

**Linking Health Information Technology to Patient Safety and Quality Outcomes:  
A Bibliometric Analysis and Review**

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**Abstract**

*Objective:* To assess the scholarly output of grants funded by the Agency for Healthcare Research and Quality (AHRQ) that published knowledge relevant to the impact of health information technologies on patient safety and quality of care outcomes.

*Study design:* We performed a bibliometric analysis of the identified scholarly articles, their journals, and citations. In addition, we performed a qualitative review of the full-text articles and grant documents.

*Data collection/extraction methods:* Papers published by AHRQ-funded investigators were retrieved from MEDLINE; journal impact factors were extracted from the 2010 Thompson Reuters Journal Citation Report; citations were retrieved from ISI's Web of Knowledge and Google Scholar.

*Principal findings:* Seventy-two articles met the criteria for review. Most articles addressed one or more of AHRQ's outcome goals and focus priorities. The average impact factor for the journals was 4.005 (range: 0.654 - 28.899). The articles, and their respective grants, represented a broad range of health information technologies.

*Conclusions:* This set of AHRQ-funded research projects addressed the goals and priorities of AHRQ, indicating notable contributions to the scientific knowledge base on the impact of information system use in health care.

## **Introduction**

Health information technology (health IT) refers to an enormously diverse spectrum of technologies that transmit and manage health information for use by consumers, providers, payers, public health officials, and other key stakeholders across the health care enterprise [1].

Health IT was promoted to a central position in the health reform political dialogue in 2004 when President Bush announced a strategic initiative to radically increase the adoption of electronic health record (EHR) systems in America [2]. President Obama and the U.S. Congress have also advanced health IT as a top priority, integrating it into health care reform and investment initiatives, including the American Recovery and Reinvestment Act of 2009 (ARRA) and Health Information Technology for Economic and Clinical Health (HITECH) Act.

Despite many efforts across public and private sectors to increase the adoption of health IT systems, adoption of sophisticated IT systems in health care remains much lower than in industries such as banking and manufacturing. When surveyed, physicians often report that costs and complexity are barriers to greater adoption and use of IT systems [3,4]. However, another major barrier is the lack of a clear linkage between the use of IT systems and improved health care outcomes [5]. Several recent systematic reviews have concluded that the evidence demonstrating a positive impact of EHR and other health IT systems on improvements to health care delivery processes (efficiency) and patient outcomes (effectiveness) is mixed [6-9]. Such findings leave many in health care and policy confused about the likely impact of widespread use of health IT systems across the U.S. health care system.

The gap between anticipated benefits of health IT and available evidence on the use of health IT in real-world clinical settings was one of the motivations that spurred the Agency for Healthcare Research and Quality (AHRQ) to create its Transforming Healthcare Quality through Information Technology (THQIT) initiative in late 2003 through the publication of four distinct yet related Requests for Applications (RFAs). These RFAs invited organizations to submit research proposals to address the stated goals of the THQIT initiative. When these RFAs were published, AHRQ's long-term outcome goals included:

- Support the successful deployment of hospital health IT systems that reduce medical errors and improve patient safety;
- Increase the identification and reporting of medical errors and adverse events;
- Decrease the number of actual errors and adverse events;
- Increase the number of hospitals utilizing electronic health records (EHRs) and computerized provider order entry (CPOE) with clinical decision support systems (CDSS); and
- Increase the number of non-hospital providers utilizing EHRs and CPOE with CDSS [10].

This paper analyzes the published findings of the Demonstrating the Value of Health Information Technology (HS-04-012) grantees, referred to as the THQIT Value grantees[10], and builds on previous programmatic analyses of the THQIT grants [11,12]. The primary purpose of this RFA was to fund research projects to increase knowledge and understanding of the value of health IT

to improve patient safety and quality of care outcomes. In this paper, we use bibliometric and qualitative methods to review the output of the THQIT value grant recipients.

Although a number of federal agencies, including the National Library of Medicine, the Department of Defense, the Veterans Administration, the Centers for Disease Control and Prevention, and others have actively funded and promoted health IT for decades, the AHRQ THQIT Value RFA was one of the first attempts by the Federal government to sponsor health IT implementation and use projects in rural hospitals and community healthcare settings to measure the value of health IT across settings with a diverse group of key stakeholders.

