*Managing and Coordinating Health Care: Creating Collaborative, Proactive Systems*
David A. Dorr, Oregon Health and Science University

## Abstract

In our current health care system, older adults with multiple chronic illnesses require significant resources; 5% of people over 65 represent 43% of health care spending. The predominant costs in the system are from exacerbations of illnesses and high acute care needs, and the factors that contribute to these problems include: 1) multiple, sometimes conflicting guidelines of best practices for individual conditions; 2) fragmentation of care, with patients seeing an average of 13 providers per year and receiving an average of 8 medications; and 3) failure to address functional and safety risks as persons age. Coordination and management of care for this at-risk population is variable and often lacking, in particular during at the most critical times of transitions in and out of the hospital.

Care Management Plus is a model intended to create a ***reliable*** and ***effective*** system of care for this population and prevent unnecessary decline, hospitalizations, and death. Development and implementation of the system can be modeled as needs, requirements, and unanticipated effects. The needs were defined by interviewing patients, clinic nurse care managers, providers (mostly physicians), and other primary care team members, and engaging in a 4 year study. Primary gaps identified included: 1) lack of collaboration between patient/family and health care team; 2) lack of reliable, complete communication; and 3) failure to prioritize care needs using both patient input ***and*** evidence regarding effective treatments. Requirements of the system were developed through an iterative process focused on gaps rather than complete re-engineering. The program combined geriatrics and disease management training with enhanced information technology for the healthcare teams, with a focus on collaborating with patients and being proactive about patient goals. Patient identification/referral was not rigidly prescribed, allowing providers to refer patients they thought could benefit most from the program. Upon evaluation of the effectiveness of Care Management Plus in this high-risk population, we discovered that improved system reliability combined with flexibility helped lead to reduction in hospitalizations, improvement in disease control, and improvement of clinic efficiency in a controlled trial. Unanticipated effects are discussed.

## Introduction

In the last hundred years, vast advances in public health and medical care have resulted in longer, healthier lives. These advances have led to a shift from infectious diseases as the top three causes of death (pneumonia, tuberculosis, and infectious diarrhea) to sequelae of chronic illnesses as the most common causes of death. For instance, heart disease, the most common cause of death in 2000, is hastened by diabetes, hypertension, and high cholesterol.(R. N. Anderson & Arias, 2003) Additionally, as people age, loss of functional ability and increasing disability become primary determinants of death, increased use of medical services, and loss of independence. For example Shugarman, Decker, & Bercovitz (2009) showed that increasing disability and multiple conditions near the end-of-life was the primary cause of increased hospitalizations and costs, not single conditions or age.

As antibiotics and sanitary practices improved the lives and health of previous generations, so too have we learned how to encourage healthy aging to reduce the burden of chronic illness and disability through medical care and changes in day-to-day behaviors. However, the health care system in the United States has developed to care for individual conditions and acute needs, rather than the ongoing care and health of people. Fixing this system requires changing health care delivery to anticipate these needs, teach and encourage people and their families to seek health, and help consistently provide care that matches medical knowledge.

