across healthcare sectors.”²³

“More recently, Rice and colleagues reported on the reduction of emergency department visits and hospitalizations in patients with severe COPD who received one education session, an action plan for self-treatment of exacerbations, and monthly telephone calls from a case-manager. Studies that implement multiple components of the chronic care model have demonstrated a significant reduction in healthcare utilization (unscheduled/emergency center visits, number of hospitalizations, and hospital length of stay).”²⁴

With co-morbid depression

“The available evidence suggests that less than one-third of COPD patients with comorbid depression or anxiety are receiving appropriate treatment.... Factors that contribute to the lack of provision of treatment are multifactorial. In their elegant review, Maurer et al reported the multistage barriers for detection and treatment of anxiety and depression in patients with COPD. These include 1) patient perceived barriers, for example lack of knowledge and reluctance to disclose symptoms of anxiety or depression; 2) physician-perceived barriers, for example lack of a standardized diagnostic approach for anxiety and depression, short-consultation time and lack of confidence to pursue in-depth psychological assessment; and 3) system-level barriers, for example poor communication between primary care and mental health systems, and lack of adequate resources for mental health treatment. In order to address these barriers, an integrated treatment approach is required from healthcare professionals, patients and caregivers. In addition, the healthcare providers should be ready to provide appropriate resources to improve the quality of service provision and clinical practice.”²⁵

²³ <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3232168/>

²⁴ Official American Thoracic Society Workshop Report: The Integrated Care of the COPD Patient, Linda Nici and Richard ZuWallack, American Thoracic Society Subcommittee on Integrated Care of the COPD Patient, January 2012

²⁵ Depression and anxiety in patients with COPD, Yhannes, A and Alexopoulos, G., European Respiratory Review, 2014

Other co-morbidities

Chronic Obstructive Pulmonary Disease And The Prevalence Of Comorbidities (%)

Source	n	Arthritis	Cardiac	HTN	Diabetes	Lipids	Psych	GI	Cancer	Osteoporosis
van Manen and colleagues	1,145	36	13	23	5	—	9	15	6	—
Mapel and colleagues	200	22	65	45	12	—	17	32	18	—
Soriano and colleagues	2,699	28	22	—	—	—	10	26	4	—
Sidney and colleagues	45,966	—	18	18	2	9	—	—	—	—
Walsh and Thomashow	3,000	70	50	52	16	51	38	62	4	32

Conclusions

“For years the relevance and impact of comorbidities on COPD was not well understood. The emerging evidence on the detrimental interrelationship of comorbidities and COPD is mounting, but this area of research is in its early stages. It is yet to be determined if non-pulmonary interventions such as those that reduce the systemic inflammatory burden, improve anemia, prevent osteoporosis, reverse malnutrition, or the like, will alter the natural history of COPD. In addition, more studies are needed to better define the burden of COPD on various comorbidities and to discover the influence of various COPD treatment strategies on these comorbidities.”²⁶

“Chronic diseases such as chronic heart failure (CHF) and chronic obstructive pulmonary disease (COPD) often develop together with one or more co-morbid conditions and never alone. Not only may a coexisting chronic disease contribute to the clinical manifestations and the severity and life expectancy of the patients, but it may also influence the efficacy and safety of patient management. While common clinical practice is to treat chronic disease as a single condition, there is an urgent need to update the terminology and classification, and to develop new criteria for the diagnosis, assessment of severity, and management of patients with multiple chronic diseases.”²⁷

²⁶ <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2645334/>

²⁷ http://www.atsjournals.org/doi/full/10.1513/pats.200809-101TH#.VS_mmE10wdU

Clinical criteria rating (survey of team member physicians is included below with selected quotes from an article in the International Journal of COPD)

