Using Population Segmentation to Provide Better Health Care for All: The "Bridges to Health" Model

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The model discussed in this article divides the population into eight groups: people in good health, in maternal/infant situations, with an acute illness, with stable chronic conditions, with a serious but stable disability, with failing health near death, with advanced organ system failure, and with long-term frailty. Each group has its own definitions of optimal health and its own priorities among services. Interpreting these population-focused priorities in the context of the Institute of Medicine's six goals for quality yields a framework that could shape planning for resources, care arrangements, and service delivery, thus ensuring that each person's health needs can be met effectively and efficiently. Since this framework would guide each population segment across the institute's "Quality Chasm," it is called the "Bridges to Health" model.

Keywords: Health care reform, community health planning, health services needs and demand, person-focused health.

CROSSING THE QUALITY CHASM (IOM 2001A) ENVISIONED AN approach to health that focuses on the individual person or patient and met six specific aims for care: it must be safe, effective, efficient, patient centered (i.e., meets the patient's desires and preferences within the care delivery environment), timely, and equitable.

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The same IOM report proposed that this person-focused system require three elements: an information-rich environment supported by health information technologies, the patient's (or advocate's) engagement in all aspects of care, and coordination among teams of caregivers. Shifting to this model from our fragmented, provider-focused health care system (in which patients must adjust to their providers' time and practice patterns) will require changes in how we assess and monitor the quality of health care, pay for health and reimburse for health care, monitor health and health needs, define optimal health, and prioritize health needs. Tailoring services in an ad hoc way to match each citizen's situation, however, would be difficult and costly.

A practical alternative, widely used in other industries, is to stratify the customer population into groups that are sufficiently homogeneous to enable arranging a set of commonly needed supports and services to meet their expected needs. Our current system essentially segments the population by the provider whose services the patients are using at the moment—for example, a nursing home population, a hospitalized population, a home health care population, or an office-based care population. The results are dehumanizing and produce discontinuous, wasteful, and unreliable care. In this article, we suggest stratifying the population based on health prospects and priorities, rather than on the health care provider of the moment. No one can expect a trauma center to meet the long-term behavior management needs of a dementia patient, just as no one would expect an SUV to meet the needs of a thrifty driver when gas is scarce, or an airport hotel to have a ski lift.

This article illustrates how the concept of segmenting patient populations can lead to more creative and effective strategies for safe, efficient, effective, timely, patient centered, and equitable health care and thus a better understanding of how to achieve better health for both the individual and all people. Since our model tries to bridge the quality chasm (IOM 2001a) for each population segment, we call it the "Bridges to Health" model. In a health care system designed around the predictable needs of various populations, clinicians find it easier to respond to individual patients' needs and preferences. Although this approach may have many applications, this article describes its uses only for the federal initiatives for quality and health information technologies. This is the first publication of this approach, but comments from scores of our colleagues over several years have helped shape the ideas. We present this approach here in order to invite comment and correction and to enable others to use it and report on its merits.

The Populations and Matching Services

Table 1 proposes segmenting the entire population into eight groups and illustrates each group using a representative person. (Later tables deliberately vary the labels slightly to help the reader better understand the eight populations.) Three considerations shape this proposal:

1. The set of population segments must be limited if the health care system is to offer a sensible array of integrated services for each segment and to make those services available almost everywhere.
2. The set of population segments should include everyone; that is, at every point in his or her life, every person should fit into one of these categories.
3. The people in each population segment must have sufficiently similar health care needs, rhythms of needs, and priorities to make the segment useful for planning, but each segment must be different enough to justify separate consideration. Planners must be able to structure the supports, service arrays, and care delivery arrangements so that they will meet the needs of anyone in that segment reasonably well, even though they may be mismatched to other segments.

Table 2 lays out the health-related concerns, major components of health services and supports, and life goals typical of each segment of the population. The last column of table 2 matches each population segment with the goals of health care developed by the Foundation for Accountability (FACCT) (Lansky and Bethell 2000) and adopted by the Agency for Healthcare Research and Quality (AHRQ 2004; IOM 2001b) for the congressionally mandated annual review of health care quality and by the Institute of Medicine in its "Priority Areas for National Action" report (IOM 2003).

Other researchers have used paradigm cases from a small array of population segments to guide reform. The "Esther Project" in Sweden, for example, uses paradigm cases to test whether disabled elderly persons with certain characteristic clinical profiles can count on good care (Institute for Healthcare Improvement 2006). The results of that inquiry guide the priorities for health care improvement.