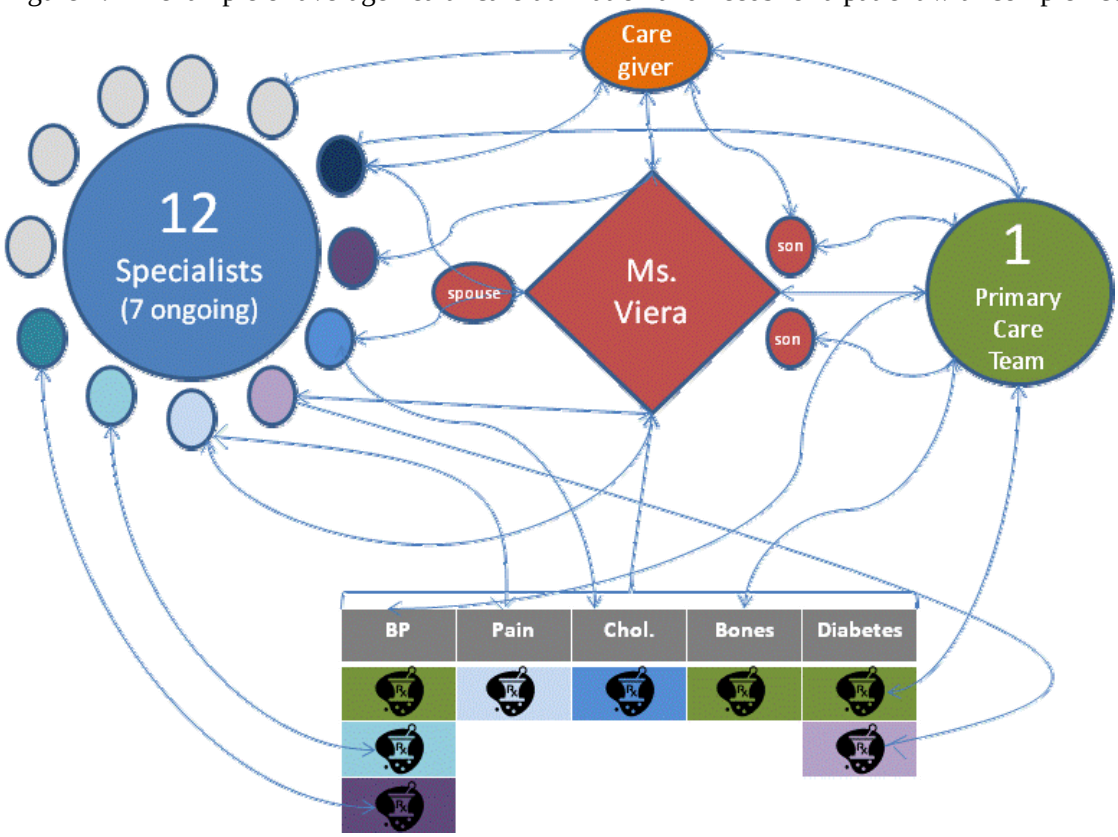
### The complexity of care and need for care coordination

As an example, consider two alternate courses that the life of a hypothetical patient, Ms. Viera, might take based on care delivery (Figure 1). Ms. Viera is a 75 year old woman, with five

common chronic conditions: 1) arthritis in her knees and hips; 2) diabetes, which she has had for the last 5 years; 3) high blood pressure; 4) moderate kidney dysfunction, leading to some swelling in her legs; and 5) some new difficulties remembering things day-to-day. She lives alone and can manage the usual household tasks. Socially, she goes to the senior center once a week, she has a part-time professional caregiver, and she has a daughter who lives about an hour away by car.

At the start of our hypothetical year, Ms. Viera looks back on last year, a fairly typical year. She saw 13 providers, 8 of whom she continues to see regularly. Her regular providers include her primary care provider, Dr. Smith, an internal medicine doctor who provides ongoing care with her team; a rheumatologist for her arthritis pain; a cardiologist; a neurologist, whom she saw in consult for her memory; a nephrologist for her kidneys and blood pressure; an orthopedist for her knees; a gynecologist; and an endocrinologist for her diabetes. She filled 50 different prescriptions for 8 chronic medications and 4 short-term medications; as shown in the diagram, several came from specialists and some from the primary care team. She avoided the hospital last year, despite having nearly ninety times the risk of a hospitalization of someone her age with no chronic illnesses.(Wolff, Starfield, & G. Anderson, 2002) As the figure shows, the number of connections – for communication, for addition to medical care plans, and for the patient, family, and caregiver to track – is enormous. The coordination of these elements and connections is the primary challenge we will address in this paper.

Figure 1. An example of average health care utilization and needs for a patient with complex conditions.



Patients like Ms. Viera represent approximately 5% of people over 65, yet use about 43% of all health care resources. (Wolff et al., 2002) When we consider re-engineering the system to improve her care, first and foremost we must weigh the benefit of that care for Ms. Viera. A primary hypothesis in care coordination research is that carefully planning and arranging care can result in better quality care and improved efficiency. Society, patients, and insurers all benefit by avoiding waste from errors and 'defects' in the care delivered compared with that intended.

**A crucial juncture**

Let us resume the case of Ms. Viera: at the beginning of our year, she has a brief hospitalization for difficulty breathing and dizziness. After about 2 days, she is diagnosed with out-of-control blood sugars and some excess fluid on her lungs. The hospital team stabilizes her, adjusting several medications, and she is discharged back to her home.