Diagnostic specificity	Medium (2.3)	Primary care questionnaires and other tools aid identification of candidates for spirometry. Spirometry can be effectively performed in primary care practices to conclusively diagnose COPD, and is an essential tool for confirming COPD and distinguishing it from other respiratory diseases. (Implementing chronic care for COPD: planned visits, care coordination, and patient empowerment for improved outcomes; Len Fromer, Dept. of Family Medicine, UCLA, International Journal of COPD 2011:6 605–614)
Screening tools available	High (2.7)	See above
Monitoring tools	Medium (2.3)	Spirometry in primary care is challenging
Treatment algorithms available	Medium (2.4)	GOLD and other standards are well grounded and accepted; other standards also exist for diagnosis and management (Ibid)
Treatment targets	Medium (2.2)	<ul style="list-style-type: none"> Possible metrics for COPD care include levels of utilization of the COPD-Population Screener™ 13 or other risk-awareness questionnaires, spirometry utilization, treatment guideline adherence (e.g., maintenance inhaler treatment for patients at or beyond moderate COPD),¹ and primary care follow-up rates promptly after an exacerbation-related emergency room (ER) or inpatient episode Currently, COPD care has fewer publicly reportable metrics than, for example, diabetes care, placing COPD at a disadvantage in pay-for-performance programs. (Ibid)

Osteoarthritis (OA)

Literature is lacking or very immature on the impacts of collaborative care for osteoarthritis. Patient reported outcomes are often more appropriate with patients who have the condition. Often occurs with co-morbidity as referenced below. Has significant impact on ADL and disability may contribute to worse outcomes for other conditions such as heart disease.

Comorbidities, prevalence and cost

Comorbidity	% Prevalence	Cost
Hypertension	32.2	17,806
Hyperlipidemia	25.1	17,192
Ischemic Heart Disease	17.4	22,279
Diabetes	14.9	20,355
Depression	10.4	25,416
Heart Failure	9.9	29,920

Evidence, literature base

Arthritis pain and disability: response to collaborative depression care, Lin EH, Tang L, Katon W, Hegel MT, Sullivan MD, Unützer J

Study intervention: IMPACT model for patients with OA. Conclusion: In a large and diverse population of older adults with arthritis (mostly osteoarthritis) and comorbid depression, benefits of improved depression care extended beyond reduced depressive symptoms and included decreased pain as well as improved functional status and quality of life.

“Canadian researchers have determined that community-based pharmacists could provide an added resource in identifying knee osteoarthritis (OA). The study, published in [Arthritis Care & Research](#), a journal of the American College of Rheumatology (ACR), represents the first evidence supporting a collaborative approach to managing knee OA. Findings suggest that involving pharmacists, physiotherapists, and primary care physicians in caring for OA patients improves the quality of care, along with patient function, pain, and quality of life.”

COAMI 2013 Management Conference — Executive Summary (Chronic Osteoarthritis Management Initiative)

Dr. DeWalt noted how Chronic Care Model elements have been applied to heart failure management, depression, and hypertension, in each case demonstrating better functional and clinical outcomes. Reflecting on aspects of the model that make it particularly relevant for OA, Dr. DeWalt noted that physicians cannot — and should not — do everything, and need to move from a “sage on the stage” perch to being more of a coach or “guide on the side.” Care needs to be standardized, Dr. DeWalt added, before it can be optimized — and OA care is far from standardized. ***Multiple chronic illnesses are the rule, not the exception, making coordinated care according to the Chronic Care Model even more imperative. Finally, he concluded, guidelines are essential, but not sufficient. Learning models that give care teams a mechanism for making changes in practice and adjusting their implementation until they achieve a reliable level of consistency are key.*** (bold italics added)

Lessons for OA from Diabetes. “M. Sue Kirkman, MD, Professor of Medicine in the Division of Endocrinology and Metabolism at the University of North Carolina, drew on her prior experience at the American Diabetes Association, where she oversaw the Association’s development of clinical practice recommendations and consensus reports.

Diabetes, like OA, is common, costly, and causes a significant amount of disability. Dr. Kirkman explained how guidelines for managing diabetes have evolved over time and in response to a changing evidence base. Some features of diabetes care, such as the fact that it is largely self-managed by patients and requires multi-disciplinary teams, made it more naturally aligned with elements of the Chronic Care Model than some other diseases. Still, the evolution of a more patient-centered approach was gradual.”²⁸

Osteoarthritis Chronic Care Program—New South Wales, Australia

Model of Care: Key points for inclusion in the OACCP are:

- A medical officer who will be an active team member and provide medical governance
- A Musculoskeletal Care Coordinator who will lead a multidisciplinary team to deliver the program

²⁸ United States Bone and Joint Initiative, Building a Model for Osteoarthritis (OA) Care: Summary of Discussions and Presentations at the Chronic Osteoarthritis Management Initiative (COAMI) Management Conference, 2013.