TABLE 1
Population Segments with Typical Patient Examples

Population	Patient and Services
1. Healthy	Mr. Smith, a 37-year-old carpenter, usually books an appointment with his primary care physician each year around his birthday for an annual checkup and necessary screenings. He also may contact his physician's office for acute, self-limiting problems such as a sore throat.
2. Maternal and infant health	Mrs. Brown, a 26-year-old waitress, had regular contact with her gynecologist for contraception and general health monitoring until deciding to become pregnant. A year later, she sought fertility treatment and had monitoring through normal pregnancy and delivery. Her newborn's checkups and immunizations follow national guidelines.
3. Acutely ill	Tom Jones, an 18-year-old high school student, broke his femur while playing football. An ambulance promptly transported him to the local emergency room. Following an uneventful surgical procedure, Tom received physical therapy to rehabilitate his leg and maintain his body strength. He returned as the team quarterback eight weeks later.
4. Chronic conditions, normal function	Mrs. Gomez, a 49-year-old teacher, has hypertension and diabetes. While she has taken classes to learn how to reduce her risks and control these conditions, she still finds that both are occasionally out of control and then makes an appointment with her physician, whose office sends her reminders for immunizations, regular checkups, and monitoring for possible complications.
5. Stable but serious disability	Mr. White, a 56-year-old telemarketer, also is a former paratrooper who is quadriplegic from a gunshot wound to the neck. He lives with his brother in an extensively adapted apartment and has a paid aide for personal care. He has a motorized wheelchair and transportation for shopping and outings. He has been suicidal at various times and often has urinary tract infections. He uses a medical home team for continuity and comprehensive coordination of services, and he and the team work from a negotiated plan of care.

(Continued)

TABLE 1—*Continued*

Population	Patient and Services
6. Short period of decline before dying	Mrs. Black, a 68-year-old realtor, found she had metastatic ovarian carcinoma a few months ago and is now fatigued and losing weight. After several unsuccessful treatment regimens, she has accepted hospice services, and friends and hospice staff ensure that she can stay home to the end of her life. The hospice clinicians manage pain and other symptoms aggressively, and she is able to direct the completion of her life to her own satisfaction.
7. Limited reserve and exacerbations	Mr. Simon, a 75-year-old executive, lives with severe activity limitations due to emphysema. He has home oxygen and a complex regimen of drugs and treatments. He and his family have learned how to manage his condition but also have a nurse practitioner on call 24/7 for guidance or for urgent home visits. He has a care plan that specifies a time-limited trial of ventilator use and no resuscitation.
8. Frailty, with or without dementia	Mrs. Evans, an 88-year-old former homemaker, has dementia with incontinence, inability to walk or to communicate verbally, and a serious pressure ulcer. Although her daughter provides most of her care, Mrs. Evans attends adult day care three days a week for full baths, dressing changes, diversion, and caregiver relief. The local senior service agency helps with monitoring needs and coordinating services. The daughter has authority to make decisions and has decided to forgo resuscitation and to avoid hospitalization unless essential to comfort.

At any one time, nearly every citizen's situation best matches the characteristics of one particular segment; but over time, most citizens move from one segment to others. Most of us spend most of our lives as healthy people (population segment 1), with occasional forays into and out of maternal and infant care (population segment 2) and acute illness (population segment 3). Eventually, most people accumulate one or more chronic conditions that require ongoing upkeep and then enter population segment 4. A small number of people live a long time with serious disabilities that are not particularly progressive, so they require

TABLE 2
Characterizing Population Segments by Health Priorities

Population Characteristics	Priority Concerns for This Population	Major Components of Health Care	IOM/AHRQ/FACCT Goals for Health Care
1. Healthy	Longevity, by preventing accidents, illness, and progression of early stages of disease	Physicians' offices, health clinics, occupational health, and health information available to the public	Staying healthy
2. Maternal and infant health	Healthy babies, low maternal risk, control of fertility	Prenatal services, delivery, and perinatal care; fertility control and enhancement	Staying healthy
3. Acutely ill, with likely return to health	Return to healthy state with minimal suffering and disruption	Emergency services, hospitals, physicians' offices, medications, or short-term rehabilitative services	Getting well
4. Chronic conditions, with generally "normal" function	Longevity, limiting disease progression, accommodating environment	Self-management, physicians' offices, hospitalizations, and ER visits	Living with illness or disability
5. Significant but relatively stable disability, including mental disability	Autonomy, rehabilitation, limiting progression, accommodating environment, caregiver support	Home-based services, environmental adaptation, rehabilitation, and institutional services	Living with illness or disability
6. "Dying" with short decline	Comfort, dignity, life closure, caregiver support, planning ahead	At-home services, hospice, and personal care services	Coping with illness at the end of life
7. Limited reserve and serious exacerbations	Avoiding exacerbations, maintaining function, and specific advance planning	Self-care support, at-home services, 24/7 on-call access to medical guidance, and home-based care	Coping with illness at the end of life
8. Long course of decline, from dementia and/or frailty	Support for caregivers, maintaining function, skin integrity, mobility, and specific advance planning	Home-based services, mobility and care devices, family caregiver training and support, and nursing facilities	Coping with illness at the end of life