For the purpose of the THQIT Value RFA solicitation, value was "defined as clinical, organizational, financial, or other benefits derived from the adoption, utilization, and diffusion of HIT less the costs of achieving these benefits." [10] However, the projects did not need to show a return-on-investment but rather demonstrate that improvements in care delivery and other processes and outcomes could be made with the anticipated realization of cost savings.

In September 2004, twenty-four value grants were awarded. These grants had funding for three years, with potential for no-cost extensions. Four of the grants concluded in the fall of 2007 after three years; sixteen grants exercised their option for a fourth no-cost extension year and concluded in the fall of 2008; and in the fall of 2009, the four remaining grants, that had experienced challenges early on, concluded.

The value grants involved a variety of health IT applications, disparate healthcare settings, and diverse groups of key stakeholders. In addition, there were a number with research focusing on rural and small community hospitals or community healthcare settings, priority settings for AHRQ. The THQIT RFA included specific requirements and goals for these grants. The investigators were "expected to produce evidence, tools, models, and other information or resources that can be utilized by public and private entities to improve the safety, quality, effectiveness and efficiency of health care." [10] Further, they were expected to pursue dissemination strategies including, but not limited to, presentations at annual meetings and/or publishing in peer reviewed journals.

Given the expectation of AHRQ that these awards would result in peer reviewed literature to inform future research and health IT implementation, we performed a bibliometric analysis and review of the peer reviewed publications from THQIT Value grantees. While the projects are not homogeneous, they offer a broad view of the outcomes of the AHRQ solicitation and present the results of health IT evaluation in settings beyond large academic medical centers traditionally associated with health IT development and evaluation [13] , including a variety of small and large organizations in both urban and rural areas. This article analyzes the connection between health IT and patient safety and quality outcomes using bibliometric methods, examining the grantees' contribution to the evidence base on health IT using impact factors of the literature, categorizing that output using medical subject headings (MeSH) [14], and comparing grant outputs with the original goals of the AHRQ THQIT portfolio and Value RFA. We aim to better understand whether the grantees met the goals set forth by AHRQ as well as the impact of these grants to demonstrate the value of health IT on patient safety and quality of care.

## **Methods**

For the purposes of this article, only the peer-reviewed publications meeting the criteria described below were selected. Of the 24 THQIT Value grants, six grants (25%) did not have eligible peer-reviewed papers for consideration at the time this manuscript was prepared. Some THQIT projects, especially those concluding more recently, have few or no peer-reviewed publications. These investigators may have forthcoming articles. More information about all of the THQIT Value grants can be found at the AHRQ-Funded Projects section of the National Resource Center for Health Information Technology website ([www.healthit.ahrq.gov](http://www.healthit.ahrq.gov)).

To identify the scholarly output of the THQIT Value grants, four separate MEDLINE searches were conducted by two of the researchers. With over 21 million citations, MEDLINE is the premier literature database for the biomedical and life sciences. As the goal was not a systematic review, the breadth and depth of MEDLINE was deemed sufficient to locate the articles published by the AHRQ investigators. THQIT Value grant Principal Investigator(s) names were the primary search terms. We examined MEDLINE for any journal articles published by one of the THQIT Value grantee authors between 2004 and mid-October 2010. The bibliographic results of these searches were then compared against the publications listed in the grantees' annual summary reports for concurrence. Full-text articles were obtained for all potential bibliographic citations. Several of the principal investigators with long standing research in related content areas had numerous articles on the topics of their grants. To limit the scope of

the review, only those articles that specifically cited the authors' respective THQIT Value grants were included.

In several instances, the MEDLINE searches identified articles that were not indexed by AHRQ's National Resource Center (NRC) for Health IT website ([www.healthIT.ahrq.gov](http://www.healthIT.ahrq.gov)), tasked by AHRQ to gather grantees' dissemination products, or identified by grantees in final and annual reports to the Agency. We further discovered that some of the articles listed in the grantee-generated project summaries, while relevant to the work performed during the respective THQIT Value grant, actually reflected work supported by other grants. These publications were excluded from this bibliometric review.