Figure 2 demonstrates one potential course that her post-hospital convalescence could take. On the left, a set of hypothetical events are described. In the next year, she goes home, appointments are planned, she attempts to resume her usual activities, sees specialists, has dizziness, chest pain, and some difficulties with control of her chronic conditions. In the usual care condition, 'System 1', the care coordination tasks and their method of completion are highlighted. Studies show that on discharge from the hospital, 1/3 of patients have care plans that are not followed or communicated (instructions to make an appointment with a physician, for instance); as well, calls from the hospital staff to the primary care provider, while helpful, frequently do not lead to follow-up without communication – from either the hospital or primary care teams - directly to the patient. By the time the provider reviews the faxed discharge summary, Ms. Viera has about a 10% chance of being rehospitalized. In the next month, Ms. Viera may increase her activities and develop symptoms from her medications. In the usual system, she may call her PCP and, waiting for the return call, have her symptoms worsen and go to the emergency department. Upon seeing 3 of her specialists in follow-up, the lack of information sharing across settings leads to new medications prescribed but not remembered by the patient or family or reconciled against her old list. Finally, in month 6, Ms. Viera may have a serious new problem: worsening chest pain. In the usual system, all of her other issues may have distracted the primary care team from controlling her blood pressure, causing a repeat hospitalization for monitoring; although she doesn't have a heart attack, her changed medications and the unfamiliarity of her surroundings in the hospital may lead to a fall and further need for rehabilitation. In each of these common scenarios, there are gaps in coordination that lead to increased utilization of health care and worsened health for Ms. Viera. Our primary purposes in this paper will be to elaborate on the reasons for our failure to create reliable health systems and to provide suggestions for improvement.

Figure 2. A year in the life of Ms. Viera and the usual system of health care coordination

| Event | System1 : usual care |
|---|---|
| Ms. Viera is hospitalized. | Courtesy call made to PCP. |
| Month 1: Ms. Viera goes home. An appointment is planned with her PCP for follow-up. | Ms. Viera receives sheet with the instructions to make an appointment; PCP receives a fax in 7 days with discharge info. |
| Month 2: Ms. Viera resumes usual activities and becomes dizzy in the morning | She calls the PCP, an appointment is scheduled, but she goes to the ED due to worsening symptoms. |
| Month 3: Adjustments to medications are made by 3 specialists. | 2 of 3 send reports to the PCP office with plan; these reports are duly filed. When seen by the PCP, she can't remember these changes. |
| Month 6: Ms. Viera has chest pain and calls her PCP for help. | PCP sees patient urgently; BP is out of control and Ms. Viera is hospitalized for observation. |
| Month 12: Review of the year for Ms. Viera and family | After her second hospitalization, she is discharged to rehabilitation and a skilled nursing facility. |

**Our purpose.**

The goal of this paper is to describe one way to enhance the current system of health care from coordination 'as usual' – which includes many gaps – to a more reliable and effective system of systems. One of the challenges in creating a reliable system is that gaps are not uniform, but vary over time and between individuals based on a wide set of criteria, such as social needs, economic issues, chronic illnesses, personal preferences, and local system infrastructure. Multiple disciplines, such as cognitive engineering, systems science, industrial engineering, and informatics, need to be combined to start to address how the current gaps can be minimized and closed.

One way to address these needs is to take the existing health care delivery system and diagnose these gaps through a structured approach by looking at goals of care, current processes, infrastructure, and participants. We have completed a series of studies looking at the primary care system, a subset of the overall health care system that focuses on ongoing, outpatient care by a primary care provider and the team.(Dorr, Wilcox, Donnelly, Burns, & Clayton, 2005)(Dorr, Tran, Gorman, & Wilcox, 2006)(Dorr et al., 2006)(Dorr, Wilcox, McConnell, Burns, & Brunker, 2007) In this system, as demonstrated in Figure 1, coordination of care is crucial since the care should be ongoing, comprehensive, and relationship-based. In these studies, we sought to define the goals of care coordination first. Then, crucial processes are defined. These processes are usually non-linear, and are started through comprehensive assessments and require iterative follow-up on care plans and patient needs. Finally, the infrastructure, both in terms of the team competencies and the clinic-based technology that may assist in reliability, and role definitions were defined from these needs. Since the potential connections are many and the needs are complex, we first sought to identify the major problems by identifying gaps in the provision of care.