information, tools, supports, and services to enable them to live full lives with disabilities (population segment 5). In general, persons with established chronic conditions (population segment 4) and serious disabilities (population segment 5) will not return to being healthy (population segment 1) or to merely needing acute care (population segment 3) or maternal/infant care (population segment 2), although they may have pregnancy or acute illness superimposed on their long-term condition. In general, substantial long-term conditions endure throughout such episodes, so the health and care system arrangements for population segments 4 and 5 should include access to acute and maternal services when needed.

Eventually, almost everyone experiences one of the end-of-life courses. The transition from being chronically ill or disabled to the degree of disability envisioned in population segments 6, 7, and 8 often is gradual. The U.S. Department of Veterans Affairs' health care system makes veterans eligible for its Home-Based Primary Care program when "they face so many challenges that they are just too sick to come to clinic" (personal communication, Thomas Edes, MD, chief of Home and Community-Based Care for the U.S. Department of Veterans Affairs, January 20, 2007). The Gold Standards Framework in Britain (Gold Standards Framework 2006) and various palliative care efforts in this country (Lynn 2004) use the criterion of "being sick enough that death in the next six months would not be surprising." This transition may require arbitrary and replicable definitions when eligibility for costly services such as home care and hospice is determined. Return from the last phase of life trajectories (population segments 6, 7, and 8) to other population segments is so unlikely as to justify only an occasional exception to the routine. Transitions from a course with organ system failure (population segment 7) to frailty (population segment 8) are more common, as a person living with a dominant organ system failure ages and accumulates multiple comorbidities and the syndrome of frailty. The care arrangements for these population segments should plan for the more common transitions.

Characterizing Quality

Crossing the Quality Chasm (IOM 2001a) envisioned a system that is safe, effective, efficient, patient centered, timely, and equitable. These aims have become the common framework for assessing providers, although they also frame a more comprehensive person-focused approach to health maintenance and improvement. Matching the priorities of each population segment to the six IOM aims is the central characterization of our Bridges to Health model. Table 3 provides a working understanding of the definitions of quality health care, which includes ensuring that information and supports for patients are available for self-management, measuring progress toward health-related goals, and prioritizing areas needing improvement in each cell of the framework. For example, whereas improvements in safety (a column) could require the prevention of falls and pressure ulcers for the frail elderly (a row), ensuring correct-site surgery is more important to those with acute problems (another row).

As each population segment (a row in table 3) intersects with each IOM aim (a column in table 3), the resulting cell offers a way to define interventions that will lead to optimal health in each population for each characteristic. The definitions in the cells in this matrix are examples and are not comprehensive. Managers and policymakers who use this approach should fill the grid with examples pertinent to their population and programs, and academicians may consider the precise allocation of issues and programs across the grid. All will see, however, that the matrix provides a ready check on the inclusiveness and scope of a quality health system's definition. A robust row or column is likely to reflect substantial attention; conversely, a weak cell is likely to stand out as needing attention. Accordingly, the Bridges to Health framework enables well-targeted efforts to eliminate the Quality Chasm.

Filling the Bridges to Health matrix with improvement activities related to the three key reforms of the Quality Chasm report helps prioritize the development of products and policies needed to serve all populations. Table 4 applies the Bridges to Health model to opportunities for health information technologies.

Table 5 provides a similar overview of some of the Centers for Medicare and Medicaid Services' current and proposed initiatives to address quality. The Bridges to Health model shows the strength and breadth of the current strategies. For example, only a few existing interventions address timeliness and equity, and strategic planners can consider whether these areas offer important opportunities. The structure of table 5 also serves as a template for reporting the progress of widespread improvement activities.