Of the original set of potential articles, 72 met the inclusion criteria. Two of the researchers evaluated the articles to determine which agency goals were addressed. Disagreements were resolved through consensus. AHRQ agency staff had previously assisted in reviewing the categorical breakdowns and provided feedback to the team. The analysis determined that 14 articles focused on relevant contextual issues related to health IT implementation and measuring improvement in quality of healthcare. While informative and applicable to health IT implementation and evaluation, the articles did not contain evidence related to the implementation or use of a given health IT system or applicable outcomes. The articles ranged from identification of factors contributing to medical errors to an analysis of the financial environment for rural hospitals. These articles provide a foundation for the implementation and evaluation of health IT and were retained for analysis of the RFA grants with respect to meeting AHRQ portfolio goals.



The remaining 58 articles were reviewed by two of the researchers to determine the relationship of the research output to the four areas of value defined in the AHRQ Value RFA: Clinical - including medical errors, effectiveness, clinical decision support systems; Organizational - including access to health care and coordination of care; Financial - including costs and productivity; and Other - including patient satisfaction, transparency, readiness for health IT adoption, etc., and the five long-term goals of the larger THQIT initiative. The review employed content analysis techniques whereby key concepts from taxonomy of health IT developed by the NRC [15] were abstracted from each article. The concepts were mapped to one or more of the RFA or THQIT goals for calculating totals across the thematic categories.

In addition to analyzing the grant output in relation to goals set forth by AHRQ, we employed bibliometric techniques to classify and examine the value grant scholarly outputs. The researchers analyzed the MeSH terms used in MEDLINE to organize the articles within the larger collection of biomedical knowledge. We classified the value grants using the NRC taxonomy [15] to explore the types of health IT systems studied by grant investigators. We further analyzed the 72 articles using journal impact factors obtained from the Thompson Reuters Journal Citation Report (JCR) and statistics such as publications rates over time.

An additional citation analysis was done using the following methods: to find citations, we looked in ISI's Web of Science using both the Cited Reference and the Search options to locate the articles and the number of times they were cited. The resulting citations were classified into non self-cites and self-cites (a self-cite is where an author cites a paper in which they are an

author). Additionally, using the Google Scholar citing feature for the article titles added additional (unique) non self-cites and self-cites. Although books and dissertations can be included in the Google Scholar citations, we only counted the peer-reviewed journal article citations that could be verified.

The bibliometric analysis and review activities produced a variety of data and information that was discussed and collated by the research team. The results, described in detail below, provide a picture of the THQIT Value grant output both in relation to AHRQ goals as well as contributions to the ever growing body of evidence on the impact of health IT to patient safety and quality of care.

## **Results**

Table I shows the categorization of the THQIT Value grant publications based on *a priori* goals set forth by AHRQ. Many of the articles addressed at least one of the goals and priorities, while some addressed more than one.

INSERT Table I

In addition to specific health IT-related goals, AHRQ was interested in supporting greater adoption and use of health IT in rural areas. The articles were analyzed as to whether the research focused on rural and/or urban populations. A few articles dealt with both urban and rural populations; 47 of the articles focused on urban populations; sixteen focused on rural

settings; 21 did not specify. The health care settings were classified into the hospital emergency department, in-patient health care, ambulatory care, long term care, and other areas such as pharmacy or education. Ten articles focused on the emergency department, 39 on in-patient facilities, 20 on ambulatory care, eight on long term care, and seven on other settings, primarily pharmacy based. A cumulative analysis of the settings, including the multiple settings with the urban and rural designations, is found in Table II.

INSERT Table II

### **MeSH Classifications**

The MEDLINE focused subject headings, assigned MeSH terms by a professional librarian, of each article were found to be broad and diverse. Nine articles had the subject of "decision support, clinical;" eight articles had the subject heading of "medical records systems, computerized;" and five articles had the subject heading of "diffusion of innovation." Four articles shared the same three subject headings and ten articles shared the same two subject headings. Of the 84 total subject headings identified, 67 were unique.