**Gaps identified**

We and others have used observations and semi-structured interviews of patients with complex conditions, physicians and nurses, and other health care professionals to identify the most common issues with care coordination in the primary care clinic.(Dorr et al., 2006)(Bodenheimer, 2008)(Wilcox et al., 2007) Principal problems identified in analysis included: 1) lack of collaboration between patient/family and health care team; 2) lack of

reliable, complete communication; and 3) failure to prioritize care needs using both patient input ***and*** evidence regarding effective treatments. Collaboration involves shared decision-making, a process whereby patients are given education about conditions, are offered options, and provided with tools to help make decisions. With multiple chronic conditions, decision-making is required frequently and must be coordinated across conditions. As well Bodenheimer & Handley (2009) found that patient-specific behavioral goal-setting and problem solving was a crucial consideration for decision making, leading to improved health. Such patient goal-setting was done less than 25% of the time, however, and patients reported that they did not feel included in the decisions more than 50% of the time.(Bodenheimer & Handley, 2009) Studies of communication in health care indicate frequent gaps in crucial communications. Some of the studied reasons for these gaps have included: a) having low signal-to-noise ratio from non-crucial communication; b) needing multiple inputs to complete the communication (e.g., specialists and primary care and the patient and family), requiring non-linear, iterative processes; and c) the mode of communication either requires more attention than is available (such as synchronous conversations with the provider) or is not timely (such as faxes).(Westbrook et al., 2007) With limited time and attention, communication failure is common, leading to errors and preventable adverse events, such as emergency department visits resulting from unreturned calls or unclear instructions. Finally, as patient condition severity and risk factors grow, prioritization of needs and next steps is crucial. Systems that remind about every potential treatment or care plan step individually lead to *alert fatigue* and failure to improve care; systems that do not incorporate patient preferences into the system lead to serious gaps in patient understanding and adherence. In one study, over 50% of patients did not understand the directions given to them by their physicians at the end of the visit. (Bodenheimer & Handley, 2009)

**Solution components**

To understand the components of the solution, we should return to our previous example with Ms. Viera. Given the same events outlined over a year, an optimal system would address a number of the previously identified gaps that the usual system does not.

Figure 3. A proactive and collaborative system of health care coordination

| Event | System2a: High care coordination | System2b: High health information technology |
|---|---|---|
| Ms. Viera is hospitalized. | Care Manager (CM) called by family. | Admitting information sent to PCP, picked up by CM. |
| Month 1: Ms. Viera goes home. An appointment is planned with her PCP for follow-up. | CM assures appointment made and calls 2-4 days post-hospitalization. CM attends PCP visit. | Scheduled outreach for follow-up tracked per protocol and CM need; these remain until communication completed. |
| Month 2: Ms. Viera resumes usual activities and becomes dizzy in the morning | CM takes call, and has patient come in per provider advice; low blood sugars are to blame and medications adjusted. | Blood sugars are tracked over time in the system, with regular follow-up calls scheduled as medications adjusted. |
| Month 3: Adjustments to medications are made by 3 specialists. | On monthly review by CM, Ms. Viera brings in her medications and notes changes. The medication list is updated. | Specialist referrals deemed critical are tracked by system and missing report causes a reminder to be triggered. |
| Month 6: Ms. Viera has chest pain and calls her PCP for help. | Under a CM protocol, her BP was controlled and she is seen, stabilized, and returned home. | Protocols are enforced by system, with reminders about patient goals and follow-up. |
| Month 12: Review of the year for Ms. Viera and family | With Ms. Viera's permission, the daughter comes in for a conference, and helps arrange to keep Ms. Viera at home. | A summary generated by the system helps inform the conference and aids in care planning. |