- Pre-program face-to-face screening and follow-up assessments using defined tools to record functional capacity and co-morbidity management
- Interventions to increase functional capacity and to manage morbid risks through nutrition, physical activity and exercise (strength and aerobic) support.
- Maximization of self-management support by linking with Arthritis NSW for the provision of evidence-based self-management programs
- The tracking of individual and service outcomes using ACI developed tools including a specifically designed web-based database
- Enablement of individuals to access appropriate and timely surgery based on clinical need
- Improvement of primary and tertiary care interface by promoting communication and coordinated care between service providers through a shared, documented action plan.²⁹

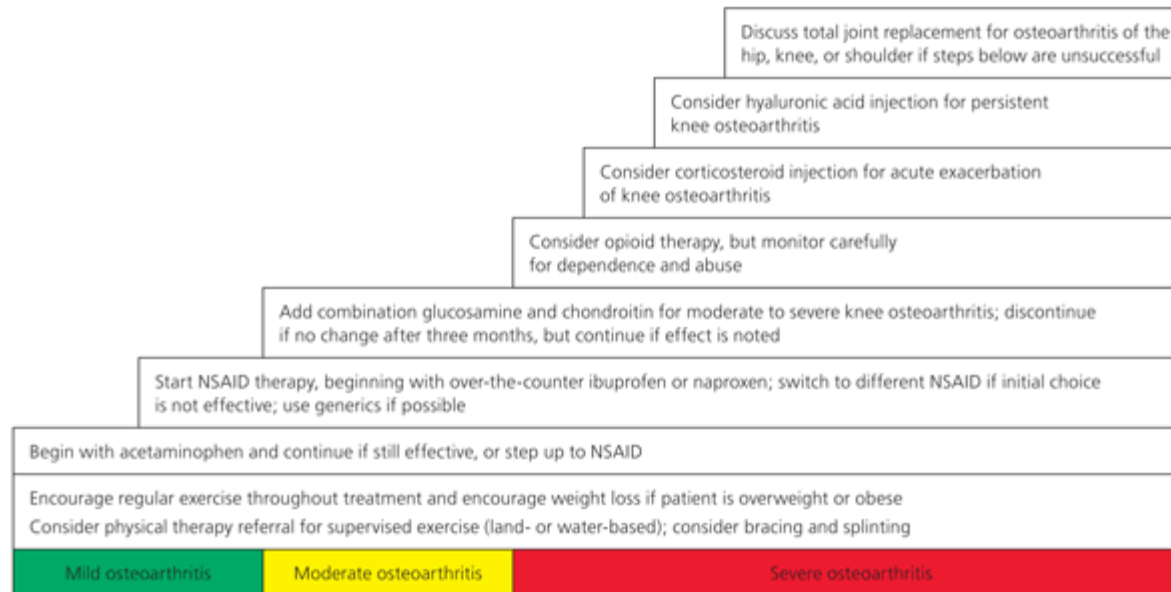
No statistically significant differences were found in changes over a 2-year period in pain and physical function between patients who received SCS-inconsistent care ($n = 163$) and patients who received SCS-consistent care ($n = 117$). SCS=stepped care strategy

...side effects and costs were important drivers for the SCS recommendations. SCS-consistent care may in this sense lead to high-quality care at the cost of pain and dysfunction. The added value of the SCS can only be appraised by considering a range of outcome measures simultaneously over a prolonged period of time in which cost–benefits and the number of side effects should be included.³⁰

²⁹ Musculoskeletal Network, Osteoarthritis Chronic Care Program Model of Care; Agency For Clinical Innovation, 2012.

³⁰ Effect of stepped care on health outcomes in patients with osteoarthritis: an observational study in Dutch general practice, Agnes J Smink, et al, September 2014.

