Waste and Inefficiency in the U.S. Health Care System

Clinical Care: A Comprehensive Analysis in Support of System-wide Improvements

New England Healthcare Institute

ABOUT NEHI

The New England Healthcare Institute (NEHI) is an independent, not-for-profit organization dedicated to transforming health care for the benefit of patients and their families. In partnership with members from all across the health care system, NEHI conducts evidence-based research and stimulates policy change to improve the quality and value of health care. Together with this unparalleled network of committed health care leaders, NEHI brings an objective, collaborative and fresh voice to health policy. **www.nehi.net**

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Acknowledgements

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Executive Summary

The U.S. spends more money on health care than any other nation in the world. According to Medicare actuaries, the U.S. will spend nearly $2.3 trillion on medical care in 2007, representing approximately 16.7 percent of the nation's Gross Domestic Product (GDP). These National Health Expenditures are expected to grow to 20 percent of GDP by 2015. Many experts believe that a significant portion of our health care dollars are wasted, with estimates suggesting that up to 30 percent of total spending could be eliminated without reducing health care quality. Waste exists within three domains of the health care system; clinical care, health care finance and administration, and drug and device development and regulation.

How to identify and remove waste and inefficiency from the health care system has been a major area of research for the New England Healthcare Institute (NEHI). In 2006, NEHI began an investigation into two questions: how much waste is there and where does it exist?

NEHI first established a consensus definition of waste: **health care spending that can be eliminated without reducing the quality of care.** We began our research efforts by convening an expert panel in February 2006, and followed that with an extensive literature review. We considered 1,460 individual articles for inclusion in the study. Selected articles were grouped into condition-specific examples of waste whenever possible, and the examples were scored for relative strength of evidence and the potential cost savings that would result from correcting the underlying causes of waste. When considering examples with both strong relative strength of evidence and minimum potential annual savings of at least $1 billion, six key findings emerged, which we have listed in order of greatest financial impact:

1. Unexplained variation in the intensity of medical and surgical services, including but certainly not limited to: end of life care, overuse of coronary artery bypass surgery (CABG) and overuse of percutaneous coronary procedures (PCI), with potential avoidable costs of up to $600 billion;

2. Misuse of drugs and treatments, resulting in avoidable adverse effects of medical treatment that could save $52.2 billion;

3. Overuse of non-urgent emergency department (ED) care that could save (conservatively) $21.4 billion;

4. Underuse of generic antihypertensives, with potential savings of $3 billion;

5. Underuse of controller medicines in pediatric asthma, particularly inhaled corticosteroids, with projected savings of $2.5 billion; and

6. Overuse of antibiotics for respiratory infections, with potential savings of $1.1 billion.

The root causes of each key finding were considered, yielding five systemic issues requiring further consideration:

1. Lack of compliance with clinical guidelines, raising issues of potential shortcomings in physician decision making;

2. Variation in the intensity of clinical care, suggesting a lack of evidence-based decisions;

3. Limited adoption of information technology in areas such as decision support and care coordination;

4. Underuse of cost effective diagnostic tests; and

5. Failure of the primary care system to meet access needs.

As a result of our work, NEHI is in the process of examining the following areas more extensively and developing a series of policy alternatives to decrease waste where feasible:

1. Investigating barriers to physician guideline compliance, understanding how physicians make decisions, and considering what can be done to decrease variation in evidence-based practice;

2. Examining the causes of emergency department overuse for non-urgent conditions, and the adequacy of the primary care system to offer alternatives;

3. Researching ways to improve current care practices through innovation, such as limiting antibiotic use in acute respiratory infections through point of service testing, or increasing controller medications in pediatric asthma through decision support systems;

4. Considering ways to advance the adoption of information technology to decrease medical errors, including decision support systems and e-prescribing in the outpatient setting;

5. Investigating suspected examples of waste that are not well documented, including the overuse of advanced imaging technologies and chemotherapy;

6. Examining the causes of geographic variation in clinical care; and

7. Building a national coalition to identify waste and illuminating best practices to eliminate it.

This report is presented in six parts. First, we discuss the magnitude of waste and inefficiency and the importance of successfully eliminating it. Next, we detail the NEHI research strategy and provide an overview of the methodology we

used. Our findings are then presented in both graphic and narrative form, and the supporting evidence is considered. Finally, we provide an analysis of root causes and conclude with a discussion of next steps for policy action. An interactive version of the entire compendium of waste articles can be accessed on the NEHI website at www.nehi.net.

Introduction

OVERVIEW OF WASTE IN HEALTH CARE

The U.S. spends more money on health care than any other nation in the world. According to Medicare actuaries, the U.S. will spend nearly $2.3 trillion on medical care in 2007, representing approximately 16.7 percent of the nation's GDP. These National Health Expenditures are expected to grow to 20 percent of GDP by 2015.[1] The United States is not unique in this regard. Health care spending in all developed countries is increasing, driven by two factors:

1. Technologic innovation for which comparative clinical and cost effectiveness is not well established; and

2. A demographic shift to an older and longer living population that will demand more of these expensive services.

In the U.S. and elsewhere, growth in health care spending is accompanied by fewer working individuals financing the care of an increasing population of older and potentially non-working individuals.

These facts are not new, and have driven a number of ideas designed to constrain health care spending, including:

- Controlling costs through explicit or implicit price setting, the former exemplified by Medicare and the latter by managed care contracting;

- Rationing actual care provided, best represented by reform efforts in Oregon; and

- Increasing efficiency and productivity in health care.

Increasing efficiency can be thought of as two distinct actions. The first action is eliminating spending that does not improve clinical quality. The second is making wise decisions to maximize the benefit received to get the most for the money spent. While there is good evidence that many opportunities exist to increase efficiency in both ways, this report focuses primarily on opportunities to reduce unnecessary spending.

PROJECT OVERVIEW

While many researchers and policy experts recognize the opportunity to reduce waste in the health care system, to date few have studied or attempted to address this problem from a system-wide perspective. By building upon the work of others in this field, the New England Healthcare Institute's goal is to create a comprehensive assessment of the problem.

We began our work by developing a consensus definition of waste to guide the research. We defined waste in clinical care as health care spending that can be eliminated without reducing the quality of care.[2] We understand that economic

arguments can be made to challenge some aspects of this definition, but we believe that this definition captures our desire to evaluate potential waste from the patient's perspective.

We have two objectives in identifying and removing costs that do not improve the quality of health care. First, we want to make a significant contribution to the national dialogue on health care cost and quality by providing a common context for understanding waste. We want to identify and understand the available evidence for avoidable costs and separate fact from un-substantiated opinion. Second, we intend to transform this knowledge into evidence-based public policy initiatives that improve the effectiveness of the health care system.

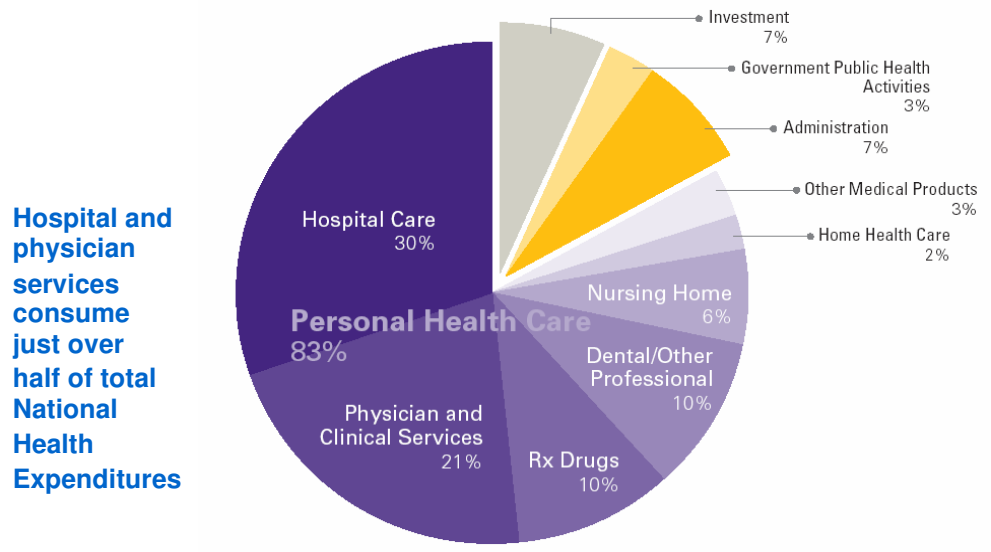
Within the health care system there are three broad areas where we have identified avoidable costs that do not lead to higher quality:

1. Clinical care;
2. Payment and finance; and
3. Drug and device research and development, regulation, and marketing.

WASTE IN CLINICAL CARE

The initial focus of this project is on the assessment of waste in the delivery of clinical care to individual patients and populations. Eighty-three percent of health care costs fall within clinical care, as shown in Figure 1.[3]

Figure 1: 2005 National Health Expenditures



Source: Center for Medicare and Medicaid Services (CMS), Office of the Actuary

Many experts believe that a significant portion of our health care dollars are wasted, with estimates suggesting that up to 30 percent of total spending could be eliminated without reducing health care quality.[4] If these conservative estimates are correct, this equals a $600 billion opportunity to improve the way we administer, manage, and deliver health care in the U.S. Realizing even a fraction of those savings would result in opportunities to redirect substantial funds to increase quality and access to care.

There is a compelling need to address waste for three reasons. First, the cost savings associated with eliminating waste are likely to be very large. Second, collaborative efforts to control waste could spur an emphasis on evidence-based practice that could lead to long-term quality improvement. Third, beyond economic arguments, wasteful spending may actually decrease the quality of health care. Unnecessary procedures and medicines, for example, expose the population to significant health risks, complications and even death. In addition, waste associated with the failure to follow accepted treatment protocols not only costs money, but decreases productivity, reduces quality of life, and may cause death.

Although many researchers and policy experts recognize the collective opportunity to decrease waste, few have studied it or developed a solution to the problem from a system-wide perspective. As a result, opinions, rather than evidence-based solutions, have dominated the discussion to date. Our belief is that much of the waste that exists today in health care can be reduced through collaboration among all health care stakeholders, if we first understand where and why it exists. Only with that common understanding and evidence base can we drive change.