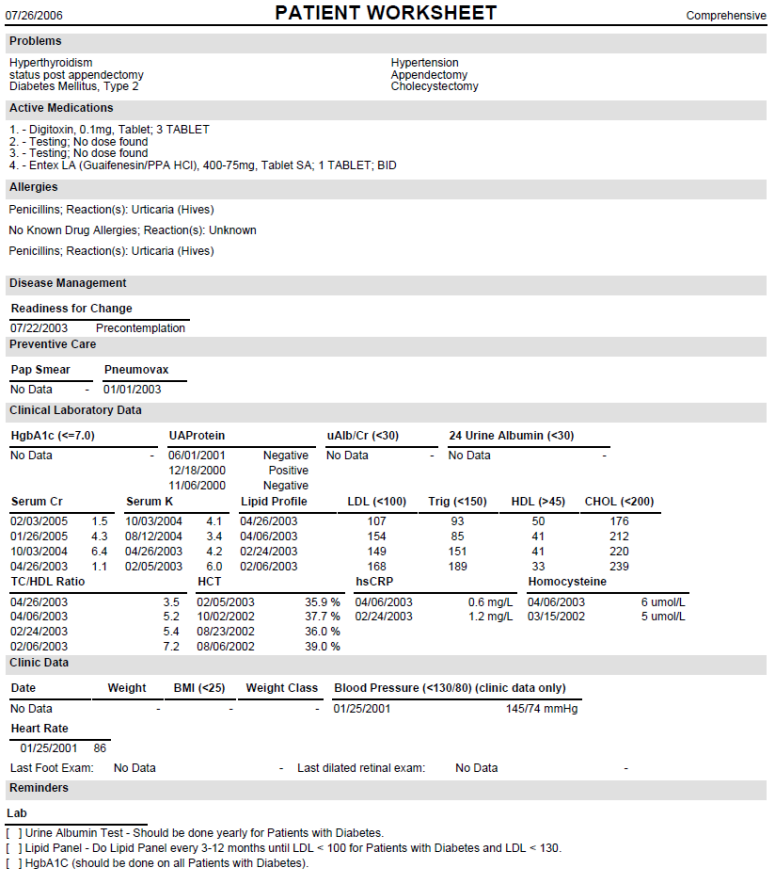
The first category identified is team reorganization. (Wagner, Bodenheimer) In disciplines like Crew Resource Management, team competencies, training, and function are crucial to reliability and effectiveness in high risk, high attention areas such as airplane cockpits.(Salas, Wilson, Burke, & Wightman, 2006) In care coordination, specific team roles are defined to cope with the high communication needs and workflow. Care managers fill a gap in team roles, since most clinic workflows are still focused on the individual visits from patients.(Dorr et al., 2006) Evidence from studies of care managers or care coordinators have increasingly shown them to be crucial to controlling disease exacerbation,(Dorr et al., 2005) reducing hospitalizations,(Dorr, Wilcox, Brunker, Burdon, & Donnelly, 2008) and improving satisfaction with care.(Wilcox et al., 2007) Competencies of care managers – such as ability to educate, to motivate patients to set and follow goals and care plans, and to be effective, efficient communicators – are crucial to define and adopt.

As well, reliable processes have been tested and implemented for individual conditions in the form of primary care team protocols; in these protocols, common conditions are identified – such as an elevated blood pressure – and the treatment plan is described in a flowchart. The protocol allows dissemination of tasks to team members beyond the beleaguered physician by pre-defining, in sequence, the steps that would normally be ordered manually. For protocols to become reliable in care coordination, however, they must address collaboration, prioritization, and the complexity of patient needs. Comprehensive assessments of preferences and goals across multiple conditions and patient needs have been shown to be successful improving the health of older adults and in facilitating patient decision-making.(Boult, Kane, Pacala, & Wagner, 1999) In our case, the care manager provides coordination by filling in the gaps in care: receiving the call from the hospital and family, making the follow-up call post-hospitalization, following protocols and being proactive in identifying needs of patients. Care managers can also

work to close the communication loop by staying focused on the key communication tasks for at risk patients, following up on critical referrals to specialists, and arranging conferences to consolidate communication. In the usual clinic flow, there is limited time for staff to accomplish these tasks, and many urgent items distract from their completion; research has shown that trained care managers can accomplish these goals more successfully, creating an effective system.