### **Health IT Taxonomy Classifications**

The value grants are a set of projects focused on the use of a wide range of health IT systems and approaches. There were 41 total concepts from the National Resource Center's taxonomy of health IT applicable to the 24 value grantees. On average the grants pertained to 1.64 categories.

Thirteen projects examined clinical decision support components or systems; seven studied computerized provider order entry; five examined the exchange of health information across provider locations; three focused on telehealth applications; one studied medical imaging systems; one examined personal health records; and one looked Web-enabled education of patients. The full range of projects is summarized in FIGURE I.

INSERT Figure I

### **Publication Rates over Time**

Value grant publications increased over time. Nine articles were published in 2006 as compared to 19 articles in 2008. The grantee publications over time are summarized in FIGURE II.

INSERT Figure II

### **Impact on the Health IT Literature**

The Impact Factor is one measure of influence particular journals may have in their fields or disciplines as well as the quality of the articles therein. The average impact factor for a journal that published an article from a THQIT value grant investigator was 4.005, and the average article influence score for a paper from a THQIT value grant investigator was 1.653 (N=58 articles).

A total of 38 different journals published the 72 papers that acknowledged an AHRQ Value grant. The AMIA Annual Symposium Proceedings published the highest number of articles, six, but is not included in ISI's JCR (neither is Studies in Health Technology and Informatics, with three articles). The top 15 journals that published more than one of the AHRQ Value Grant papers are summarized in Table III. The Journal of the American Medical Informatics Association (JAMIA) and the Journal of Biomedical Informatics (JBI) were the only two journals officially recognized by JCR as a "Medical Informatics" journal. Pediatrics and JAMIA had the highest impact factors. Six other journals had higher impact factors but only had one paper published in each: JAMA (28.899), Archives of Internal Medicine (9.813), Neurology (8.172), Annals of Surgery (7.9), Canadian Medical Association Journal (CMAJ) (7.271), and Critical Care Medicine (6.373).

INSERT Table III

### **Citation Analysis**

Using ISI's Web of Science and Google Scholar, we identified the 72 papers that acknowledged AHRQ value grants. For these 72 papers, two papers were cited >30 times, 11 papers were cited >9 times, 29 were cited 3-9 times, and 30 were cited <3 times.

The AHRQ Value grant papers were cited a total of 376 times. Of the 376 citations, 21.5% were self-citations. Using ISI's Web of Knowledge, we identified 221 citations (58.8%), some of which were also found through Google Scholar (GS) but were not double-counted. Unique citations found through GS totaled 155 (41.2%).

Additional, detailed citation analysis was performed for certain groups of articles based on their MeSH or health IT taxonomy classifications. The detailed citation analysis is summarized in Table IV. Our goal was to review important groups of papers most germane to the *a priori* goals and priorities set forth by AHRQ.

INSERT Table IV

The six categories that aligned with AHRQ's *a priori* goals were Decision Support, Medication/ePrescribing, Cost Issues, Patient-Centered Approaches and Systems, Quality of Care, and Patient Safety. A total of 35 papers (48.6% of the 72 papers) were represented across these categories, with the number per category ranging from two to eight papers. The categories with the highest number of papers (eight each, Medication/ePrescribing and Patient Safety) also had the two highest citation rates (74 and 24, respectively). However, the category with smallest number of papers, Cost Issues, did not have the least amount of citations. Citations per paper ranged from 1.33 (Patient-Centered Approaches) to 9.25 (Patient Safety). Impact factors for the citing articles ranged from 0.967 (Patient-Centered Approaches) to 9.813 (Patient Safety).

Other papers identified in the review but for which we did not perform a detailed citation analysis because their content did not align with AHRQ's *a priori* goals, include the following, categorized under headings created by the authors:

- Transitions and Handoffs [50,51]
- Evaluation of Health IT [52-67]
- Foundations of Health IT [68-81]

- Commentaries [82-86]

### Discussion

In this paper we examine the set of AHRQ-funded grants that were designed to address the knowledge gap between the expected benefits of health IT and the measured benefits of health IT systems in use by real-world clinicians. Using bibliometric methods, we present the impact to date of these grant's scholarly output on the health IT knowledge base. We further categorized and reviewed the articles to explore whether the grants met the goals and priorities established by the funding agency.