TABLE 3
Opportunities for Health and Quality as Defined by the Six IOM Aims and the Eight Population Segments

	Safe (No Harm)	Effective (No Needless Failures)	Efficient (No Waste)	Patient Centered (No Helplessness or Unjustified Routines)	Timely (No Needless Delays)	Equitable (No Unjustified Variation)
1. Healthy	Minimal and known risk from false positive or false negative screenings	Primary preventive actions and interventions; evidence-based screenings; evidence-based use of short-term medications	No administrative redundancy or excess; no ineffective testing and screening	Lifestyle reflects informed preferences; 24/7 access to clinical guidance and information; services reflect patients' goals, concerns, and situations	Convenient and responsive scheduling; no waiting for health care services; immediate access to results of screenings; immediate access to clinical guidance and information	Equal access to health care services; equal access to healthy lifestyle choices, health education, and maintenance; opportunities tailored to situation; CLAS[a]
2. Maternal and infant health	Minimal and known risk from false positive or false negative screenings; no perinatal or maternal injury or death from health care; minimal infertility; no undesired pregnancy	Evidence-based prenatal care, delivery, and postnatal care; evidence-based primary and secondary preventive interventions for both mother and child	Backup experts available; planned rapid transfer of seriously ill newborns; evidence-based fertility services	Informed and shared decisions reflecting parents' values (constrained by legal limits)	Convenient and responsive scheduling, no waiting for health care services; immediate access to results of tests; immediate access to clinical guidance and other information; timely education and support; rapid transfers when needed	Equal access to health care services; equal access to healthy lifestyle choices, health education, and maintenance; opportunities tailored to situation; CLAS[a]; equal opportunity for important treatments

(Continued)

TABLE 3—*Continued*

	Safe (No Harm)	Effective (No Needless Failures)	Efficient (No Waste)	Patient Centered (No Helplessness or Unjustified Routines)	Timely (No Needless Delays)	Equitable (No Unjustified Variation)
3. Acutely ill but curable	No medication errors; no surgical errors; minimal and known risk of complications of diagnosis/treatment	Evidence-based diagnosis and treatment; effective symptom prevention and relief	No administrative redundancy or delays; no redundant services	Shared decision making; patient and family informed; care in best setting for patient	Little waiting; adequate notice of expected events	CLAS[a]; equal opportunity for important treatments
4. Chronic conditions, generally normal function	Minimal and known risk from false positive and false negative screenings; minimal and known risk from diagnosis/treatment options; no medication errors	Evidence-based secondary and primary prevention and rehabilitation	Care continuum management across multiple providers	Lifestyle reflecting informed decisions; self-monitored care; patient and family education	Little waiting for health care services; adequate notice of expected events; convenient and responsive scheduling; immediate access to test results, clinical guidance, and other information; short time to diagnosis and treatment for positive screens and worsening conditions	CLAS[a]; equal opportunity for important treatments
5. Stable, significant disability (often not elderly)	No medication or transfer errors; reliable, skilled, responsive personal care; safe environment, including safe equipment; safe and timely transportation	Reliable personal care; effective rehabilitation; appropriate prevention screenings and interventions	Community-based services; regular assessment and care planning; care coordinated among all providers and personal caregivers; family caregiver training and support	Self-care to degree possible; caregiver services and support	Timely mobility devices; quick response to intercurrent problems	CLAS[a]; equal opportunity for important treatments; no bias due to disability

6. Short period of decline near death (mostly cancer)	Avoiding interventions with net harm; adherence to negotiated treatment decisions; trained staff	Pain and symptom prevention and relief; emotional and spiritual support; consideration of survival limits in decision making	Home-based care; avoidance of unduly burdensome treatments	Care in accord with preferences; self-directed life closure; advance care planning; bereavement support; life closure counseling and support	Home-based care; 24/7 on-call team with rapid response to home for crises	CLAS[a]; equal opportunity for important treatments and supportive services; no bias due to personal characteristics
7. Exacerbations, organ system failure	No medication errors; safe medical equipment; safe environment; avoiding interventions with net harm	Prevention of exacerbations and aggressive treatment of early exacerbations; monitoring to prevent exacerbations	Care plan tailored to living situation and survival limits, including trials of treatment; prevention of exacerbations	Decisions in accord with informed preferences, including advance care planning for contingencies; 24/7 access to care; bereavement support	Rapid response to home for crises; immediate access to medical guidance	CLAS[a]; equal opportunity for important treatments and supportive services; no bias due to personal characteristics
8. Long dwindling course (mostly frailty and dementia)	Safe environment; no pressure ulcers, restraints, or avoidable injury from falls; minimal medication adverse effects; no transfer injuries	Home-based care; nutritional support; reliable facility care when needed; support for caregivers; appropriate preventive services; comfort and respect	No unwarranted medical treatments; services in accordance with advance care plan	Advance care planning consistent with patient’s wishes; resolution of family issues; support of family caregivers	Home evaluation and treatment available promptly; 24/7 rapid response to home for crises	CLAS[a]; equal opportunity for important treatments; no bias due to personal characteristics

Note: [a]CLAS = culturally and linguistically appropriate services.