Stepped-Care Approach for the Treatment of Osteoarthritis



Redesigning the care of rheumatic diseases at the practice and system levels

“Changing delivery-of-care processes for rheumatic diseases to improve outcomes and costs will require redesign not only within rheumatology practices but also within health systems. Preventive services, acute care, management of chronic co-morbidities, and rheumatology care for rheumatic disease patients can only be accomplished through the close integration of multiple practices and other health system resources.”³¹

³¹ Eric D. Newman, MD, Geisinger Health System, J. Timothy Harrington, MD, University of Wisconsin School of Medicine and Public Health, Rheumatology, Clin Exp Rheumatol 2007; 25 (Suppl. 47): S64-S68.

Clinical criteria review
Results of survey of team physicians

1. Diagnostic specificity and ease	Medium (2)	Diagnosis can be difficult in early stages; condition underdiagnosed significantly according to literature
2. Screening methods available, accepted	Medium to low (<2)	Screening is problematic; Canadian study found pharmacists could assist based on medications
3. Monitoring tools available, accepted	Low (1.3)	WOMAC, others, many on ADL, pain, function (time consuming to collect)
4. Available treatment algorithms	High (3)	Stepped therapy approaches available and well established in patients that are diagnosed; OARSI for knee; see diagram below for AAFP material
5. Treatment target specificity	Medium (2)	Patient assessment is more subjective

CHF

Comorbidities, prevalence and costs

Comorbidity with CHF	% Prevalence	Cost
Hypertension	18.9	28,017
Ischemic Heart Disease	15.7	28,440
Hyperlipidemia	13.8	28,524
Diabetes	10.8	30,659
Chronic Kidney Disease	10.0	37,256
Arthritis	9.9	29,920

Population level evaluation

Selected national data (2010)

- Annual admission rate almost 50%.
- Annual cost estimated at \$28.8 billion

VA data

- 8% prevalence
- Average 20 clinic visits/year
- 5 year mortality is 36%

Evidence, literature base

Incidence of heart failure is relatively low but is growing as a result of the aging population. It is one of two most frequent reasons for hospitalization (with COPD) and thus is extremely costly to treat. Studies and clinical trials find mixed results for collaborative care models. In the PCDM pilot (Four VA Centers) there were no differences in outcomes with usual care. (This population may not conform to a “regular” Medicare cohort of patients.) In later stages, CHF patients are quite frail and may require more regular contact, tele-monitoring and clinic-based approaches. In cases of earlier stages, a COMPASS-like model is more likely to demonstrate improved outcomes.³²

Successful Models of Comprehensive Care for Older Adults with Chronic Conditions: Evidence for the Institute of Medicine’s “Retooling for an Aging America” Report

For example, the meta-analytical evidence that interdisciplinary primary care for heart failure can reduce the use and total cost of health services provides guidance and empirical support for the recent enthusiasm for the “medical home” concept³³

National Heart Foundation of Australia. Multidisciplinary care for people with chronic heart failure. Principles and recommendations for best practice. 2010.

Current chronic care management research emphasizes the importance of integrated and coordinated approaches and cross sector collaboration. The Innovative Care for Chronic Conditions framework (adapted from the Chronic Care Model) provides a useful framework for structuring healthcare planning and delivery across all levels of service provision.³⁴

Does the Collaborative Model Improve Care for Chronic Heart Failure?

Conclusions: Organizational participation in a common disease targeted collaborative provider interaction improved a wide range of processes of care for CHF, including both medical therapeutics and education and counseling. Our data support the use of programs like the IHI BTS in improving the processes of care for patients with chronic diseases.

In this study of patients discharged home from the ED without hospital admission, we examined those who received early collaborative care provided by a PC physician and a cardiac specialist. We found that patients who received collaborative care within 30 days of discharge had lower rates of death, recurrent emergency visits, and hospitalizations. A sizable proportion of patients did not visit any physician within 30 days after ED discharge, and they experienced greater death and higher risk of the composite of HF-specific outcomes and mortality. Patients who received early collaborative care were more likely to undergo important diagnostic tests, including cardiac functional assessment and evaluation for myocardial ischemia, were more likely to undergo coronary revascularization, and received more evidence-based drug therapies than PC patients alone.³⁵

³² Collaborative Cardiac Care In Primary Care, Denver VA Medical Center, Connor McBryde, MD, Nov. 30, 2010

³³ Successful models of comprehensive care for older adults with chronic conditions: evidence for the Institute of Medicine’s “Retooling for an Aging America” report, Boulton C, et al., *J Am Geriatr Soc* 2009;57(12):2328-2337.