However, distractions still exist for redefined teams, especially as the number of patients followed by a care manager grows. Previous work has shown that 2-5% of patients in a usual primary care clinic meet the criteria defined by Ms. Viera: at-risk, diagnosed with multiple comorbid illnesses, and in need of ongoing care coordination. In a clinic of 7 physicians, more than a thousand patients may meet these criteria, leading to overwhelmed, ineffectual care managers. With health information technology, key process points can be defined and used to remind care managers about crucial elements, increasing efficiency and reliability. For example, most electronic health record systems focus on the individual clinic visit and workflow, relegating additional tasks to extensive to do lists. In several studies, individual physicians received hundreds of these tasks each day. The primary goal of care coordination is to monitor, over time, the active care and treatment plan for patients, and enact elements to increase success of plan completion. In our example, the adapted health information technology (HIT) functions help prioritize these tasks by identifying crucial elements to share within the primary care team, assuring they are delivered to the correct team members in the right format, and reminding clinicians about uncompleted tasks. To start this process, the HIT must be able to identify all patients under care management. This allows filtering and prioritized data flow. In our studies, the HIT enabled the care managers to follow an average 350 patients at a time, or approximately 1000 per year.(Dorr et al., 2007) Thus, a patient under care management can have prioritized messages sent about their hospital stay, have automatic follow-up after sentinel events that persist beyond an individual call or visit, and move to the top of the queue for attention. The system can embed protocols, although needs expressed by the care managers required flexibility in the protocols; the care managers needed only the next step defined and reminded upon to account for rapidly changing status. Care managers also indicated that bundled tasks – where every task due is intertwined into each encounter – were necessary to maximize efficiency and avoid fatigue. Even amongst individual patients, care managers needed to identify what tasks were highest priorities and be reminded about these first.(Dorr et al., 2006) For instance, since Ms. Viera sees 12 specialists a year, the care manager would designate which are critical referrals that will directly affect the care plan and be reminded about these elements only. Finally, summarization of the complex care and needs of patients was crucial to quickly address issues and couple patient history with anticipated care needs in one spot. Figure 4 shows this summary mechanism, the patient worksheet, which has shown – by itself – to improve adherence with evidence-based treatments for chronic and preventive illness by 17-30%. (Wilcox et al., 2005)

***Figure 4. Comprehensive summary sheet***



07/26/2006 **PATIENT WORKSHEET** Comprehensive

**Problems**

Hyperthyroidism
status post appendectomy
Diabetes Mellitus, Type 2
Hypertension
Appendectomy
Cholecystectomy

**Active Medications**

1. - Digitoxin, 0.1mg, Tablet; 3 TABLET
2. - Testing; No dose found
3. - Testing; No dose found
4. - Entex LA (Guaifenesin/PPA HCl), 400-75mg, Tablet SA; 1 TABLET; BID

**Allergies**

Penicillins; Reaction(s): Urticaria (Hives)

No Known Drug Allergies; Reaction(s): Unknown

Penicillins; Reaction(s): Urticaria (Hives)

**Disease Management**

**Readiness for Change**

07/22/2003 Precontemplation

**Preventive Care**

| Pap Smear | Pneumovax |
|---|---|
| No Data - | 01/01/2003 |

**Clinical Laboratory Data**

| HgbA1c (<=7.0) | UAProtein | uAlb/Cr (<30) | 24 Urine Albumin (<30) |
|---|---|---|---|
| No Data - | 06/01/2001 Negative | No Data - | No Data - |
| | 12/18/2000 Positive | | |
| | 11/06/2000 Negative | | |

| Serum Cr | | Serum K | | Lipid Profile | LDL (<100) | Trig (<150) | HDL (>45) | CHOL (<200) |
|---|---|---|---|---|---|---|---|---|
| 02/03/2005 | 1.5 | 10/03/2004 | 4.1 | 04/26/2003 | 107 | 93 | 50 | 176 |
| 01/26/2005 | 4.3 | 08/12/2004 | 3.4 | 04/06/2003 | 154 | 85 | 41 | 212 |
| 10/03/2004 | 6.4 | 04/26/2003 | 4.2 | 02/24/2003 | 149 | 151 | 41 | 220 |
| 04/26/2003 | 1.1 | 02/05/2003 | 6.0 | 02/06/2003 | 168 | 189 | 33 | 239 |

| TC/HDL Ratio | | HCT | | hsCRP | | Homocysteine | |
|---|---|---|---|---|---|---|---|
| 04/26/2003 | 3.5 | 02/05/2003 | 35.9 % | 04/06/2003 | 0.6 mg/L | 04/06/2003 | 6 umol/L |
| 04/06/2003 | 5.2 | 10/02/2002 | 37.7 % | 02/24/2003 | 1.2 mg/L | 03/15/2002 | 5 umol/L |
| 02/24/2003 | 5.4 | 08/23/2002 | 36.0 % | | | | |
| 02/06/2003 | 7.2 | 08/06/2002 | 39.0 % | | | | |