TABLE 4
Priorities for Use of Interoperable Health Information

	Safe	Effective	Efficient	Patient Centered	Timely	Equitable
1. Healthy	Online information regarding risks and benefits of screening procedures	E-reminders directly to person	E-schedule, e-visits, e-prepopulation of electronic health records and personal health records	Use of preferred technologies to access information and reminders; access to one's own health information	All patient-specific information readily available at time of visit	Available in language and level of education of choice
2. Maternal and Infant	Online monitoring of pregnancy and fertility management	E-reminders and follow-up	Interoperable electronic system for transfer of records	Access to information about treatment options	Secure message capability	Available in language and level of education of choice
3. Acutely ill but mostly curable	Computerized physician order entry with decision support	Effective clinical decision support systems	Interoperable electronic health records among care settings	Patient education and shared decision support information	Electronic 24/7 response to patient's needs from remote sites	Available in language and level of education of choice
4. Chronic condition, normal function	Online information about risks and benefits of all treatments and screenings; ambulatory computerized physician order entry	Real-time home-monitoring devices; e-reminders for screens and monitoring	Electronic use of shared care plans	Longitudinal electronic health records and personal health records	Secure messaging capability	Available in language and level of education of choice

5. Stable but significant disability	Online information on risks and benefits of all treatments and screenings; ambulatory clinical physician order entry	E-reminders	Home-based e-monitoring	Personal health record and interoperable electronic health records among all care providers	Secure messaging capability	Available in language and level of education of choice
6. Short period of decline near death	Access to information about risks and benefits of specific treatments	Online monitoring for comfort control	Online access to advanced care plans	Online access to advanced care plans	Direct 24/7 immediate communication capability in event of life closure	Available in language and level of education of choice
7. Organ system failure	Computerized physician order entry with decision support	Home-based monitoring systems	Home-based monitoring; online access to advanced care plans	Shared decision support tools	Secure messaging capability	Available in language and level of education of choice
8. Long dwindling course (frailty, dementia)	Monitoring devices for falls, pressure, etc.; computerized physician order entry with decision support	Pain management	Electronically available health care plans	Advance care plans available electronically	24/7 access to rapid response in event of life closure	Available in language and level of education of choice

TABLE 5
Some Current Medicare or Medicaid Initiatives Concerning Quality and Value

	Safe (No Harm)	Effective (No Needless Failures)	Efficient (No Waste)	Patient Centered (No Helplessness or Care Barriers)	Timely (No Needless Delays)	Equitable (No Unjustified Variation)
1. Healthy	Voluntary physician's office reporting	Immunization, cancer screening		Electronic records		
2. Maternal and infant health						
3. Acutely ill, but mostly curable		Correct treatment for pneumonia, heart attacks		H-CAHPS[a]	Rapid treatment for pneumonia, heart attacks	
4. Chronic conditions, normal function	Fistula First for dialysis; voluntary physician's office reporting	Diabetes management, CHF/COPD[b] and high-cost demos; adequate dialysis	Risk contracts in demos	AMB-CAHPS[a]		
5. Stable with significant disability	Survey/certification, nursing home and home care quality	Home/community waiver evaluations		Resources follow patient's initiative		Enforcement of Americans with Disabilities Act
6. Short period of decline near death	Hospice quality	Rural hospice and advance planning demonstrations		Hospice plan of care		
7. Exacerbations, organ system failure		Chronic condition demonstrations	Care management demonstrations	Self-care classes; advance planning demonstration		
8. Long dwindling course	Pressure ulcer prevention; no restraints; survey/certification, nursing home and home care quality	Pain treatment in nursing homes	Home and community waivers	NH-CAHPS[a]		

Note: [a] CAHPS is the Consumer Assessment of Healthcare Providers and Systems, with a version for hospitals (H-CAHPS), ambulatory care (AMB-CAHPS), and nursing homes (NH-CAHPS).

[b] CHF = chronic heart failure; COPD = chronic obstructive pulmonary disease.

Population Size and Costs

Table 6 estimates the number of people in each segment and the cost of their care. Because expenditures are made over a period of time, during which people may move from one segment to another, the spending estimates in table 6 are based on our best estimates of the costliest segment for each person for a substantial part of the year. These estimates include the cost of drugs and paid long-term care, but not unpaid caregiving, loss of income, or disability income. Since data are not generally organized around the proposed categories, evidence of population sizes and costs is drawn from triangulating the relevant data—that is, using data from two or more sources to produce a single estimate (see the notes to table 6). Such estimates are first approximations, both because independent errors affect each source and because the method requires combining sources that use different definitions and time periods.

In addition to generating more reliable estimates generally, the future development of the model will require estimating the frequency and importance of transitions among population segments, examining the nature of outliers, and sharpening definitions. Table 6 gives the likely relationships of population size and cost at this stage. Some segments contain most of the population, and others consume most of the money. Persons living with a serious disability and those passing through a period of frailty at the end of life are quite costly, despite being small in number at any particular time.