Research Design and Methodology

In examining waste in clinical care, NEHI reviewed three broad areas: where waste exists in terms of both disease conditions and health services, why it exists when it does, and how many dollars are wasted. The broader goals for our analysis of waste in clinical care are simple but challenging:

1. To identify areas where we can do the right thing better; and

2. To identify areas where we need a better understanding of what the right thing is.

NEHI has accomplished the first of three goals:

Phase I – Create an Evidence-Based Landscape: To develop an evidence-based "landscape" of waste in clinical care, we analyzed extensive data in the peer reviewed literature published since 1998, interviewed nationally-recognized experts and developed models to quantify waste based on these data. The framework we have developed allows us to compare the evidence of waste and the strength of that evidence with the potential savings that could be achieved if the waste were eliminated. This analysis has provided us with early estimates of potential costs arising from different types of clinical care waste and has allowed us to define priorities for further work based on strength of evidence and potential cost savings. This landscape and our preliminary understanding of the root causes of waste in clinical care form the body of this report.

Phase II – Identify Solutions: Based on the landscape and our understanding of root causes, we will undertake more detailed research in areas of waste with the highest potential cost savings. The goal for this phase of work will be to develop the understanding and insight necessary to create a series of policy alternatives to address waste in the health care system.

Phase III – Develop Action Plans: Finally, we intend to transform the results of our analyses into specific action plans by creating pilot policy programs, case studies and tool kits for removing waste guided by the dialogue generated from our case studies.

GATHERING EVIDENCE FOR WASTE IN CLINICAL CARE

Overview

To begin our analysis, we asked a group of nationally-recognized experts for guidance as to what they thought were significant areas of waste. We then undertook an extensive literature review, and sought feedback and guidance from a diverse group of health care leaders. Finally, we grouped the evidence we found in the literature into discrete "clusters" (for example the overuse of antibiotics for respiratory infections), which we prioritized

according to both the strength of the evidence in the literature and the potential cost savings resulting from the elimination of the wasteful practice.

Expert Panel

On February 23, 2006, NEHI convened a panel of nationally-recognized experts to help us frame the issues inherent in clinical care waste (complete biographies are included in Appendix A). The experts were:

- Stuart Altman, PhD, Sol C. Chaikin Professor of National Health Policy, Brandeis University;
- Robert Brook, MD, ScD, Vice President and Director, RAND Health, and Professor of Medicine and Health Services, UCLA School of Medicine;
- Elliott Fisher, MD, MPH, Co-Director of the VA Outcomes Group and Professor of Medicine, Dartmouth Medical School;
- Lisa Latts, MD, MBA, MSPH, Vice President, Programs in Clinical Excellence, Wellpoint, Inc.;
- David Torchiana, MD, Chairman and CEO of Massachusetts General Physicians Organization and Associate Professor of Surgery, Harvard Medical School; and
- Sean Tunis, MD, MSc, Senior Fellow, Health Technology Center and former Chief Medical Officer, CMS.

We asked the panel to consider several questions in framing the issues:

- What is the single greatest area of waste in clinical care today?
- What are some examples of unnecessary or inappropriate clinical services?
- If you were given $1 billion and three years, which of these areas would you change and why?
- What mechanisms - financial, educational, technological, or other - would be most effective in reducing unnecessary medical utilization in these top areas?

As the panelists prioritized opportunities for reducing waste in clinical care they agreed on four areas that they felt contributed the most to clinical waste:

1. Sub-optimal management of chronic, long term conditions including asthma, hypertension, diabetes, and cardiac disease;
2. The variation in diagnosis, treatment, and outcomes across acute and chronic conditions, or what the panel termed the “reliability” of clinical care;

3. Unnecessary imaging, specifically high tech modalities such as CT, MRI, and PET; and

4. Underuse of medications proven to be of clinical benefit.

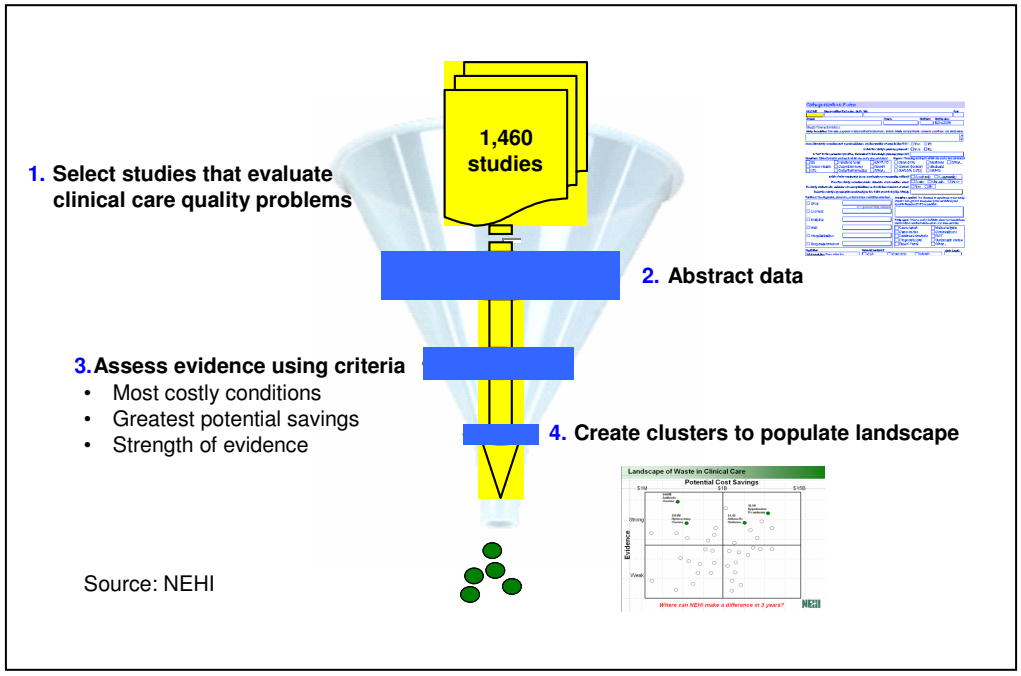
METHODOLOGY

Literature Review

In order to identify and quantify critical areas of waste in clinical care, we also conducted an extensive literature review. This review served as the foundation for separating evidence from opinion, and to provide a clear understanding of what the published data said.

To organize our literature review, we began with the important work of the Institute of Medicine (IOM). As part of its seminal report *Crossing the Quality Chasm*, the IOM published a compendium of work (through 1997) that addressed the impact of overuse, underuse, or misuse of clinical services on the quality of care.[5] NEHI adopted a data model similar to the IOM because we believed that waste arose from these same mechanisms. However, while the IOM's goal was to find evidence of suboptimal quality, we focused on finding specific evidence of waste, that is, health care spending that could be eliminated without reducing the quality of care. Because we believed that variation in the intensity of services provided was a potential contributor to waste, we added unexplained variation as an additional generator of waste. An important part of our analysis was to differentiate between evidence of suboptimal quality and evidence of clinical waste. We began our review in 1998 as we found most significant articles prior to 1997 were contained in the IOM report.

Figure 2: From Evidence to Action



We worked with the National Library of Medicine and Countway Medical Library in Boston to design a search strategy to identify peer-reviewed literature pertinent to our goals. Using the search strategy outlined in Appendix B, we found over 3,000 articles related to waste and inefficiency and identified 1,460 of them that merited further consideration for inclusion in our analysis. Each of these 1,460 articles was reviewed by at least two physicians. From this review, we identified 462 articles that contained examples of clinical waste; it was these articles that served as the basis for our analysis (see Figure 2). Because many of the articles addressed multiple conditions and multiple services, we classified them into relevant disease conditions (e.g. heart disease, asthma, etc.), services (e.g. drugs, imaging, etc.), and mechanism of waste (e.g. overuse, underuse, misuse, or unexplained variation in clinical practice). From these analyses, we produced 578 specific examples of clinical waste. We then categorized these specific examples and identified "clusters of evidence" based on the quantity and consistency of the examples found in the literature. Each "cluster of evidence" addressed a single medical condition, service, and mechanism of waste.

For each "cluster of evidence", we evaluated the strength of the data, looking at the scientific soundness of the research and the consistency of findings among articles comprising the cluster. Each cluster received a score of "strong", "moderate", or "weak" evidence from our physician reviewers. To estimate potential cost savings for each cluster, we analyzed data from the articles and/or developed models based upon published reports. While the models are limited in their analysis, we are confident that they capture both the relative cost savings among conditions and the order of magnitude of cost savings that could be realized (see Appendix C for a further description of this methodology.)

LIMITATIONS OF THE ANALYSIS

We recognize that this analysis of the peer-reviewed literature offers an incomplete picture of waste, because it only reflects what health services researchers have chosen to investigate and publish. Publication bias has been well described by Begg and others.[6] Proprietary materials and surveys could offer additional insight into the understanding of waste and inefficiency, but we have purposefully chosen to survey only peer-reviewed evidence in this initial phase of our analysis. As part of Phase II, we will consider additional evidence from other sources to inform our work.

We also acknowledge that despite our best efforts to capture all relevant articles published between 1998 and 2006, some articles were likely missed. We strongly believe, however, that the omission of some articles has not prevented gaining a thorough understanding of the issues surrounding waste in clinical care.