**Clinic Data**

| Date | Weight | BMI (<25) | Weight Class | Blood Pressure (<130/80) (clinic data only) |
|---|---|---|---|---|
| No Data | - | - | - | 01/25/2001 145/74 mmHg |

**Heart Rate**

01/25/2001 86

Last Foot Exam: No Data - Last dilated retinal exam: No Data -

**Reminders**

**Lab**

[ ] Urine Albumin Test - Should be done yearly for Patients with Diabetes.
[ ] Lipid Panel - Do Lipid Panel every 3-12 months until LDL < 100 for Patients with Diabetes and LDL < 130.
[ ] HgbA1C (should be done on all Patients with Diabetes).

**Building a sustainable model, or system of systems, for Ms. Viera and unanticipated effects**

Once we identified needs and potential solutions, we worked to implement this system in a model of care. In seven intervention clinics at Intermountain Health care, a large integrated health delivery system, we installed care managers, trained them, and adapted the HIT over 2 years to achieve the previously identified components . Over a subsequent 4 year period, patients seen by these care managers lived longer, had 24-40% fewer hospitalizations, and had significantly better control of their conditions than similar patients at clinics without care managers.(Dorr et al., 2005)(Dorr et al., 2008)The clinics achieved higher efficiency, as measured by clinical output (patients seen and complexity of conditions treated); and the payments from the greater efficiency covered the costs of the care managers and allowed for expansion of the program. (Dorr et al., 2007) Unanticipated effects included variation in referral patterns and care management patterns that led to some variation in outcomes; for instance, patients with predominantly social or financial problems did not see a significant reduction in hospitalization or emergency department visits, despite the care managers' efforts. As well, diffusion of the care management efforts within the clinic takes 6-9 months to become fully mature, and approximately 10% of physicians do not utilize the care managers in the voluntary framework.(Dorr et al., 2007) A positive unanticipated effect was the strength of integration for a set of providers and patients; a subset of patients saw the care manager as 'a life-saver', and a set of providers 'could not imagine practicing without the care manager'.

With these successes, the next step is to study maintenance and sustainability. With our qualitative studies, we defined core aspects of successful care management and embedded these in a training and IT enhancement program. The core components of the model were defined as:

1) a trained care manager who completes comprehensive assessment, prioritizes needs, and collaborates with patient and family; 2) a supportive, trained team who recognizes the role of the care manager; and 3) Health information technology that can identify patients at risk, enroll them in care management, and enact flexible protocols that address step-wise, comprehensive care planning. A training and IT support program was created and funded through grants; details are available at *caremanagementplus.org* . To date, over 75 clinical teams have participated in the training and worked to enhance their IT systems. In all, 73% of the teams were able to implement the core components. Further work is occurring on sustainability, since many of the care management tasks are not specifically reimbursed despite their value. Changes in the reimbursement system such as payments for the 'medical home' – a comprehensive model of primary care – or direct payments for care coordination may enable many to adapt these models.

**Conclusions**

Successful models of care coordination that meet identified needs and improve patient health can be created by describing needs and gaps in meeting those needs, developing solutions from requirements, and addressing change management processes. We have shown that one such successful model uses care managers to augment team function and HIT to remind about prioritized tasks. Future work will need to explore sustainability and reinforcement of change to the system.

**References**


Anderson, R. N., & Arias, E. (2003). The effect of revised populations on mortality statistics for the United States, 2000. *National Vital Statistics Reports: From the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System*, *51*(9), 1-24.

Bodenheimer, T. (2008). The future of primary care: transforming practice. *The New England Journal of Medicine*, *359*(20), 2086, 2089. doi: 10.1056/NEJMp0805631.