The THQIT value grants are a diverse set of projects focused on implementing and evaluating a wide range of health information technologies. Previous examinations have also concluded the same [11,87]. The analysis here further reveals that the scholarly output of this set of grants is equally as diverse. The grants produced **72** peer-reviewed articles that correlate fairly well with the major goals and priorities of their funding agency. However, the outputs were unevenly distributed. Articles tended to focus on clinical and organizational impacts of health IT and less on financial outcomes. This is likely due to the fact that return-on-investment (ROI) and other financial analyses of health IT systems are complex and cumbersome as reported by the grant investigators early on in their grant cycle [11]. This means there may still be a gap in the knowledge base of health IT that warrants specific emphasis in a future RFA from AHRQ or another funder. Support for financial analyses may be a catalyst to address lingering concerns

for the financial sustainability of health IT present in repeated surveys of clinicians, hospital administrators, and others involved in the deployment and use of health IT systems.

In addition to addressing funding agency goals, the scholarly output of the THQIT value grants further represents a strong contribution to the shared knowledge base around health IT.

Publications from the value grantees generally grew over time with the majority of publications in the final years of the grant lifecycle. Many of the journals publishing THQIT value grant articles are high quality, high impact journals. This is likely due to the overlap of THQIT and AHRQ goals with well established health research areas such as Quality of Care, Patient Safety, and Medications. Journals that focus on these areas have been in existence for many years and therefore have a broad audience that reads and cites articles from those journals. Further evidence of overall impact was found in the many value grant papers that were cited by multiple subsequent publications, many of which themselves were published in high impact journals. Few of citations (21.5%) were self-cites, indicating that other biomedical and informatics scholars perceived value in the evidence published by the value grantees. The data from the citation analysis in total demonstrates that the grants produced knowledge generally viewed to be of high quality.

The Patient-centered Application and Systems category, however, is the one exception to the generally high level of quality and impact for THQIT value publications. In this category, the overall rate of citations per paper was the lowest (just over 1 citation per paper) and the impact factors were also on the low end of the overall range (0.967 to 2.956). The proportion of self-cites was also much higher (50%). These data may suggest that journals that publish articles focused on patient-centered approaches in informatics are younger and that fewer informatics



scholars are publishing on patient-centered systems. This would then indicate that these THQIT value grant publications are contributing to a relatively new but maturing body of evidence on patient-centered approaches related to health IT and that such funding from an agency like AHRQ is necessary to continue support for these types of applications and research.

This study further raises some interesting findings relevant to those performing reviews and bibliometric analyses of the published literature. Our analysis of the MeSH terms used to classify the THQIT value grants revealed very few common terms. Although the grants and their respective papers were diverse in nature, one would expect to find in the list of subject headings one or more general terms applicable to health IT, such as “Medical Informatics;” “Decision Support Systems, Clinical;” or “Medical Records Systems, Computerized.” Therefore those identifying articles for a review may wish to amend their methods for searching Medline and similar indices to ensure they capture the broad range of papers applicable to a particular sub-discipline within the broad umbrella of health IT.

In addition, we found that only two of the most common journals that published value grant articles are officially recognized as “Medical Informatics” journals by JCR, and several common journals are not included anywhere in the JCR. Some bibliometric analyses exclusively utilize the JCR and its categorization of journals to analyze a portfolio of articles. This practice may compromise the validity of the analysis, especially in health informatics disciplines, given that the exclusive use of the JCR may exclude important sources of scholarly knowledge and evidence (such as the AMIA Annual Symposium Proceedings). Moreover, the JCR may wish to reconsider the journals included in its “Medical Informatics” category. While several journals,

like JGIM, are primarily clinical journals, several of those found in this set (e.g., Telemedicine Journal and e-Health) are principally focused on publishing health informatics evidence.