Research Findings

CLINICAL LANDSCAPE

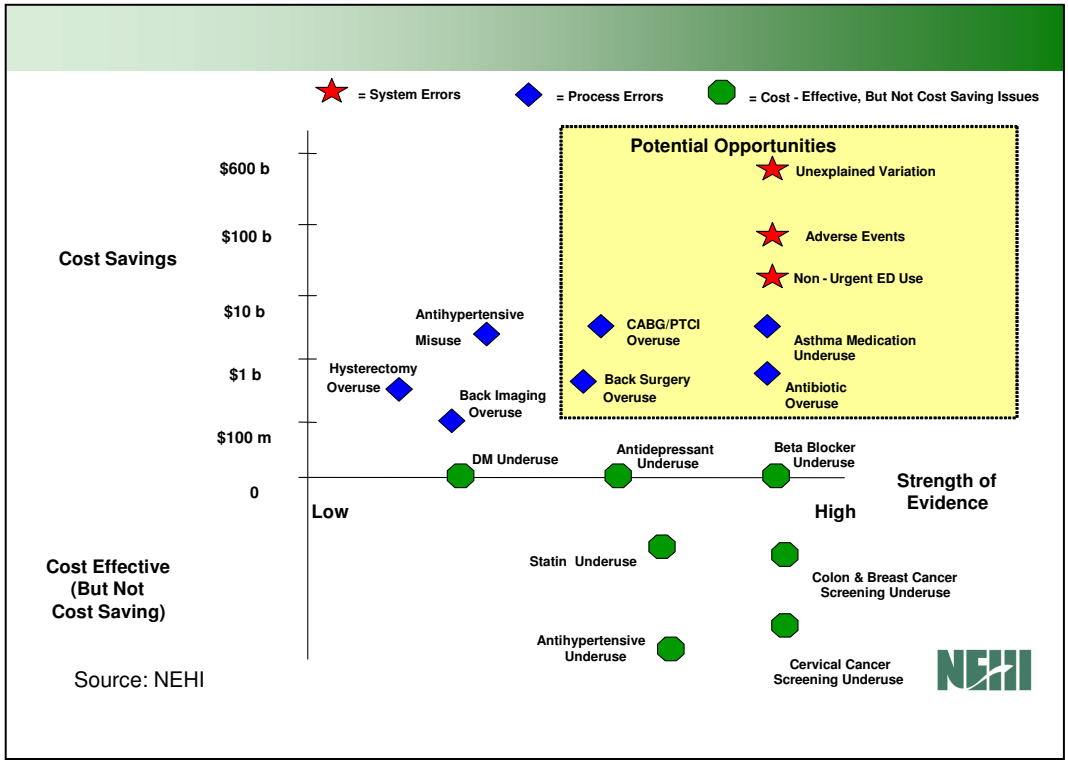
To graphically summarize our findings and to show the interaction between the strength of evidence and the potential cost savings for each cluster, we developed a landscape of waste in clinical care (see Figure 3). Cost savings, shown on the vertical axis, are expressed logarithmically because of the dramatic differences in potential savings. In order to make valid comparisons among articles written over an eight year period, all results were extrapolated to a 2006 population base, and all savings estimates were adjusted to reflect 2006 dollars. We used an annual discount rate of 4.2 percent, which was the average annual medical CPI over the eight year study period.[7] We know that actual medical costs likely grew at a higher rate due to increased rates of diagnosis and shifts in service mix to more costly procedures, so our cost saving estimates are conservative (see Appendix C for a summary of our findings).

The evidence demonstrates that the majority of waste results from system-wide problems in care delivery, often related to uncertainty, that are common to many clinical conditions. These clusters are represented by red stars in the landscape and include adverse treatment events, unnecessary ED use for non-urgent conditions, and unexplained variation in the intensity of the entire spectrum of clinical services.

Our findings also point to a number of process failures, often arising from cases where we fail to do the right thing right, such as the underuse of asthma medications or the overuse of antibiotics for respiratory infections. These cases account for approximately $9 billion of waste annually. We have indicated these process errors using blue diamonds in the landscape, and they represent approximately two percent of the estimated $600 billion that may be wasted in clinical care each year.

Finally, we identified several instances of overuse or underuse that are widely thought to be wasteful, such as underuse of disease management, for which we could not find evidence of significant cost savings. By and large, these interventions are cost-effective but not cost saving. They would require us to spend more money to obtain better clinical quality outcomes. We have represented these with green circle shapes in the landscape.

Figure 3: Waste Landscape



SIX KEY FINDINGS

We narrowed our findings to identify targets for further work. Using the criteria of moderate to high relative strength of evidence and a minimum potential annual savings of at least $1 billion, we identified six focus areas, listed below in order of greatest financial impact:

1. Unexplained variation in the intensity of medical and surgical services, including but certainly not limited to end of life care, overuse of coronary artery bypass surgery (CABG), and overuse of percutaneous coronary procedures (PCI), with total potential avoidable costs of up to $600 billion;[8]

2. Misuse of drugs and treatments, resulting in avoidable adverse effects of medical treatment that could save $52.2 billion;

3. Overuse of non-urgent emergency department (ED) care that could save (conservatively) $21.4 billion;

4. Underuse of appropriate medications:

   - generic antihypertensives, with potential savings of $3 billion;

   - controller medicines, particularly inhaled corticosteroids, in pediatric asthma, with projected savings of $2.5 billion; and

5. Overuse of antibiotics for respiratory infections, with potential savings of $1.1 billion.

The root causes of these findings span a continuum ranging from failure to follow established guidelines and practices (areas where we know what should be done but don't do it) to unexplained variation resulting from incomplete knowledge and uncertainty regarding the best course of action. This continuum is accompanied by increasing risk as one progresses from the "known" to the "unknown". When uncertainty is minimal, as is the case in the "known", the clinical, political, and financial risks of creating change are understandably less than in situations where uncertainty dominates and the potential pain of change is higher.

Discussion of Key Findings

UNEXPLAINED GEOGRAPHIC VARIATION IN INTENSITY OF CARE

Our research suggests that by far the largest source of wasteful spending is unexplained variation in patterns of care that are not associated with differences in measures of clinical outcomes. There is very strong evidence that significant geographic variation exists in the frequency and intensity of many medical interventions studied.[9,10] Some procedures, such as emergency hip fracture repair or colectomy for colon cancer, are performed at similar rates across the country. Many other interventions vary dramatically among regions with no real explanation for the variation.[11] The literature refers to these services as supply-sensitive or provider-sensitive services, and documents that the costs of the variation between high and low utilizing regions approaches thirty percent of total health care spending.[12] Much of the evidence comes from studies of Medicare populations, but data exist to demonstrate the same variation in non-Medicare populations as well.[13]

We found strong evidence that the rates of many specific surgical procedures vary among geographic areas. The procedures studied include:

1. Coronary artery bypass grafting (CABG);
2. Percutaneous coronary artery angioplasty (PCI);
3. Back surgery;
4. Cholecystectomy;
5. Hip replacement surgery;
6. Carotid artery surgery;
7. Lower extremity arterial bypass surgery; and
8. Radical prostatectomy.

Three of these procedures, CABG, PCI, and back surgery, have been frequently identified in the literature as interventions with wide geographic variation.[14,15]

We also found marked variation in the intensity of non-surgical services, including diagnostic testing, hospital admission, ICU utilization and the use of physician consultations. There are significant regional variations in the intensity of treatment of 12 chronic conditions during the last 24 months of life, including marked variation in services provided by academic medical centers, which most people would expect to provide the most scientific and appropriate care available.[16] Clinical outcomes were generally equivalent between high and low utilizing areas, and patient satisfaction was often higher in lower utilization regions. Careful scrutiny of these data, however, points to the need for caution.

Important outcomes that could significantly alter the interpretation of these studies, including functional status and quality of life, were not reported.

These data result largely from the work of Drs. Jack Wennberg, Elliott Fisher, and their team at Dartmouth Medical School. Taken together, their reports regarding variation in the intensity of a broad range of clinical services lead us to believe that the cost of potentially avoidable clinical care approximates 30 percent of total health care spending. If this estimate is correct, $600 billion could be saved each year by understanding and preventing unexplained variations in care patterns.

MISUSE OF SERVICES LEADS TO AVOIDABLE ADVERSE TREATMENT EVENTS

Adverse treatment events broadly fall into one of three categories:

1. Medical errors, such as operating on the wrong extremity or prescribing an ineffective drug;

2. Adverse drug events, both predictable and unexpected; and

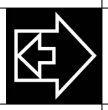
3. Complications of interventions, including hospital acquired infections.

Adverse treatment events are well documented sources of waste. Studies from Harvard Medical School suggest that adverse events conservatively account for five percent of total health care spending, or $100 billion per year, and that almost half of all adverse events (46.5 percent) are avoidable.[17]

Evidence shows that over half of all adverse drug events occur outside of the hospital setting.[18] Although ideas to address these errors are abundant, little has actually been done to solve the systemic causes that contribute to their existence, such as uncoordinated prescribing among physicians.

Hospital acquired infections make up an additional set of avoidable costs. Between five and ten percent of all patients admitted to acute care hospitals acquire one or more infections, resulting in an estimated 90,000 deaths each year and annual waste totaling an estimated $4.5 to $5.7 billion per year.[19] A recent report from the Pennsylvania Health Care Cost Containment Council (PHC4) suggests that the problem may be much larger. In 2004, hospitals in Pennsylvania reported 11,668 hospital acquired infections; of these, 15.4 percent of the patients who acquired an infection died. The direct medical cost associated with these infections in Pennsylvania was $2 billion.[20] If these findings are similar elsewhere, conventional estimates of the costs attributable to hospital acquired infections are grossly understated.

Taken together, avoidable adverse treatment events and hospital acquired infections conservatively result in a minimum of $52.2 billion that are wasted each year, not to mention the human toll of these avoidable events.



OVERUSE OF NON-URGENT EMERGENCY DEPARTMENT SERVICES

Forty percent of all Emergency Department (ED) visits are for non-urgent conditions and 31 percent of non-urgent visits occur during regular business hours.[21] These visits are more expensive than comparable office visits. They result in higher volumes of more expensive testing and, in 5.5 percent of cases, potentially avoidable hospital admissions.[22]

Without question, non-urgent ED use results in small part from lack of appropriate primary care for the uninsured. But the majority of non-urgent ED visits are made by insured people who perceive barriers to receiving care when they feel they need it.[23]

In Massachusetts, there is strong evidence of ED overuse for non-urgent illnesses and some evidence of potentially low primary care capacity.[24] One would not immediately associate Boston with a lack of primary care physicians, but inadequate primary care infrastructure and capacity may be a significant problem. An article in The Boston Globe highlighted the difficulty of finding a primary care physician in Boston, possibly contributing to ED overuse in the Commonwealth.[25] Our estimates suggest that eliminating avoidable ED use could save at least $21.4 billion per year on a national basis; it could also free-up emergency departments to take care of true emergencies and ensure that these valuable community resources are available to the seriously-ill patients who need them the most.

UNDERUSE OF APPROPRIATE MEDICINES

Almost half of the articles we reviewed examined the underuse of prescription drugs. We found strong evidence that statins, antihypertensives, and antidepressants were either underused or misused, but did not contribute to waste. Improving the underuse of β-blocker therapy following heart attack might lead to cost savings by decreasing subsequent heart attacks, but the evidence clearly shows that any savings are very dependent upon the cost of the drug.[26] We found strong evidence of two specific areas of underuse that lead to clinical waste:

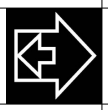
a. Underuse of Generic Antihypertensives: There is a strong body of evidence to suggest that the underuse of generic antihypertensives is widespread and provides an opportunity to remove unnecessary costs.[27,28] Many hypertensive patients could be treated with inexpensive generic medications, such as diuretics and first generation β-blockers, rather than the more expensive branded antihypertensives that are typically prescribed. JNC-VII guidelines support this evidence, and the Antihypertensive and Lipid Lowering Treatment to Prevent Heart Attack Trial (ALLHAT) demonstrated that in the majority of patients, older, less expensive drugs could be used without sacrificing any clinical benefit, while newer classes of drugs should be reserved for more difficult cases.[29,30] Our analyses of the evidence suggest that at least $3 billion could be saved each year by simply making less expensive but equally effective and safe medication choices.

b. Underuse of Controller Medications in Pediatric Asthma: Another important example of the underuse of appropriate medicines that we found widely documented in the literature was the underuse of inhaled corticosteroids and other controller medicines in pediatric asthma. Guidelines from the National Institutes of Health (NIH) recommend that asthma is best treated with a combination of two types of medicines, one for long-term control and another for quick relief.[31] Evidence suggests that inhaled steroids and leukotriene modifiers (long–term controllers) are underused by up to 60 percent of children with asthma, resulting in many avoidable emergency visits and hospitalizations.[32] In addition, patients and their parents are using the wrong mix of medicines. Regular use of inhaled steroids would reduce hospitalizations by 25 percent and could avoid direct medical costs totaling $2.5 billion each year.[33] Indirect costs are perhaps even more important in chronic diseases like asthma, where parents are often forced to miss work when their children become ill. Parents' absenteeism from work and presenteeism from being up with sick children at night and then working the following day lead to indirect productivity costs that are substantial.