³⁴ National Heart Foundation of Australia. Multidisciplinary care for people with chronic heart failure. Principles and recommendations for best practice. 2010.

³⁵ Does the Collaborative Model Improve Care for Chronic Heart Failure?, Steven M. Asch, MD, MPH, *Medical Care*, July 2005: 43(7).

Improved Outcomes with Early Collaborative Care of Ambulatory Heart Failure Patients Discharged From the Emergency Department

Douglas S. Lee, MD, PhD

Conclusions: Early collaborative heart failure care was associated with increased use of drug therapies and cardiovascular diagnostic tests and better outcomes compared with PC alone.³⁶

Primary Results of the Patient-Centered Disease Management (PCDM) for Heart Failure Study: A Randomized Clinical Trial

Interventions: The PCDM intervention included collaborative care by a multidisciplinary care team consisting of a nurse coordinator, cardiologist, psychiatrist, and primary care physician; home tele-monitoring and patient self-management support; and screening and treatment for comorbid depression.

Results: There were no significant differences in baseline characteristics between patients randomized to the PCDM intervention (n = 187) vs usual care (n = 197); baseline mean KCCQ overall summary scores were 37.9 vs 36.9 (P = .48). There was significant improvement in the KCCQ overall summary scores in both groups after 1 year (mean change, 13.5 points in each group), with no significant difference between groups (P = .97). The intervention was not associated with greater improvement in the KCCQ overall summary scores when the effect over time was estimated using 3-month, 6-month, and 12-month data (P = .74). Among secondary outcomes, there were significantly fewer deaths at 1 year in the intervention arm (8 of 187 [4.3%]) than in the usual care arm (19 of 197 [9.6%]) (P = .04). Among those who screened positive for depression, there was a greater improvement in the Patient Health Questionnaire 9 scores after 1 year in the intervention arm than in the usual care arm (2.1 points lower, P = .01). There was no significant difference in 1-year hospitalization rates between the intervention arm and the usual care arm (29.4% vs 29.9%, P = .87).

Conclusions and Relevance: This multisite randomized trial of a multifaceted HF PCDM intervention did not demonstrate improved patient health status compared with usual care.³⁷

³⁶ Improved Outcomes with Early Collaborative Care of Ambulatory Heart Failure Patients Discharged From the Emergency Department, Douglas S. Lee, MD, PhD; *Circulation*. 2010 Nov 2;122(18):1806-14.

³⁷ Primary Results of the Patient-Centered Disease Management (PCDM) for Heart Failure Study: A Randomized Clinical Trial, Bekelman, et al., *JAMA Intern Med*. 2015 May 1;175(5):725-32. doi: 10.1001/jamainternmed.2015.0315.

Clinical criteria review

Results of survey of team physicians

1. Diagnostic specificity and ease	Medium (2.3)	Diagnosis initially can be challenging as HF is syndromic without clear diagnostic benchmarks
2. Screening methods available, accepted	Medium (2.0)	Not clear when to screen
3. Monitoring tools available, accepted	Medium (2.2)	Re-hospitalization remains relatively high and monitoring (even home monitoring) is challenging given the potential for rapid symptom deterioration ³⁸
4. Available treatment algorithms	High (2.8)	Sense from team: treatment approaches relatively standard in lower acuity patients; complexity increases significantly with co-morbidities and disease progression
5. Treatment target specificity	Medium (2.2)	Targets can be difficult to measure and achieve

³⁸ Home Monitoring Heart Failure Care Does Not Improve Patient Outcomes; Looking Beyond Telephone-Based Disease Management; Akshay S. Desai, MD, MPH; Circulation. 2012;125:828-836

Appendix 2—Cochrane Review

Full table of studies; for the entire journal article see: Interventions for improving outcomes in patients with Multi-morbidity in primary care and community settings (Review); Smith SM, Soubhi H, Fortin M, Hudon C, O'Dowd T