Payer Differences

The U.S. health care system has a variety of payers, each with different scope, coverage, and delivery models. Table 7 estimates the comparative distribution of population segments among commercial insurers, Medicaid, Medicare, and the Veterans Health Administration. Clearly, the priorities of Medicare, Medicaid, and the Veterans Health Administration should be somewhat different from one another and quite different from those of commercial insurers. An overwhelming proportion of the stable disabled and the three segments comprising the last phase of life are in the public systems. Medicaid plans now cover about 40 percent of all pregnancies and deliveries (Kaiser Family Foundation 2002; Martin et al. 2003) and have more responsibility in this arena than do other

TABLE 6

Initial Estimates of Population Size and Annual Cost

Population	Population Size (in United States)	Cost/Person/Year	Total Cost/Year
1. Healthy	~160 million (fn1-A)	~$800 (fn 1-B)	~$130 billion (fn 1-C)
2. Maternal and infant health	~10 million (4 million mothers and babies, 2 million fertility problems) (fn 2-A)	~$12,000 per delivery, $2,000 per infant, $1,000 per fertility problem (fn 2-B)	~$60 billion (fn 2-C)
3. Acutely ill but mostly curable	~12 million (fn 3-A)	~$25,000 (fn 3-B)	~$300 billion (fn 3-C)
4. Chronic with adequate function	~110 million (fn 4-A)	~$7,000 (fn 4-B)	~$800 billion (fn 4-C)
5. Stable with significant disability (often not elderly)	~7 million (fn 5-A)	~$40,000 (fn 5-B)	~$290 billion (fn 5-C)
6. Short period of decline near death (mostly cancer)	~1 million (fn 6-A)	~$45,000 (fn 6-B)	~$50 billion (fn 6-C)
7. Intermittent exacerbations and sudden death (mostly heart and lung failure)	~2 million (fn 7-A)	~$45,000 (fn 7-B)	~$100 billion (fn 7-C)
8. Long dwindling course (mostly frailty and dementia)	~6 million (fn 8-A)	~$45,000 (fn 8-B)	~$270 billion (fn 8-C)
Totals	300 million (fn 9-A)		$2.0 trillion (fn 9-C)

Notes: Estimates of costs of medical and nursing care from all payers, not including family caregiving, out-of-pocket costs for housing or personal care, or income support. All cost estimates are inflated to approximate 2005 dollars, starting from the date of the estimate cited and using inflation rates from "The Inflation Calculator" at http://www.westegg.com/inflation (accessed March 15, 2007). All the estimates were rounded in order to emphasize their exploratory nature.

Sources: 1-A. Anderson and Horvath (2004) estimated that all chronic conditions (our population segments 4 through 8) affected 125 million persons. Subtracting this figure and our estimates for mothers and babies and for acutely ill (population segments 2 and 3) from the entire population yields about 160 million.

1-B. The $800 estimate reflects our calculation of an ordinary cost for routine preventive services (AHRQ 2003).

1-C. The product of the number of healthy persons and their annual costs.

2-A, 2-B, and 2-C. There were just over 4 million live births in 2004 (National Center for Health Statistics 2002), and we assumed that there are about the same number of mothers and babies (i.e., that multiple births approximately offset neonatal death). The cost is about $8,000 for an uncomplicated pregnancy and delivery (Francis 2006). We arbitrarily increased that by half to consider the costs of complications. The cost of infant care for the first year is about $1,300 for a healthy infant (American Academy of Pediatrics 2005), so we used $2,000 to accommodate minor and major illnesses in the first year, yielding a first approximation of $8 billion. About 1.2 million women use infertility services at about $1.7 billion per year (Kirschstein 2000), and about 854,000 had abortions costing an average of $372 (so $403 in 2005 dollars) in 2001 (Guttmacher Institute 2006). Thus, about 2 million women have a fertility concern costing almost $2.04 billion in 2005 dollars, for a rough average of $1,000 each.

(Continued)

TABLE 6—*Continued*

3-A. In 2003, 12 million surgery patients had an overnight stay (Community Tracking Survey 2006). This overestimates by including some surgery patients for chronic conditions that would make them part of categories 4 through 8 and underestimates acute conditions treated in emergency rooms, surgical centers, physicians' offices, and other settings. We assumed that these errors roughly balanced.

3-B. The average cost for discharged hospitalized patients from the Medical Expenditure Panel Survey (AHRQ 2003) in 2003 was $19,837, which escalated to $21,000 in 2005 dollars and which we rounded up to $25,000, since acutely ill persons in hospitals probably have rather larger costs than do chronically ill persons with exacerbations.