Furthermore, bibliometric analyses often use the Cited Reference or “Articles citing this one” feature available from ISI’s Web of Knowledge or a particular journal publisher. Nearly 40% of the citations we identified came from Google Scholar, indicating that the use of a multi-pronged method to identify and analyze citations may yield more accurate measures of an article’s true impact.

### **Limitations and Future Directions**

Six of the 24 Value Grant recipients did not have eligible peer-reviewed publications for analysis and other papers may be under review or in the formation phase, potentially limiting our ability to classify and quantify the total impact of the THQIT value grants. Further, it is recognized that impact factor grows with the length of time in print, particularly for seminal articles. It is likely too early to determine which, if any, of the articles examined in this study will be viewed as seminal in the future. Also, there is a growing recognition that open access journal publications are increasingly cited more. No attempt was been made to control for this phenomenon.

Furthermore, this review of the THQIT grants took a principally bibliometric approach, focusing on the classification of the grants and the impact factors of the publications. Our methods did not address the substantive findings or outcomes reported in each paper. A meta-analysis or systematic review of the THQIT value grants was beyond the scope of this project. However, such an analysis of the papers’ content would likely reveal insightful knowledge about the

lessons learned and evidence gathered by this unique group of investigators across multiple clinical settings and geographic locations. In particular, the value grants possessed a sizable number of projects that specifically examined clinical decision support and computerized provider order entry. The impact of THQIT value publications on the cumulative knowledge base for CDS and CPOE could potentially be significant given a general paucity of well-designed studies in these areas. Two recent reviews of CDS [88,89] examined 45 and 91 unique studies, respectively. We identified more than two dozen papers from value grantees that involved the use of health IT systems employing decision support techniques. Further analysis would be required to confirm what we suspect might be a major impact on the CDS and CPOE literature.

Finally, the THQIT value grants predominately examined health information technologies deployed in both inpatient and acute hospital settings. Therefore the contributions to the evidence base for health IT may be considerable, but it is absent knowledge relevant to the segment of the health care continuum that delivers proportionally the highest amount of care to the U.S. population, ambulatory care settings. This fact was recognized by AHRQ, so the agency published a follow-on round of RFAs in 2008 that specifically sought to fund health IT research on the use of information technologies in ambulatory care settings to improve quality and safety outcomes. This portfolio, referred to as the Ambulatory Safety and Quality (ASQ) grants, will likely be the target of bibliometric and other analyses in the future. A future initiative might also consider comparing the ASQ and THQIT portfolios or examining a combined portfolio of research funded by AHRQ to address quality and safety issues relevant to the adoption and use of health information technologies.

## **Conclusions**

AHRQ's Transforming Healthcare Quality through Information Technology (THQIT) Value grants have resulted in a wide range of research projects designed to inform future health IT development and adoption and to provide a basis for linking health IT with healthcare quality and patient safety. These research projects have addressed the goals and priorities of AHRQ, and they have made significant contributions to the scientific knowledge base on the impact of information system use in health care.

**AUTHORS' CONTRIBUTIONS**

All authors qualify for authorship by their contributions to the manuscript. J. McGowan conceived and guided the overall study design. E. Whipple and J. McGowan contributed to the acquisition, analysis, and interpretation of the data. B. Dixon contributed to the analysis and interpretation of the data. All authors contributed to the drafting and revising of the article and approved the final manuscript.

**CONFLICT OF INTEREST**

The authors have no conflict of interest.

**ROLE OF THE FUNDING SOURCE**

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**TABLE I****AHRQ Priorities and Goals for the THQIT Value Grants**