Study	Participants	Duration, follow-up	Intervention elements	Outcomes	Results: intervention versus control
Predominantly organizational interventions					
Bognor 2008	Aged >50, depression and hypertension (n=64)	Intervention 6 weeks, follow-up 2 weeks later	Care manager, structured visits, telephone contact, and patient care plans (adherence based model)	Depression scores (CES-D score); systolic blood pressure; drug adherence	CES-D score 9.9 v 19.3, P=0.006; systolic blood pressure (mm Hg) 127.3 v 141.3, P=0.003; ≥80% adherence to antidepressants 23% v 10%, P=0.001, ≥80% adherence to anti-hypertensives 25% v 10%, P<0.001
Boult 2011	Aged >65, multiple conditions and high service use (n=904)	Intervention 18 months, follow-up at six and 18 months	Organizational: guided care nurse managers, enhanced multidisciplinary team, home assessments and monthly monitoring, patient care plans. Professional: education of nurse managers. Patient: self-management support	Primary outcome: health service use hospital admissions, nursing facility use, visits, and home healthcare episodes. Secondary outcomes: quality of chronic care (PACIC) scores	Adjusted intervention: control ratio of service use: hospital 30 day readmissions 1.01 (95% CI 0.83 to 1.23); hospital days 0.79 (0.53 to 1.16); skilled nursing facility admissions 1.00 (0.77 to 1.30); skilled nursing facilities days 0.92 (0.6 to 1.4); emergency department visits 0.84 (0.48 to 1.47); primary care visits 1.04 (0.81 to 1.34); specialty care visits 1.02 (0.91 to 1.14); home healthcare episodes 1.07 (0.93 to 1.23); (PACIC) scores 0.70 (0.53 to 0.93)
Hogg 2008	Aged >50, at least two conditions and at risk of experiencing adverse outcome (n=241)	Intervention 15 months, follow-up on completion of intervention	Enhanced multidisciplinary team with structured home visit, drug review, and patient care plans	Primary outcome: chronic disease management score. Secondary outcomes included preventive care delivery score, physical health outcomes, health service use, psychosocial measures, quality of life, and activities of daily living	Difference in chronic disease management score after intervention 0.091 (95% CI 0.037 to 0.144)
Katon 2010	Depression and diabetes or coronary heart disease, or both	Intervention 12 months, follow-up at 12 months	Organizational: TEAMcare nurses, structured visits, patient care plans and treatment targets, weekly team	Primary outcomes: depression scores (SCL-20); diabetes (glycated hemoglobin); systolic blood pressure; and low density	Adjusted between group difference (95% CI): depression scores SCL-20) -0.41 (-0.56 to -0.26); glycated hemoglobin -0.56% (-0.85% to -0.27%); systolic blood pressure (mm Hg) -3.4 (-6.9 to 0.1);