3-C. The product of 3-A and 3-B, rounded, yields this estimate.

4-A. Anderson and Horvath (2004) estimated 125 million Americans with chronic conditions. Subtracting estimates for the more severe chronic conditions included as population segments 5 through 8 yields 110 million with chronic conditions generally consistent with living in one's usual social role.

4-B. The results of dividing 4-C by 4-A.

4-C. The Centers for Disease Control and Prevention reported that 75 percent of U.S. health care expenditures goes to care for chronic disease (CDC 2006). In 2005, health care expenditures were about $2 trillion, so chronic conditions were estimated to cost $1.5 trillion, minus the costs associated with the more severe forms given as categories 5 through 8, yielding approximately $800 billion.

5-A. The U.S. Census listed 6.8 million community-dwelling Americans as having a self-care disability lasting six months or more (Waldrop and Stern 2000). This estimate includes some who fit into category 8 but excludes some who are capable of self-care but are still quite disabled, so we used 7 million as the estimate.

5-B. The results of dividing 5-C by 5-A. This estimate, like all the others here, does not include the costs of family caregiving, out-of-pocket costs for housing or personal care, or income support.

5-C. An estimate of the costs of disabling illness in 1986, inflated to 2005 dollars (Kirschstein 2000).

6-A. There were 565,000 cancer deaths and 1.4 million new cases projected in 2006 (American Cancer Society 2006). Some cancer patients will not follow this course, but other conditions also follow this trajectory (e.g., chronic renal failure before end stage, AIDS with wasting, etc.). As a first approximation, we used 1 million persons.

6-B. The EPA's *Cost of Illness Handbook* estimates the cost of the year in which one dies with cancer to be about $45,000 (U.S. EPA 2006).

6-C. The product of 6-A and 6-B. The total costs of cancer are about $190 billion per year (American Cancer Society 2006), so this estimate would put about one-quarter of the costs of cancer care into the period of living with a fatal course.

7-A. The result of dividing 7-C by 7-B.

7-B. This is the average of the costs of the last year of life with chronic heart failure, chronic obstructive lung disease, and end-stage renal failure, inflated to 2006 dollars (Hogan et al. 2000).

7-C. This is the sum of the total costs estimated (Hogan et al. 2000) for chronic heart failure ($38 billion), chronic obstructive lung failure ($32 billion), and end-stage renal failure ($ 8.4 billion), escalated to 2005 dollars. This overincludes milder cases of these conditions but underincludes the other conditions that give rise to this trajectory of a fragile stability interrupted by exacerbations. Our estimate is $100 billion.

8-A. In 2003, there were 1.5 million nursing home residents, virtually all in this group (National Center for Health Statistics 2006). Since this represents less than half of the people who have substantial disability and frailty in old age and only about half of the course of those who do use nursing homes (Family Caregiver Alliance 2006), we estimated 6 million people.

8-B. Without considering the costs of family caregiving, out-of-pocket costs of housing or personal care, or costs of income support, the direct costs of home care are about $19,000 per year (Alzheimer's Association 2006) and of nursing home care, about $70,000 per year (Mature Market Institute 2004). We have used an average between those estimates, $45,000.

8-C. The product of 8-A and 8-B.

9-A. The U.S. Census Bureau estimated the U.S. population to be 298 million on March 30, 2006 (U.S. Census Bureau 2006).

9-C. The Office of the Actuary, Centers for Medicare and Medicaid Services, estimated a 7.4 percent increase in health care costs in 2005 over 2004 (Boards of Trustees 2006). We inflated the National Health Expenditures Survey estimates of 2004 health care expenditures (Kaiser Family Foundation 2005) by 7.4 percent.

TABLE 7
Estimates of Certain Large Payers' Contributions to the Annual Costs of Health Care for Each Population Segment

Population	Total Cost/Year	Commercial	Medicare	Medicaid	Veterans
1. Healthy	~\$130 billion	High	Low	Low	Low
2. Maternal and infant health	~\$60 billion	Average	Very low	High	Very low
3. Acutely ill but mostly curable	~\$300 billion	Average	Average	Average	Average
4. Chronic with adequate function	~\$800 billion	Average	High	Average	High
5. Stable with significant disability (often not elderly)	~\$290 billion	Low	High	High	High
6. Short period of decline near death (mostly cancer)	~\$50 billion	Low	High	Average	High
7. Intermittent exacerbations and sudden death (mostly heart and lung failure)	~\$100 billion	Low	High	Average	High
8. Long dwindling course (mostly frailty and dementia)	~\$270 billion	Low	High	High	High

Note: These are rough estimates of "column percentage." "High" means that this payer will pay more toward this population segment than would be predicted just by the proportion of overall health costs that this payer supports. Since costs are linked to population size, this also means that "high" indicates that more patients of this sort rely on this payer than would be the case if patients were allocated randomly across payers.

public agencies and nearly as much as all commercial health care plans together. Since public payers also bear substantial responsibility for the overall health of their beneficiaries, policymakers and program managers may find our framework helpful in establishing payment incentives and quality standards that address the populations for which they are responsible.