OVERUSE OF MEDICINES

More antibiotics are prescribed for acute respiratory infections than for any other illness. Otitis media (ear infection), pharyngitis (sore throat), and other upper respiratory infections account for approximately 75 percent of all ambulatory care prescriptions.[34] Our analyses of the peer-reviewed literature showed that there is strong evidence that most of the antibiotics prescribed for the treatment of these infections are unnecessary, as these common infections are largely due to viruses that are not susceptible to antibiotics. Although simple and inexpensive point-of-service lab tests are available to identify the patients who truly need antibiotics, these tests are not widely used. The data suggest that up to 55 percent of antibiotic prescriptions are medically unnecessary and could be avoided, resulting in annual savings of $1.1 billion.[35]

Changing the patterns of prescribing unnecessary antibiotics for these common infections will require an exceptional effort to reconsider how medical care for these illnesses is delivered. The American Academy of Pediatrics, the American Academy of Family Physicians, and the Centers for Disease Control and Prevention (CDC) are actively leading efforts to reduce antibiotic prescribing, but more work remains to be done.[36] Cost savings aside, there is another compelling reason to address the overuse of antibiotics: widespread antibiotic use plays a role in the development of multi-drug resistant bacteria (antibiotic use in beef, swine, and fowl production may also be a significant factor).[37] According to the IOM, drug resistant infections render many older, less expensive antibiotics useless and might cost the U.S. health care system $6.7 billion annually.[38] Including this estimate, the total combined annual savings from eliminating the overuse of antibiotics may approach $8 billion.



LACK OF RELIABLE EVIDENCE:

We began our research with an idea of where we would find examples of waste. However, our hypotheses did not always turn out to be true. Below are three areas where we expected to find reliable evidence documenting waste but did not.

a. Overuse of Hysterectomy: We expected to find many reports documenting the overuse of hysterectomy and only found a single article, which reported that 12 percent of hysterectomies are avoidable.[39] We are aware of earlier work done by RAND that produced a somewhat higher percentage and speculate that studies have been done but not published in the peer reviewed literature.[40]

b. Overuse of High-Tech Imaging: We expected to find studies reporting data about the overuse of high tech imaging and we found mixed results. Two articles discussed the overuse of imaging related to back pain, and we were able to project $300 million annual savings related to avoidable MRIs from these studies.[41,42] We are aware of anecdotal reports of much larger savings resulting from aggressive radiology utilization management, but those reports do not appear in the peer reviewed literature.[43,44]

c. Savings from Disease Management Programs: We found very few articles addressing potential savings from disease management (DM) programs, despite widely held concerns about inadequate and costly care coordination and the potential of DM programs to increase efficiency and improve clinical outcomes. It is logical to believe these programs offer an opportunity to increase quality that will result in long term cost savings. We are aware of the successes reported by many disease management companies, but there is little published evidence documenting those successes. The scholarly literature appears to be generally neutral as to whether disease management actually saves money.[45]

Conclusions

Our findings demonstrate the pervasiveness of waste and identify five broad root causes for the sources of waste in clinical care that have emerged from our Phase I work:

1. **Variation in the Intensity of Clinical Care**: Data show that the magnitude of waste due to unexplained variation in intensity of medical services among geographic areas is significant, with estimates reaching as high as 30 percent of total health care spending. The causes of unexplained variation are only partially understood, and while it is likely that fraud and physician induced demand for services contribute to the variation, we believe that the magnitude of these inputs is small. There is little evidence that physicians actually perform treatments solely to maximize their incomes.[46] The preponderance of unexplained variation leading to waste results from uncertainty.

   Uncertainty in health care arises from two causes. First, human biology inherently varies in response to both disease and treatment. As an example, for most people influenza represents only a nuisance from which they rapidly and easily recover. For others, however, the identical virus results in rampant infection and death. To a clinician it is not always apparent which will occur and this uncertainty drives variation in treatment decisions. Second, much of what physicians do in their daily work is not grounded in evidence, but represents the art of medicine rather than the science. Clinical decision making evolves from "schools of thought" formed during residency training which persist throughout a physician's career and are slowly molded by individual clinical experience. As one physician reports, "If an event occurs only once in one hundred cases, but occurs in the second case that I see, it will forever color my thinking in a way that may be flat wrong but is perfectly logical to me."[47] In this way, local medical norms or cultures form physician behavior, leading to regional variations in approaches to diagnoses and treatments. Determining optimal practices and disseminating them have proven difficult, and it is important that evidence point to "the right thing".

2. **Lack of Compliance with Evidence-based Guidelines**: Uncertainty clearly contributes to waste; but even when we think we know the "right thing", doing it consistently remains elusive. From our analyses, much of the waste in clinical care results from failure to comply with established and accepted clinical practices, such as the failure to prescribe inhaled corticosteroids to children with asthma. There are many reasons for these failures. Certainly physician behavior and wariness of "cookbook medicine" play some role, but many other factors contribute to this problem as well.[48] For example:

   - The sheer number of guidelines is staggering, with many competing guidelines addressing the same clinical conditions;
   - Some guidelines have much more impact on cost and outcomes than others, but this is not readily apparent to practitioners;

- Best practices can and should change as new information becomes available, yet this does not always happen in a timely manner;
- Failing to continually monitor and update guidelines undermines their credibility, but continuous monitoring is expensive and difficult;
- Responsibility for guideline establishment is dispersed: no one group or agency has "ownership"; and
- Patients themselves often have preconceived notions and expectations regarding their care that conflict with guidelines (as in the case of patient demand for antibiotics to treat respiratory infections, which can lead physicians to stray from established guidelines).

To many in the health care community guidelines exemplify the scientific method whereby one adopts a process, measures the result, and then modifies the process - the cycle of continuous quality improvement. Guidelines, however, are not viewed favorably by all. Guidelines take time and effort. They often disrupt existing practice patterns and are perceived as threats to physician autonomy. Most importantly, perhaps, they are often not available at the moment that decisions are made.

3. **Limited Adoption of Clinical Information Technologies**: Decision support systems at the point of care, where clinical decisions are actually made, are available but are not broadly adopted. In addition to facilitating guideline compliance, these technologies are proven to decrease adverse effects of treatment, such as drug errors and wrong site surgeries, that are major drivers of avoidable waste in health care. Information technology offers a chance to dramatically decrease these events through expert decision support, drug tracking, and electronic order entry.[49] Efforts have been made to improve decision making in institutional settings and large hospital affiliated groups, and the results are extremely successful.[50] But most health care in the U.S. is not delivered within sophisticated, vertically integrated systems. Most physicians practice in small, single specialty practices and are unlikely to have wide access to computerized decision support and patient tracking systems.[51] In most medical offices computers are used for billing purposes, not for improving the quality and consistency of care.

   Electronic medical record keeping and e-prescribing technologies exist today and can play an important role in reducing waste in clinical care. For example, systems that control how chemotherapeutic drugs are administered by requiring laboratory data, imaging results, and responses to treatment could provide significant reductions in clinical waste. Adoption of these electronic systems has been limited by several factors. Computerized decision support systems are expensive and individual physicians are unlikely to realize any direct benefit. Physicians are unlikely to make large investments in technology for the benefit of others. Individual health plans would benefit from physicians using better decision support technology, but investment by individual plans would probably lead to "free riding" by

competitors, making individual plans unwilling to invest unless they control a significant market share.[52] Moreover, the federal government (which would likely realize the largest savings from better clinical decision making) is unwilling to undertake significant investment in health information technology. In addition to decreasing adverse drug events, computerized decision support offers the potential to avoid delays in diagnosis by providing analyses of differential diagnoses, avoiding and streamlining care by providing "expert" algorithms, and allowing physicians to better manage the uncertainty of complex cases.

4. **Failure of Primary Care Systems to Provide Timely Access**: Evidence indicates that avoidable emergency department (ED) care, avoidable hospital admissions from the ED, and inappropriate intensity of ED services may stem from a lack of access to appropriate levels of primary care.[53] People use emergency services either because they do not have another source of care or because they feel that their clinician is not conveniently available. Unnecessary emergency visits can result in inappropriate diagnostic and therapeutic interventions, including antibiotic use and hospital admissions. According to The Commonwealth Fund, Americans of all incomes report greater difficulty accessing timely urgent care outside of hospital emergency departments than residents of most other industrialized countries.[54]

5. **Underuse of Cost Effective Diagnostic Tests**: Point of care testing is a technology that enables other health professionals - nurses, physician assistants, and pharmacists - to diagnose and treat many simple, common conditions that currently clog our emergency departments. These technologies could improve diagnostic accuracy at a lower cost than conventional lab tests, and also decrease antibiotic prescribing. They are readily available and affordable, yet not well adopted in clinical practice. Many physician offices and community health centers do not employ point of service testing because of reimbursement problems and regulations governing lab tests, leading to more expensive testing where the results are not known for several days. To improve adoption, reimbursement strategies should be changed and utilization of these tests added to performance "scorecards" such as those produced by the National Committee for Quality Assurance. An even bigger issue, however, is whether the testing needs to be physically available in physician offices or is better placed in more accessible locations such as pharmacies.

Moving on: Opportunities for Change

In this first phase of NEHI's project to identify and reduce clinical waste, we have summarized the findings of our research and identified ways that we can eliminate waste and inefficiency in the health care system. Based on our findings, there are several opportunities for meaningful change. Some are low risk and more focused in scope. Others will require broad systemic changes and, as a result, they will be more challenging to undertake. Our steps to success in reducing waste in health care include the following:

1. **Examining the Causes of Geographic Variation in Clinical Care**: By working with experts across diverse medical and social science disciplines, NEHI has generated a better understanding of the causes of practice variation and examined potential ways to decrease it. We focused on the issues associated with physician guideline compliance and the incentives that could increase their compliance. This topic is gaining national attention and our work has provided timely information on barriers to physician adoption of evidence-based practices. NEHI is now in the process of developing public policy options that address variation in patient management, provider mix, lack of accountability on the part of both providers and patients, and lack of outcomes data that truly promote evidence-based medicine.