Study	Participants	Duration, follow-up	Intervention elements	Outcomes	Results: intervention versus control
	(n=214)		meetings, and use of electronic registry to track patient progress. Professional: education of nurse managers. Patient: support for self-care (behavioral activation theory)	lipoprotein cholesterol. Secondary outcomes: increases in drug adjustments, quality of life, and satisfaction with care	low density lipoprotein cholesterol (mg/dL) -9.1 (-17.5 to -0.8)
Krska 2001	Aged >65, at least two conditions (n=332)	Intervention 3 months, follow-up three months after drug review	Senior care connections: structured visit with pharmaceutical patient care plan created by pharmacist and implemented by practice team	Primary outcome: pharmaceutical care issues. Secondary outcomes: medicine costs, quality of life, and health service use	Pharmaceutical care issues (%) resolved after intervention: 82.7% v 41.2%, P<0.001
Sommers 2000	Aged >65, at least two conditions (n=543)	Intervention 2 years, follow-up 12 months after intervention	Organizational: enhanced multidisciplinary team including social worker, home assessment, and patient care plans, professional: training of care coordinators	Health service use including admissions, office visits, emergency department visits, home care visits, and nursing home visits. Patient reported health status: social activities count, quality of life, depression scores, nutrition checklists, and drug adherence	Odds ratio admissions/patient/year 0.63 (95% CI 0.41 to 0.96); ≥1 60 day readmissions 0.26 (0.08 to 0.84). Not fully reported for seven other outcomes, non-significant for six. Difference in adjusted mean scores, social activities count 0.50 (95% CI 0.02 to 1.00). Symptom scale 0.50 (-3.20 to 0.16), SF-36 self-rated health 0.10 (-0.27 to 0.02), not reported for four other outcomes, non-significant
Predominantly patient oriented:					
Eakin 2007	Multi-morbidity defined as at least two conditions (n=175) (data for multi-morbidity group from authors)	Intervention 16 weeks, follow-up 6 months after intervention	Patient: self-management support, diet, and exercise intervention delivered by health educator; organizational: structured visits and telephone contact (chronic care model: patient self-management)	Dietary behavior, support for healthy lifestyles, and physical activity	Adjusted mean (SE): dietary behavior (lower score better) 2.20 (0.05) v 2.41 (0.05), P<0.5; support for healthy lifestyle (higher score better) 2.98 (0.06) v 2.68 (0.06), P<0.05; change minutes walking/week 8 (22) v -10 (27), P>0.5
Gitlin 2006	Aged >70, multiple conditions and reported	12 months intervention, follow-up at completion	Patient (Advancing Better Living for Elders, ABLE): occupational therapy and physiotherapy home	Primary outcomes: functional difficulty (activities of daily living, activities of daily living,	Difference in adjusted means at 12 months: activities of daily living -0.10 (95% CI -0.21 to 0.02); instrumental activities of daily living -0.12 (-0.26 to

Study	Participants	Duration, follow-up	Intervention elements	Outcomes	Results: intervention versus control
	difficulties with activities of daily living (n=319)	of intervention, 4 year mortality follow-up	based intervention including balance and muscle strengthening and fall recovery techniques, patient: problem solving techniques (lifespan theory of control)	instrumental activities of daily living, and mobility), self-efficacy and fear of falling (self-efficacy for falls). Secondary outcomes: adaptive strategy use and presence of home hazards. Four year follow-up: mortality	0.03); mobility -0.14 (-0.29 to 0.01); overall self-efficacy 0.09 (-0.06 to 0.23); fear of falling 0.56 (0.15 to 0.97); mortality at two years 5.6% (9 deaths) v 13.2% (21 deaths), P=0.02. Mortality at four years no significant difference, intervention increased survivorship by 3.5 years
Hochhalter 2010	Aged >65, at least two of seven chronic conditions (n=79)	Intervention 3 months, follow-up three months after intervention	Patient engagement intervention led by "coaches" with focus on making most of healthcare (chronic care model: patient self-management)	Primary outcome: patient activation measure. Secondary outcomes: total unhealthy days, self-efficacy, and self-rated health	Patient activation measure: reported as no significant difference between intervention and control at follow-up
Lorig 1999	Aged >40, at least two of heart disease, lung disease, arthritis, or stroke (n=536) (subgroup of patients with comorbidities)	Intervention 7 weeks, follow-up at six months	Patient (weekly community based meetings led by trained volunteer lay leaders focusing on self-management and peer support) (Bandura's self-efficacy theory)	Health service use: admissions, emergency department plus visits to physician. Health behaviors: four measures. Health status: eight measures	Adjusted mean difference (SD). Number of admissions 0.19 (0.73) v 0.33 (1.2), P<0.5; nights in hospital 1.05 (6.3) v 2.1 (6.8), P<0.5; number of physician visits 4.96 (6.1) v 6.87 (7.2), P>0.5. Significance of 12 measures relating to health behaviors and health status in comorbidity subgroup not reported

The COMPASS project described was supported by Grant Number 1C1CMS331048 from the Department of Health and Human Services, Centers for Medicare & Medicaid Services. The contents of this publication are solely the responsibility of the authors and do not necessarily represent the official views of the U.S. Department of Health and Human Services or any of its agencies. Michigan Center for Clinical Systems Improvement (Mi-CCSI) is a sub-awardee of this grant.

The analysis presented here was conducted by the awardee. Findings might or might not be consistent with or confirmed by the findings of the independent evaluation contractor.

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