Bodenheimer, T., & Handley, M. A. (2009). Goal-setting for behavior change in primary care: an exploration and status report. *Patient Education and Counseling*, *76*(2), 174-180. doi: 10.1016/j.pec.2009.06.001.

Boult, C., Kane, R. L., Pacala, J. T., & Wagner, E. H. (1999). Innovative healthcare for chronically ill older persons: results of a national survey. *The American Journal of Managed Care*, *5*(9), 1162-1172.

Dorr, D. A., Tran, H., Gorman, P., & Wilcox, A. B. (2006). Information needs of nurse care managers. *AMIA ... Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium*, 913.

Dorr, D. A., Wilcox, A., Burns, L., Brunker, C. P., Narus, S. P., & Clayton, P. D. (2006). Implementing a multidisease chronic care model in primary care using people and technology. *Disease Management: DM*, *9*(1), 1-15. doi: 10.1089/dis.2006.9.1.

Dorr, D. A., Wilcox, A., Donnelly, S. M., Burns, L., & Clayton, P. D. (2005). Impact of generalist care managers on patients with diabetes. *Health Services Research*, *40*(5 Pt 1), 1400-1421. doi: 10.1111/j.1475-6773.2005.00423.x.

Dorr, D. A., Wilcox, A., Jones, S., Burns, L., Donnelly, S. M., & Brunker, C. P. (2007). Care management dosage. *Journal of General Internal Medicine*, *22*(6), 736-741. doi: 10.1007/s11606-007-0138-z.

Dorr, D. A., Wilcox, A., McConnell, K. J., Burns, L., & Brunker, C. P. (2007). Productivity enhancement for primary care providers using multicondition care management. *The American Journal of Managed Care*, *13*(1), 22-28.

Dorr, D. A., Wilcox, A. B., Brunker, C. P., Burdon, R. E., & Donnelly, S. M. (2008). The effect of technology-supported, multidisease care management on the mortality and hospitalization of seniors. *Journal of the American Geriatrics Society*, *56*(12), 2195-2202. doi: 10.1111/j.1532-5415.2008.02005.x.

Salas, E., Wilson, K. A., Burke, C. S., & Wightman, D. C. (2006). Does crew resource management training work? An update, an extension, and some critical needs. *Human Factors*, *48*(2), 392-412.

Shugarman, L. R., Decker, S. L., & Bercovitz, A. (2009). Demographic and Social Characteristics and Spending at the End of Life. *Journal of Pain and Symptom Management*, *38*(1), 15-26. doi: 10.1016/j.jpainsymman.2009.04.004.

Westbrook, J. I., Braithwaite, J., Georgiou, A., Ampt, A., Creswick, N., Coiera, E., et al. (2007). Multimethod evaluation of information and communication technologies in health in the context of wicked problems and sociotechnical theory. *Journal of the American Medical Informatics Association: JAMIA*, *14*(6), 746-755. doi: 10.1197/jamia.M2462.

Wilcox, A. B., Dorr, D. A., Burns, L., Jones, S., Poll, J., & Bunker, C. (2007). Physician perspectives of nurse care management located in primary care clinics. *Care Management Journals: Journal of Case Management ; The Journal of Long Term Home Health Care*, *8*(2), 58-63.

Wilcox, A. B., Jones, S. S., Dorr, D. A., Cannon, W., Burns, L., Radican, K., et al. (2005). Use and impact of a computer-generated patient summary worksheet for primary care. *AMIA ... Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium*, 824-828.

Wolff, J. L., Starfield, B., & Anderson, G. (2002). Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Archives of Internal Medicine*, *162*(20), 2269-2276.

**Acknowledgements**

Funding for this research comes from The John A. Hartford Foundation, the Agency for Healthcare Research and Quality, and the National Library of Medicine. This paper does not reflect the official positions of any of these institutions. Thank you to the Care Management Plus team and collaborators includes Kelli Radican, Gwenivere Olsen, Nima Behkami, Marsha Pierre-Jacques Williams, Adam Wilcox, John McConnell, Kristen Dahlgren, Molly King, Estela Vasquez, Stuart Morrice, Cherie Brunker, Mary Carpenter, Liza Widmier, Susan Butterworth, Eric Coleman, Heather Young, Steve Counsell, Tom Bodenheimer and Cheryl Schraeder.