   In addition, the Ambulatory Care Quality Alliance (a consortium of medical specialty societies, health plans, and the Centers for Medicare and Medicaid Services), is making a strong effort to identify a single set of guidelines that address a number of the most common and expensive conditions[55]. If they are successful, we will work with the Alliance to seek partnerships with other interested organizations to have this unified set of guidelines adopted.

2. **Developing Focused Recommendations to Improve Current Care Practices**: NEHI will develop case studies for areas of waste where the evidence suggests that changing current practice would save costs, such as limiting antibiotics for acute respiratory infections, increasing the use of certain asthma drugs, or standardizing hypertension therapy. These studies will be limited in scope and will result in specific recommendations. From these studies, we will develop policy recommendations to address areas of waste directed toward public policy makers, health plans, and physician practices.

3. **Strategies to Reduce Emergency Department (ED) Use for Nonurgent Conditions**: We hypothesize that key reasons for nonurgent ED use are the lack of patient access to adequate primary care services and the convenience of accessing the ED. This is a timely topic given primary care shortages both in New England and nationally. In collaboration with the Institute for Healthcare Improvement (IHI), NEHI will explore alternative ways to care for uncomplicated illness given the constraints of physician supply. We will begin by reviewing the literature to identify root causes of nonurgent

emergency department use. We will also scan the literature and interview NEHI member organizations, IHI collaborators and industry leaders for promising strategies to channel nonurgent ED use into more productive encounters in alternative settings. NEHI and IHI will assess the feasibility of the most promising strategies by conducting small-scale rapid prototype testing at several clinical sites, paying close attention to the potential impact on vulnerable populations. We will synthesize our findings and make clear, evidence-based recommendations to limit use of the ED for nonurgent conditions.

4. **Expanding Efforts to Advance the Adoption of Information Technology**: NEHI will work to expand efforts to support technology's role in decreasing avoidable adverse events, including e-prescribing systems, inter-operable data bases and regional outpatient electronic medical records. Most adverse treatment events occur in outpatient settings, making it necessary to eventually expand the scope of activity beyond hospital walls. NEHI has completed considerable research into the beneficial effects of using technology in health care, including our work in computerized physician order entry systems, remote patient monitoring, and most recently, Tele-Intensive Care Units, that would provide a base for this effort. State governments emerge as the entity most able to forge collaborations for technology adoption, and NEHI intends to work closely with stakeholders at this level to spread adoption of important technologies. The data also show that many avoidable events are the result of faulty decisions that could have been prevented by clinical decision support systems. NEHI and the Massachusetts Technology Collaborative are working together to expand the adoption of hospital computerized physician order entry systems (CPOE) which, when combined with decision support systems, are proven to reduce adverse drug events.

5. **Investigating Examples of Waste That Are Not Well Documented in the Literature**: NEHI will undertake novel research examining areas of waste that did not appear in our extensive literature review and yet are often believed to be sources of waste in clinical care. We will seek to better understand specific clinical events that we hypothesized to be sources of significant waste, such as excessive high tech imaging or chemotherapy treatment, but for which little or no data exist.

6. **Building a National Coalition to Eliminate Waste**: NEHI will explore potential partnerships with national organizations such as RAND, the Institute of Medicine, the Pittsburgh Regional Health Initiative, and the Veterans Healthcare System to build a national coalition to identify waste and best practices to eliminate it.

In this first report on waste and inefficiency in the health care system, we have objectively analyzed the evidence that exists in the medical literature, supplemented by expert opinion. Ultimately, we need solutions that can lead directly to meaningful change in health care. We will continue to build regional and national collaboratives that will work with us to bring these follow-on projects to fruition, meeting our ultimate mission of transforming health care by saving lives and saving money.

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APPENDICES

Appendix A: Expert Panelists

STUART ALTMAN, PHD

Dr. Altman is the Sol C. Chaikin Professor of National Health Policy at Brandeis University and an economist whose research interests are primarily in the area of federal and state health policy. Between 1971 and 1976, Professor Altman was Deputy Assistant Secretary for Planning and Evaluation/Health at HEW. From 1973 to 1974 he also served as the Deputy Director for Health of the President's Cost-of-Living Council where he was responsible for developing the Council's program on health care cost containment. In 1997, he was appointed by President Clinton to the National Bipartisan Commission on the Future of Medicare. Professor Altman was Dean of The Heller School from 1977 until July 1993 and interim President of Brandeis University from 1990-1991. He served as the Chairman of the Prospective Payment Assessment Commission (ProPAC), responsible for advising Congress on the Medicare DRG Hospital Payment System, for twelve years. Professor Altman is a member of The Institute of Medicine of the National Academy of Sciences; a member of the Board of Overseers of the Beth Israel Deaconess Medical Center in Boston, Massachusetts; and Co-Chairman of the Advisory Board to the Schneider Institute for Health Policy.

Professor Altman has MA and PhD degrees in Economics from UCLA and taught at Brown University and the Graduate School of Public Policy at the University of California at Berkeley. In addition, Dr. Altman has served on the Board of The Robert Wood Johnson Clinical Scholars Program and on the Governing Council of the Institute of Medicine. He is the Chair of the Robert Wood Johnson Foundation sponsored Council on Health Care Economics and Policy.

ROBERT H. BROOK, MD, SCD

Dr. Brook is the Director of the RAND Health Science Program and Professor of Medicine and Health Service at the UCLA Medical School. He is an internationally known expert on quality assessment and assurance, the development and use of health-status measurements in health policy, the efficiency and effectiveness of medical care, and variation in the use of medical services across geographic areas. Dr. Brook has published nearly 300 peer-reviewed articles and has conducted pioneering work in the field of quality measurement.

Dr. Brook has received numerous professional honors, including the Peter Reizenstein Prize, 2000, for "Defining and Measuring Quality of Care: A Perspective from U.S. Researchers," the National Committee for Quality Assurance Health Quality Award for pursuit of health care quality at all levels of the health system, Research America's 2000 Advocacy Award for Sustained Leadership at the National Level, the Robert J. Glaser Award of the Society of General Internal Medicine, the Richard and Hinda Rosenthal Foundation Award of the American College of Physicians, and the Distinguished Health Services Research Award of the Association of Health Services Research. He received his

MD from the Johns Hopkins Medical School and his ScD from the Johns Hopkins School of Hygiene and Public Health.

ELLIOTT S. FISHER, MD, MPH

Dr. Fisher is Professor of Medicine and Community and Family Medicine, Dartmouth Medical School, Hanover NH and Co-Director, VA Outcomes Group, VA Medical Center, White River Junction, VT. He is a general internist and a former Robert Wood Johnson Clinical Scholar who has broad expertise in the use of administrative databases and survey research methods in health systems evaluation. His research has focused on exploring the causes and consequences of variations in clinical practice and health care spending across U.S. regions and among health care providers. His most recent work suggests that at least 30 percent of Medicare spending is now devoted to medical services that provide no detectable health benefits. A cum laude graduate of Harvard College, Dr. Fisher holds an MD degree from the Harvard Medical School and an MPH degree from the University of Washington.

LISA M. LATTS, MD, MBA, MSPH

Dr. Latts is Vice President, Programs in Clinical Excellence, for WellPoint, Inc. She is responsible for the WellPoint Enterprise Quality Program and WellPoint's Centers of Clinical Excellence programs. Dr. Latts practices as a specialist in Medical Complications of Pregnancy at the University Hospital in Denver, Colorado. She received her medical degree from the University of Minnesota and completed a residency in Internal Medicine at the University of Colorado. Dr. Latts also completed a General Internal Medicine fellowship, specializing in Medical Complications of Pregnancy. She has a Masters of Science in Public Health and a Masters in Business Administration from the University of Minnesota Medical School.

DAVID F. TORCHIANA, MD

Dr. Torchiana is the Chief Executive Officer of the Massachusetts General Physicians Organization, and an Associate Professor of Surgery at Harvard Medical School. He graduated from Yale College in 1976, and from Harvard Medical School in 1981. Dr. Torchiana completed residencies in general surgery and cardiothoracic surgery at the Massachusetts General Hospital before joining the Department of Surgery there in 1989. He became Chief of Cardiac Surgery in 1998. In January 2003, he assumed his current role as Chairman and CEO of the Massachusetts General Physicians Organization. The MGPO, associated with the Massachusetts General Hospital, is a member of the Partners HealthCare System and a teaching affiliate of the Harvard Medical School. The organization is the largest physician group practice in New England, representing more than 1,500 physicians.

SEAN TUNIS, MD, MSC

Dr. Tunis is a Senior Fellow at the Health Technology Center in San Francisco and an adjunct faculty member in the Department of Medicine at the Johns Hopkins School of Medicine. Through September of 2005, Dr. Tunis was the Director of the Office of Clinical Standards and Quality (OCSQ) and Chief

Medical Officer at the Centers for Medicare and Medicaid Services (CMS), where he had lead responsibility for clinical policy and quality for the Medicare and Medicaid programs. He also co-chaired the CMS Council on Technology and Innovation, and served as Executive Director for the CMS Quality Council.

Dr. Tunis joined CMS in 2000 as the Director of the Coverage and Analysis Group within OCSQ. Before joining CMS, Dr. Tunis was a senior research scientist with the Lewin Group, and also served as the Director of the Health Program at the Congressional Office of Technology Assessment and as a health policy advisor to the U.S. Senate Committee on Labor and Human Resources. He received a BS degree in History of Science from Cornell University, and a medical degree and masters in Health Services Research from the Stanford University School of Medicine. Dr. Tunis did his residency training at UCLA and the University of Maryland in Emergency Medicine and Internal Medicine. Dr. Tunis practices as a part-time Emergency Physician in Baltimore, Maryland.

ROBERT MITTMAN, MPP (MODERATOR)

An experienced moderator, Mr. Mittman brings a multidisciplinary perspective to emerging technology and health care forecasting and planning. Mr. Mittman specializes in developing innovative approaches to modeling and forecasting under conditions of little or conflicting data. He is co-author of The Future of the Internet in Health Care: A Five-Year Forecast. He was also a contributing author of IFTF's annual Health Care Outlook report and of The Future of American Health Care, Vol. IV, Transforming the System: Building a New Structure for a New Century. He is the founder of Facilitation, Foresight, Strategy, a forecasting consultancy.