Health Needs of the Population Segments

Our model rests on pursuing the health of each population segment. Achieving this goal for some population segments, such as the healthy, might require mainly ancillary services to supplement current care arrangements, such as creating electronic health records, having information available and controlled by the patient through a personal health record, and providing reminder systems for patients and clinicians. Reliably improving the health of some population segments, however, probably requires quite fundamental changes in service delivery arrangements and the availability of important options. The last four populations are so disabled or sick, for example, that substantial reengineering to ensure continuity of clinicians and to involve patients or their advocates in planning their care across multiple settings could prove to be among the highest priorities.

Development Needs for the Bridges to Health Concept

We have discussed the Bridges to Health model with scores of clinicians, managers, and policymakers, who usually find it easy to grasp and quickly move on to productive discussions using the model. Although the population segmentation approach in the Bridges to Health model rests on well-established business principles, it is in its infancy in health care. With the insight from applying this model and with improved data, researchers and managers can test alternative ways of segmenting the populations and establishing effective, efficient, and coordinated care that supports both patients' engagement in observed differences in priorities and optimal solutions for discernible populations.

Some existing subpopulations challenge our proposed segmentation. Medicare law and financing, for example, make end-stage renal disease (ESRD) patients a distinct group, with its own quality improvement program. These patients fit in the chronic condition segment (population segment 4) early on and may worsen to have serious chronic conditions with exacerbations (population segment 7) unless another condition dominates in shaping the last part of the patient's life. ESRD patients traditionally have received dialysis mostly from specialized providers. Whether it is wise to continue that separation is a matter of current debate, since end-stage renal disease patients accumulate many more health problems and need the services of the nonrenal care delivery system, and since the distinct ESRD delivery system cannot also address the need for comprehensive and reliable services for patients with milder renal failure who do not yet qualify as "end stage." As we suggest here, the Bridges to Health model does not continue to treat ESRD patients as a separate segment.

Another classification challenge arises from mental illness. Mild mood and adjustment disorders readily fit into the first four populations: healthy, maternal/infant health, acute illness, and chronic conditions. Care delivery systems that have been optimized for these populations will certainly need to include reliable services for the ordinary run of mental distress, since the people in these populations so often have these needs. Serious, persistent mental illness is disabling but only modestly life threatening and thus is part of our segment 5. The optimal services use many of the same resources as those for persons living with congenital disabilities or spinal cord or brain injury, such as home assistance, environmental modification, and transportation services. The mental health services for persons with conditions like schizophrenia or substance abuse have often been quite different from those for the rest of health care. Population segment 5, people with relatively stable but substantial disability, includes diverse etiologies, living situations, and resources. Just as the acute care delivery arrangements include substantial subdivisions (e.g., among traditional medical and surgical specialties), the disabled population might be served best by keeping all in a population segment that optimizes life opportunities, autonomy, and direct support in the community but that expects programs to often subdivide according to particularly widespread or distressing clinical situations. More experience and analysis will clarify how best to match service delivery to the variety of patients in the relatively stable but seriously disabled population, segment 4.

For purposes like quality measurement and eligibility for services, the population assignments need to last for an administratively feasible period. People enter the last three populations only in their last phase of life and then do not often move into another group. A person in the stable disabled population remains there until he or she enters an eventually fatal course and becomes part of one of the last three populations. Transitions among the first four population segments and between those and the last four will always be common and may require establishing administrative procedures for payment and quality measurement purposes.

Conclusion

Each person needs somewhat different services for optimal health. Clinicians, therefore, always need to customize their service. Working within systems that reflect the likely priorities and needs of large segments of the population leads to efficient and reliable health care and supports the improvement of health across the entire U.S. population. Our Bridges to Health concept enables a rational customization of health care around important and coherent segments of the population and thus is more useful than the usual focus on diagnoses or provider types. The examples and estimates in this article represent first approximations and "proof of concept." Further research and debate can generate better estimates and a more complete concept. One particularly important perspective in our work is that of the affected patients. Even though providers and the public have some sense of what serves people well in certain circumstances, it is the voices of patients and family members who face those circumstances that should determine their health and clinical priorities.

In sum, the proposed Bridges to Health model enables a pragmatic transformation of the arrangements for care and services so that each citizen can count on maintaining optimal health throughout life.

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