Appendix B: Search Strategy

NEHI searched the National Library of Medicine's MEDLINE database using PubMed for studies on waste in clinical care. The NEHI team worked closely with medical librarians from the National Library of Medicine and Harvard University's Countway Library of Medicine to develop search strategies. The search was structured around Medical Subject Heading (MeSH) terms and other general keywords related to waste, inefficiency, or poor quality in clinical care. NEHI performed two searches: one centered on the IOM's concepts of overuse, underuse, and misuse in clinical care; the other on more general keywords. In both instances, the search was limited to studies:

- Conducted in the United States;
- Published in English;
- Published between 1998 and March 2006; and
- Involved humans only.

The results of both searches were combined, and duplicate studies removed, resulting in 1460 primary studies for review. The specific search terms, strategies (queries), and results follow below.

MeSH TERMS / SUBHEADINGS:

MeSH search terms	Subheadings

• Health services
• Delivery of health care
• Health service research
• Diagnostic techniques and procedures
• Quality of health care
  • Guideline adherence
  • Physician's practice patterns
  • Utilization review
  • Outcome and process assessment health care
	• Economics
	• Statistics & numerical data
	• Trends
	• Utilization

• Pharmaceuticals • Pharmacologic actions	• Adverse effects • Contraindications • Diagnostic use • Economics • Supply and distribution

GENERAL SEARCH TERMS AND KEYWORDS

General search terms	Keywords words included
Overuse	Overuse; Overused; Overusing; Overutilisation; Overutilization; Overutilization of health services
Misuse	Misuse; Misused; Misusing; Misutilisation; Misutilization; Misutilized
Underuse	Underuse; Underused; Underutilization; Underutilize; Underutilized; Underutilization; Underutilize; Underutilized
Care gap	care gap; care gaps
Others	Inappropriate; wasted money; wasted resources; inefficiency; marginally beneficial; unnecessary care; necessary care; recommended care; regional variation

SEARCH STRATEGIES AND RESULTS

Term	Strategy/Query	Number of Citations	Date Searched
Underuse	("Health Services/economics"[MAJR] OR "Health Services/statistics and numerical data"[MAJR] OR "Health Services/supply and distribution"[MAJR] OR "Health Services/utilization"[MAJR]) OR ("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health Care/utilization"[MAJR]) OR	447	3/20/2006

Term	Strategy/Query	Number of Citations	Date Searched
	("Pharmaceutical Preparations/adverse effects"[MAJR] OR "Pharmaceutical Preparations/contraindications"[MAJR] OR "Pharmaceutical Preparations/diagnostic use"[MAJR] OR "Pharmaceutical Preparations/economics"[MAJR] OR "Pharmaceutical Preparations/supply and distribution"[MAJR]) OR "Pharmacologic Actions"[MAJR] OR ("Diagnostic Techniques and Procedures/adverse effects"[MAJR] OR "Diagnostic Techniques and Procedures/economics"[MAJR] OR "Diagnostic Techniques and Procedures/statistics and numerical data"[MAJR] OR "Diagnostic Techniques and Procedures/trends"[MAJR] OR "Diagnostic Techniques and Procedures/utilization"[MAJR]) OR ("Guideline Adherence/economics"[MAJR] OR "Guideline Adherence/statistics and numerical data"[MAJR] OR "Guideline Adherence/trends"[MAJR] OR "Guideline Adherence/utilization"[MAJR]) OR ("Physician's Practice Patterns/economics"[MAJR] OR "Physician's Practice Patterns/statistics and numerical data"[MAJR] OR "Physician's Practice Patterns/trends"[MAJR] OR "Physician's Practice Patterns/utilization"[MAJR]) OR ("Utilization Review/economics"[MAJR] OR "Utilization Review/organization and administration"[MAJR] OR "Utilization Review/statistics and numerical data"[MAJR] OR "Utilization Review/trends"[MAJR] OR "Utilization Review/utilization"[MAJR]) OR "Outcome and Process Assessment (Health Care)"[MAJR] OR ("Health Services Research/economics"[MAJR]		

Term	Strategy/Query	Number of Citations	Date Searched
	OR "Health Services Research/organization and administration"[MAJR] OR "Health Services Research/statistics and numerical data"[MAJR] OR "Health Services Research/utilization"[MAJR]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND ("underuse"[All Fields] OR "underused"[All Fields] OR "underutilisation"[All Fields] OR "underutilise"[All Fields] OR "underutilised"[All Fields] OR "underutilization"[All Fields] OR "underutilize"[All Fields] OR "underutilized"[All Fields]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])		
Misuse	("Health Services/economics"[MAJR] OR "Health Services/statistics and numerical data"[MAJR] OR "Health Services/supply and distribution"[MAJR] OR "Health Services/utilization"[MAJR]) OR ("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health Care/utilization"[MAJR]) OR ("Pharmaceutical Preparations/adverse effects"[MAJR] OR "Pharmaceutical Preparations/contraindications"[MAJR] OR "Pharmaceutical Preparations/diagnostic use"[MAJR] OR "Pharmaceutical Preparations/economics"[MAJR] OR "Pharmaceutical Preparations/supply and distribution"[MAJR]) OR "Pharmacologic Actions"[MAJR] OR ("Diagnostic Techniques and Procedures/adverse effects"[MAJR] OR "Diagnostic Techniques and Procedures/economics"[MAJR] OR "Diagnostic Techniques and Procedures/statistics and numerical	434	3/20/2006

Term	Strategy/Query	Number of Citations	Date Searched
	data"[MAJR] OR "Diagnostic Techniques and Procedures/trends"[MAJR] OR "Diagnostic Techniques and Procedures/utilization"[MAJR]) OR ("Guideline Adherence/economics"[MAJR] OR "Guideline Adherence/statistics and numerical data"[MAJR] OR "Guideline Adherence/trends"[MAJR] OR "Guideline Adherence/utilization"[MAJR]) OR ("Physician's Practice Patterns/economics"[MAJR] OR "Physician's Practice Patterns/statistics and numerical data"[MAJR] OR "Physician's Practice Patterns/trends"[MAJR] OR "Physician's Practice Patterns/utilization"[MAJR]) OR ("Utilization Review/economics"[MAJR] OR "Utilization Review/organization and administration"[MAJR] OR "Utilization Review/statistics and numerical data"[MAJR] OR "Utilization Review/trends"[MAJR] OR "Utilization Review/utilization"[MAJR]) OR "Outcome and Process Assessment (Health Care)"[MAJR] OR ("Health Services Research/economics"[MAJR] OR "Health Services Research/organization and administration"[MAJR] OR "Health Services Research/statistics and numerical data"[MAJR] OR "Health Services Research/utilization"[MAJR]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND ("misuse"[All Fields] OR "misused"[All Fields] OR "misusing"[All Fields] OR "misutilisation"[All Fields] OR "misutilization"[All Fields] OR "misutilized"[All Fields]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])		

Term	Strategy/Query	Number of Citations	Date Searched
Overuse	("Health Services/economics"[MAJR] OR "Health Services/statistics and numerical data"[MAJR] OR "Health Services/supply and distribution"[MAJR] OR "Health Services/utilization"[MAJR]) OR ("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health Care/utilization"[MAJR]) OR ("Pharmaceutical Preparations/adverse effects"[MAJR] OR "Pharmaceutical Preparations/contraindications"[MAJR] OR "Pharmaceutical Preparations/diagnostic use"[MAJR] OR "Pharmaceutical Preparations/economics"[MAJR] OR "Pharmaceutical Preparations/supply and distribution"[MAJR]) OR "Pharmacologic Actions"[MAJR] OR ("Diagnostic Techniques and Procedures/adverse effects"[MAJR] OR "Diagnostic Techniques and Procedures/economics"[MAJR] OR "Diagnostic Techniques and Procedures/statistics and numerical data"[MAJR] OR "Diagnostic Techniques and Procedures/trends"[MAJR] OR "Diagnostic Techniques and Procedures/utilization"[MAJR]) OR ("Guideline Adherence/economics"[MAJR] OR "Guideline Adherence/statistics and numerical data"[MAJR] OR "Guideline Adherence/trends"[MAJR] OR "Guideline Adherence/utilization"[MAJR]) OR ("Physician's Practice Patterns/economics"[MAJR] OR "Physician's Practice Patterns/statistics and numerical data"[MAJR] OR "Physician's Practice Patterns/trends"[MAJR] OR	211	3/20/2006

Term	Strategy/Query	Number of Citations	Date Searched
	"Physician's Practice Patterns/utilization"[MAJR]) OR ("Utilization Review/economics"[MAJR] OR "Utilization Review/organization and administration"[MAJR] OR "Utilization Review/statistics and numerical data"[MAJR] OR "Utilization Review/trends"[MAJR] OR "Utilization Review/utilization"[MAJR]) OR "Outcome and Process Assessment (Health Care)"[MAJR] OR ("Health Services Research/economics"[MAJR] OR "Health Services Research/organization and administration"[MAJR] OR "Health Services Research/statistics and numerical data"[MAJR] OR "Health Services Research/utilization"[MAJR]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND ("overuse"[All Fields] OR "overused"[All Fields] OR "overusing"[All Fields] OR "overutilisation"[All Fields] OR "overutilization"[All Fields] OR "overutilization of health services"[All Fields]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])		
		Subtotal: 1092	
Inappropriateness	("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health Care/trends"[MAJR] OR "Delivery of Health Care/utilization"[MAJR]) AND (inappropriate[tiab] OR "records"[MeSH Terms]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])	412	3/20/2006
Care gaps	("care gap"[All Fields] OR "care gaps"[All Fields]) AND ("United States"[MeSH] OR "usa"[Affiliation])	8	3/21/2006

Term	Strategy/Query	Number of Citations	Date Searched
	AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])		
Uncertainty	("Health Services/economics"[MAJR] OR "Health Services/statistics and numerical data"[MAJR] OR "Health Services/supply and distribution"[MAJR] OR "Health Services/utilization"[MAJR]) OR ("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health Care/utilization"[MAJR]) OR ("Pharmaceutical Preparations/adverse effects"[MAJR] OR "Pharmaceutical Preparations/contraindications"[MAJR] OR "Pharmaceutical Preparations/diagnostic use"[MAJR] OR "Pharmaceutical Preparations/economics"[MAJR] OR "Pharmaceutical Preparations/supply and distribution"[MAJR]) OR "Pharmacologic Actions"[MAJR] OR ("Diagnostic Techniques and Procedures/adverse effects"[MAJR] OR "Diagnostic Techniques and Procedures/economics"[MAJR] OR "Diagnostic Techniques and Procedures/statistics and numerical data"[MAJR] OR "Diagnostic Techniques and Procedures/trends"[MAJR] OR "Diagnostic Techniques and Procedures/utilization"[MAJR]) OR ("Guideline Adherence/economics"[MAJR] OR "Guideline Adherence/statistics and numerical data"[MAJR] OR "Guideline Adherence/trends"[MAJR] OR "Guideline Adherence/utilization"[MAJR]) OR ("Physician's Practice Patterns/economics"[MAJR] OR "Physician's Practice Patterns/statistics	4	3/23/2006

Term	Strategy/Query	Number of Citations	Date Searched
	and numerical data"[MAJR] OR "Physician's Practice Patterns/trends"[MAJR] OR "Physician's Practice Patterns/utilization"[MAJR]) OR ("Utilization Review/economics"[MAJR] OR "Utilization Review/organization and administration"[MAJR] OR "Utilization Review/statistics and numerical data"[MAJR] OR "Utilization Review/trends"[MAJR] OR "Utilization Review/utilization"[MAJR]) OR "Outcome and Process Assessment (Health Care)"[MAJR] OR ("Health Services Research/economics"[MAJR] OR "Health Services Research/organization and administration"[MAJR] OR "Health Services Research/statistics and numerical data"[MAJR] OR "Health Services Research/utilization"[MAJR]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])AND "Uncertainty"[MAJR]		
Reliability	("Health Services/economics"[MAJR] OR "Health Services/statistics and numerical data"[MAJR] OR "Health Services/supply and distribution"[MAJR] OR "Health Services/utilization"[MAJR]) OR ("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health Care/utilization"[MAJR]) OR ("Pharmaceutical Preparations/adverse effects"[MAJR] OR "Pharmaceutical Preparations/contraindications"[MAJR] OR "Pharmaceutical Preparations/diagnostic use"[MAJR] OR "Pharmaceutical Preparations/economics"[MAJR] OR "Pharmaceutical Preparations/supply	128	3/23/2006

Term	Strategy/Query	Number of Citations	Date Searched
	and distribution"[MAJR]) OR "Pharmacologic Actions"[MAJR] OR ("Diagnostic Techniques and Procedures/adverse effects"[MAJR] OR "Diagnostic Techniques and Procedures/economics"[MAJR] OR "Diagnostic Techniques and Procedures/statistics and numerical data"[MAJR] OR "Diagnostic Techniques and Procedures/trends"[MAJR] OR "Diagnostic Techniques and Procedures/utilization"[MAJR]) OR ("Guideline Adherence/economics"[MAJR] OR "Guideline Adherence/statistics and numerical data"[MAJR] OR "Guideline Adherence/trends"[MAJR] OR "Guideline Adherence/utilization"[MAJR]) OR ("Physician's Practice Patterns/economics"[MAJR] OR "Physician's Practice Patterns/statistics and numerical data"[MAJR] OR "Physician's Practice Patterns/trends"[MAJR] OR "Physician's Practice Patterns/utilization"[MAJR]) OR ("Utilization Review/economics"[MAJR] OR "Utilization Review/organization and administration"[MAJR] OR "Utilization Review/statistics and numerical data"[MAJR] OR "Utilization Review/trends"[MAJR] OR "Utilization Review/utilization"[MAJR]) OR "Outcome and Process Assessment (Health Care)"[MAJR] OR ("Health Services Research/economics"[MAJR] OR "Health Services Research/organization and administration"[MAJR] OR "Health Services Research/statistics and numerical data"[MAJR] OR "Health Services Research/utilization"[MAJR]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND		

Term	Strategy/Query	Number of Citations	Date Searched
	("reliability/quality"[All Fields] OR "reliability/significance"[All Fields] OR "reliability/usefulness"[All Fields] OR "reliability analyses"[All Fields] OR "reliability analysis"[All Fields] OR "reliability and validity"[All Fields] OR "reliability assessment"[All Fields] OR "reliability check"[All Fields] OR "reliability checks"[All Fields] OR "reliability considerations"[All Fields] OR "reliability diagnosis"[All Fields] OR "reliability efficiency"[All Fields] OR "reliability enhancement"[All Fields] OR "reliability evaluation"[All Fields] OR "reliability experiments"[All Fields] OR "reliability indicators"[All Fields] OR "reliability literature"[All Fields] OR "reliability measure"[All Fields] OR "reliability measurement"[All Fields] OR "reliability measurements"[All Fields] OR "reliability measures"[All Fields]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])		
Other: Waste, inefficiency, marginally beneficial, unnecessary care	("wasted money"[All Fields] OR "wasted resources"[All Fields] OR inefficiency[All Fields] OR "marginally beneficial"[All Fields] OR "unnecessary care"[All Fields] OR "necessary care"[All Fields]) AND "Health Care Quality, Access, and Evaluation"[MAJR] AND ("United States"[MeSH] OR "usa"[Affiliation]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])	66	3/21/2006
Other 2: Recommended care, regional variation	("Health Services/economics"[MAJR] OR "Health Services/statistics and numerical data"[MAJR] OR "Health Services/supply and distribution"[MAJR] OR "Health Services/utilization"[MAJR]) OR ("Delivery of Health Care/economics"[MAJR] OR "Delivery of Health Care/statistics and numerical data"[MAJR] OR "Delivery of Health Care/supply and distribution"[MAJR] OR "Delivery of Health	47	3/21/2006

Term	Strategy/Query	Number of Citations	Date Searched
	Care/utilization"[MAJR]) OR ("Pharmaceutical Preparations/adverse effects"[MAJR] OR "Pharmaceutical Preparations/contraindications"[MAJR] OR "Pharmaceutical Preparations/diagnostic use"[MAJR] OR "Pharmaceutical Preparations/economics"[MAJR] OR "Pharmaceutical Preparations/supply and distribution"[MAJR]) OR "Pharmacologic Actions"[MAJR] OR ("Diagnostic Techniques and Procedures/adverse effects"[MAJR] OR "Diagnostic Techniques and Procedures/economics"[MAJR] OR "Diagnostic Techniques and Procedures/statistics and numerical data"[MAJR] OR "Diagnostic Techniques and Procedures/trends"[MAJR] OR "Diagnostic Techniques and Procedures/utilization"[MAJR]) OR ("Guideline Adherence/economics"[MAJR] OR "Guideline Adherence/statistics and numerical data"[MAJR] OR "Guideline Adherence/trends"[MAJR] OR "Guideline Adherence/utilization"[MAJR]) OR ("Physician's Practice Patterns/economics"[MAJR] OR "Physician's Practice Patterns/statistics and numerical data"[MAJR] OR "Physician's Practice Patterns/trends"[MAJR] OR "Physician's Practice Patterns/utilization"[MAJR]) OR ("Utilization Review/economics"[MAJR] OR "Utilization Review/organization and administration"[MAJR] OR "Utilization Review/statistics and numerical data"[MAJR] OR "Utilization Review/trends"[MAJR] OR "Utilization Review/utilization"[MAJR]) OR "Outcome and Process Assessment (Health Care)"[MAJR] OR ("Health		

Term	Strategy/Query	Number of Citations	Date Searched
	Services Research/economics"[MAJR] OR "Health Services Research/organization and administration"[MAJR] OR "Health Services Research/statistics and numerical data"[MAJR] OR "Health Services Research/utilization"[MAJR]) AND ("United States"[MeSH] OR "usa"[Affiliation]) AND ("recommended care"[All Fields] OR "regional variation"[All Fields]) AND English[lang] AND "humans"[MeSH Terms] AND ("1998"[PDAT] : "2006"[PDAT])		
		Total: 1759	

Appendix C: Total Costs and Projected Savings in Selected High-Cost Conditions

Single Conditions	Evidence	Relative Strength of Evidence	Total Cost ($) †,††	Yearly Savings†† ($U.S. millions)
Heart Conditions			120,326	
• β-blockers post MI	Underuse	§§§		(4500/QALY-280m saving)
• CABG and PCI	UV	§§§		2480
• Statins	Underuse	§§		(3215-9830/QALY)
• Carotid surgery		§		435
Trauma			84,263	
Cancer			56,568	
• Breast Screening	Underuse	§§§		(5-19,000/QALY)
• Cx Screening	Underuse	§§§		(7-53,000/LYG)
• Colorectal Screening	Underuse	§§§		(10-40,000/LYG)
Mental Illness			55,979	
• Depression Meds	Underuse	§§		Neutral
Hypertension			44,312	
• Drugs	Underuse	§§		(1075-100K/LYG)
• Drugs	Misuse	§§		3000
Diabetes			33,352	
• Annual Eye Exam	Underuse	§		(2700/QALY)
• Disease Management	Underuse	§		Neutral
Back Problems			29,227	
• Back Surgery	UV	§§§		954 m
• Imaging	Overuse	§		300
Acute Resp Infections			14,849	
• Antibiotics	Overuse	§§§		1120*
Asthma			14,260	
• Controller Meds	Underuse	§§§		2500
Gyn Conditions			13,671	
• Hysterectomy	Overuse	§	2,450	318.5**

Multiple Conditions			2,000,000	
• Wasted Medications	Misuse	§		1270
• Non Urgent ED Use	Overuse	§§§		21400
• Adverse Events		§§§		46500
• Unexplained Variation in Treatment	UV	§§§	17,670	5380*

* Does not include costs of additional lab tests.

** Overstated because it includes malignancies.

† Medical Expenditure Panel Survey, 2003.

†† All costs/savings adjusted to 2006 dollars and populations, using 10 yr average Medical CPI of 4.2%/yr, in $US millions.

Appendix D: Literature Review Methodology

Each article chosen for inclusion was reviewed and abstracted by a physician using a standard data instrument, and the results were stored in a master database. Key data elements recorded in the master database included:

1. Condition studied;

2. Service category studied:
   a. Drugs;
   b. Imaging;
   c. Lab Tests;
   d. Outpatient visits;
   e. Hospital services, including ED;
   f. Invasive procedures;

3. Waste Mechanism:
   a. Overuse;
   b. Underuse;
   c. Misuse;
   d. Unexplained variation;

4. Study Design;

5. Internal and external validity score;

6. Sample size; and

7. Bibliographic data.

Many articles addressed multiple conditions, service categories, or waste mechanisms, providing examples of waste comprising different combinations of conditions, services, and mechanisms. We therefore categorized articles into "unique examples of waste" that considered unique combinations of the three parameters. For example, an article focused on overuse of antibiotics in pharyngitis and otitis media was recorded as providing two examples of waste, overuse of antibiotics in otitis media and overuse of antibiotics in pharyngitis. We assigned each example of waste to a Major Diagnostic Condition, based upon the AHRQ MDC system. Many articles addressed broad processes of care delivery and were unable to be readily categorized into the MDC system, so we created additional MDCs to accommodate Multiple Conditions and Ambulatory Care Sensitive Conditions.

A series of univariate, bivariate, and multivariate analyses were prepared to allow examination of several parameters.

BY WASTE MECHANISM

Overuse	169
Underuse	287
Misuse	30
Unexplained Variation	106

BY SERVICE CATEGORY

Drugs	313
Imaging	61
Lab Tests	61
Visits	78
Hospitalizations	60
Surgery/Procedures	94

BY MDC

Nervous System	6
Eye	2
Ear, Nose, Mouth, Throat	33
Respiratory System	77
Circulatory System	155
Digestive System	22
Hepatobiliary System	0
Musculoskeletal System	20
Skin and Breast	16
Endocrine System	16
Urinary System	14
Male Reproductive System	5
Female Reproductive System	8
Pregnancy and Childbirth	5
Newborn and Neonatal Period	0
Hematological System	0
Multiple Cancers	7
Antibiotic Resistance	2
Mental Disorders	22
Alcohol and Drug Dependency	1
Adverse Treatment Effects	29
Healthy Behaviors Services	1
Trauma and Burns	12
HIV/AIDS	5
Multiple Medical Conditions	57
Potentially Avoidable Hospitalization	12
Preventive Services/ Cancer Screening	60
Dental Disease	

BY SERVICE CATEGORY AND WASTE MECHANISM

	Overuse	Underuse	Misuse	Unexplained variation
Drugs	75	175	21	31
Imaging	23	21	0	15
Lab Tests	12	32	1	7
Visits	29	27	2	14
Hospital Services	16	10	1	22
Procedures	21	47	0	39

Lastly, a multivariate analysis of condition, service category, and waste mechanism was performed. The results are shown in Table 1 of this appendix.

Using the multivariate analysis, we were able to identify individual "clusters of evidence" that each addressed a unique condition/ service/ mechanism combination, such as underuse of inhaled steroids in asthma. The strength of evidence supporting each cluster of evidence was then estimated, considering the quality of individual articles comprising the cluster, the sample size and number of articles, the potential for the findings to be generalized to other populations, and the consistency of findings across articles. Grades of weak, moderate, or strong were assigned.

Table 1

	Drugs				Imaging				Lab				Office Visits				Hospitalization				Surgery - Procedure			
	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV
Abdominal	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Acne	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ACSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	7	0	2	0	0	0	0
Acute Abdominal Pain	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
ADEs, Falls, Decubiti, Delerium, Periop Complications	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
ADHD	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
AIDS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anesthesia Services	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anxiety	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Appendicitis	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Arthritis / Joint Condition	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Asthma	1	1	20	2	0	0	0	0	0	0	1	0	0	0	2	0	0	0	3	0	0	0	2	0
Bacterial Endocarditis	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bladder Cancer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Breast Cancer	0	1	4	0	0	2	6	3	0	0	0	0	0	0	2	0	0	1	1	0	0	0	4	3
Bronchiolitis	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bronchitis	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burn Injury	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
C Sections	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
C Spine	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAD	0	0	11	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	8	3
Carotid Stenosis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Cervical Cancer	0	0	0	0	0	0	0	0	0	3	4	0	0	1	2	0	0	0	0	0	0	1	0	0
CHF	0	1	10	1	0	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Childhood Immunizations	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Chlamydia	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CNS Cancers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Colorectal Cancer	0	0	0	0	0	0	1	0	0	0	5	0	0	0	1	0	0	0	0	2	0	0	7	3
COPD	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Croup	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CT, MRI, PET Imaging	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cystic Fibrosis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depression	1	1	6	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Diabetes	0	0	8	0	0	0	0	0	0	0	2	0	0	0	1	1	0	1	0	0	0	0	2	0
Diabetes, Hypertension, CHF, Hyperlipidemia	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diabetes, MI, Pneumonia, Stroke, CHF, Breast Cancer	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Diabetic Nephropathy	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
DVT	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Dysrhythmia	0	1	11	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0
EOL Care	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1
ESRD	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Gastroenteritis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
GERD	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GI Disease	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glaucoma	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Heart Conditions	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hepatitis C	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hip Fracture	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Hip Fractures	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Hip, Knee, Spine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Hyperlipidemia	0	0	12	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Hypertension	0	0	9	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Hypochondriasis	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Imaging Overuse and Risks	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Influenza	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Intracerebral Hemorrhage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
LBW Infants	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1 Continued

	Drugs				Imaging				Lab				Office Visits				Hospitalization				Surgery - Procedure			
	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV	Misuse	Overuse	Underuse	UV
Low Back Pain	0	0	0	0	0	2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Lung Cancer	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lung Cancer, Breast Cancer, Prostate Cancer, Colorectal Cancer	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
MI	0	1	26	5	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	3	0	1	7	10
MI, Hip Fractures, Colorectal Cancer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
MI, Pneumonia, Heart Failure, 18 JCAHO Measures	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Multiple Ambulatory Conditions, ADE	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Multiple Cancers	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
Multiple Conditions	11	8	7	5	0	7	3	5	1	2	5	5	1	8	4	6	0	1	1	5	0	7	2	7
Musculoskeletal Conditions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
NI Pregnancy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
NOS	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nosocomial Infection	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osteoporosis	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Otitis	1	6	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Pain, NOS	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pedi ACSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Pedi Preventive Care	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Peptic Ulcer Disease	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pharyngitis	1	10	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0
Pneumonia	0	3	8	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1
Prenatal Care	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Pressure Ulcer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Preventive Care	0	0	0	0	0	0	2	0	0	0	2	0	0	0	5	1	0	0	0	0	0	0	0	0
Prostate Cancer	0	0	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1
Pyloric Stenosis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Renal Failure Due to HIV	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Routine Physical Exams	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0
Sarcoidosis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Schizophrenia	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shoulder Pain (Chronic, Atraumatic)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sinusitis	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smoking Cessation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Stroke	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Supply Sensitive Services	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Traumatic Brain Injury (TBI)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Tuberculosis	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
URI	0	19	0	1	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
UTI	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vision Screening	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Wounds	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	21	75	175	31	0	23	21	15	1	12	31	7	2	21	27	14	1	16	10	20	0	21	47	39

Appendix E: Landscape Methodology

Individual condition, service, and mechanism clusters were assigned a strength of evidence score of strong, moderate or weak, and potential savings resulting from elimination of the cluster as a source of waste were calculated using standard discounting methods. Savings estimates were, whenever possible, based upon published analyses, although in many cases it was necessary to develop savings estimates by combining elements from more than one published source. All savings estimates were net of the projected cost of interventions required to correct the source of possible waste. Because we chose to estimate net savings, our savings estimates are, by design, sensitive to variation in intervention costs.

Clinical inefficiency results from two resource allocation problems: spending that can be eliminated without affecting quality (waste), and spending that increases both overall cost and quality. Many evidence clusters that were considered did not result in clinical waste in spite of improving clinical quality. These interventions were often highly cost effective, but did not result in net cost savings. In the case of β-blockers post MI, we performed a rudimentary sensitivity analysis based upon findings of Phillips et al. We found that the incremental cost effect of achieving universal compliance with recommendations ranged from a net saving of $280 million per year at a drug cost of $50/year to an actual cost of $4500/Quality Adjusted Life Year (QALY) gained at the prevailing drug cost of $452/year. Whenever available, we relied upon data from the CEA Registry at Tufts University (available online at www.tufts-nemc.org/cearegistry) to inform our analyses of other examples of cost effectiveness rather than attempting to replicate prior analyses ourselves.

The focus of this report is waste. The landscape included in the findings report plots clusters of evidence that can potentially decrease costs. Appendix 5 provides a more complete landscape and supporting document which includes evidence of interventions that might be expected to significantly increase clinical quality (although this presumption remains untested in the case of some interventions such as prostate cancer screening and other recommended screening strategies). Cost-effectiveness is critically important and considers relevant interventions that provide an important “bang for the buck”. Suboptimal resource allocation decisions underlie a significant portion of medical inefficiency, but these poor decisions are not the focus of our current work. The interested reader, however, is referred to one of the standard texts addressing cost-effectiveness analysis, such as *Cost Effectiveness in Health and Medicine* (Gold, Siegel, Russell, and Weinstein) or *Using Cost-Effectiveness Analysis to Improve Health Care: Opportunities and Barriers* (Neumann).

In order to make meaningful comparisons of savings, it is necessary to adjust for differences in populations and the time value of money. All cost estimates were made using 2006 populations and dollars. U.S. Census population data were used to estimate both the total and Medicare populations in the year of the reported findings, and to adjust the findings to be inclusive of the estimated 2006 population. Reported costs and savings were adjusted to reflect estimated costs

in 2006 dollars using the 10 year average of the Medical Component of the Consumer Price Index, using standard discounting procedures.

Cardiac intervention and back surgery cost savings were calculated using published data from the Center for Clinical Evaluative Sciences at Dartmouth Medical School. We analyzed the rates of the procedures for each of 306 Hospital Referral Regions, and calculated median (50th percentile) national rates. We then modeled the effect of an intervention that would decrease utilization in regions currently performing above the median rate to the median, without changing utilization in regions below the median. Evidence suggests that the optimal utilization rate is most likely much lower than the median rate, but this model is thought to provide a conservative estimate of what might be possible. Published Dartmouth cost data were used to determine spending in both the intervention and non-intervention groups, resulting in an estimate of the cost savings from eliminating variation in the upper half of the distribution. Because the published studies focused on the Medicare population only, we developed Medicare/non-Medicare ratios based upon Milliman data and extrapolated the results to the total population. Finally, as already discussed, the estimates were adjusted to 2006 populations and dollars.

Two additional limitations of the methodology warrant mention. In the case of hysterectomy, we were unable to obtain data that separated costs into those attributable to benign versus malignant disease, and therefore believe that our estimate is overstated. In the case of avoidable antibiotic use for URI, we did not include the costs of rapid point of service testing because we could not reliably determine what percentage of patients would be suspected of having streptococcal infections and warrant testing versus what percentage would have a low probability and not require testing.

Lastly, we did not attempt to reproduce cost saving estimates for the care of chronic medical conditions addressed by Fisher et al in the same manner that we analyzed cost savings for cardiac and back surgical procedures. However, we did use estimates of avoidable costs and total spending included in those reports to predict cost savings resulting from eliminating variation.

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