| <b>EHRs = Electronic Health Records; CPOE = Computerized Provider Order Entry;<br/>CDSS = Computerized Decisions Support Systems; AC = Ambulatory Care</b> |                                 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| <b>Value RFA Priorities</b>                                                                                                                                | <b>Count of Articles (N=58)</b> |
| <u>Clinical</u> : Medical Errors; Effectiveness; CDSS                                                                                                      | 28                              |
| <u>Organizational</u> : Access; Coordination                                                                                                               | 16                              |
| <u>Financial</u> : Costs; Productivity                                                                                                                     | 10                              |
| <u>Other</u> : Patient Satisfaction; Transparency; Environment                                                                                             | 13                              |
| <b>THQIT Initiative Goals</b>                                                                                                                              |                                 |
| Reduced Medical Errors in Hospitals                                                                                                                        | 9                               |
| Increased Identification & Reporting of Medical Errors                                                                                                     | 1                               |
| Decrease in #s of Medical Errors & Adverse Events                                                                                                          | 12                              |
| Increase in hospital use of EHRs & CPOE w/ CDSS                                                                                                            | 16                              |
| Increase in #s of AC Providers using CPOE w/ CDSS                                                                                                          | 10                              |



**TABLE II****Health Care Settings for THQIT Value Grantees**

|                                                   | <b>Urban</b> | <b>Rural</b> | <b>Not Specified</b> | <b>Total</b> |
|---------------------------------------------------|--------------|--------------|----------------------|--------------|
| <b>Emergency Department</b>                       | 6            | 1            | 3                    | 10           |
| <b>In-Patient Facilities</b>                      | 15           | 15           | 9                    | 39           |
| <b>Ambulatory Care Facilities</b>                 | 17           | 0            | 3                    | 20           |
| <b>Long Term Care Facilities</b>                  | 8            | 0            | 0                    | 8            |
| <b>Other, including<br/>Pharmacy and Academia</b> | 1            | 0            | 6                    | 7            |
| <b>TOTALS</b>                                     | 47           | 16           | 21                   | 84           |

**TABLE III****Impact Factor for AHRQ Value Grant Papers**

| Frequency | Journal                                                          | Impact Factor |
|-----------|------------------------------------------------------------------|---------------|
| 6         | AMIA Annual Symposium Proceedings                                | n/a           |
| 5         | Journal of the American Medical Informatics Association: JAMIA * | 3.974         |
| 5         | Journal of General Internal Medicine: JGIM                       | 2.654         |
| 4         | Journal of the American Geriatric Society: JAGS                  | 3.656         |
| 4         | Journal of Biomedical Informatics: JBI *                         | 2.432         |
| 4         | Journal of Hospital Medicine                                     | 1.496         |
| 3         | Studies in Health Technology Informatics                         | n/a           |
| 3         | American Journal of Medical Quality: AJMQ                        | 1.5           |
| 3         | Journal of Rural Health                                          | 1.105         |
| 2         | Health Care Management Reviews                                   | n/a           |
| 2         | Informatics in Primary Care                                      | n/a           |
| 2         | Pediatrics                                                       | 4.687         |
| 2         | Quality and Safety in Health Care: QSHC                          | 2.803         |
| 2         | Telemedicine Journal and e-Health                                | 0.967         |
| 2         | Journal of Medical Systems                                       | 0.654         |

\* Denotes those journals classified by JCR as a “Medical Informatics” journal.

**TABLE IV****Citations for the Six Categories that align with the AHRQ Value Grant Goals**

|                                         | # of Papers | Overall cites | Cites per paper | Total non self-cites | Total self-cites | ISI cites | GS cites | Impact Factor Ranges |
|-----------------------------------------|-------------|---------------|-----------------|----------------------|------------------|-----------|----------|----------------------|
| Decision Support                        | 6           | 22            | 3.67            | 15                   | 7                | 13        | 9        | 2.432—3.974          |
| Medication/e-Prescribing                | 8           | 24            | 3               | 20                   | 4                | 12        | 12       | 2.654—3.974          |
| Cost Issues                             | 2           | 15            | 7.5             | 13                   | 2                | 12        | 3        | 3.656—3.974          |
| Patient-Centered Approaches and Systems | 6           | 8             | 1.33            | 4                    | 4                | 3         | 5        | 0.967—2.956          |
| Quality of Care                         | 5           | 15            | 3               | 10                   | 5                | 7         | 8        | 1.496—4.687          |
| Patient Safety                          | 8           | 74            | 9.25            | 66                   | 8                | 44        | 30       | 0.977—9.813          |

ISI = ISI Web of Knowledge

GS = Google Scholar

**Figure 1**

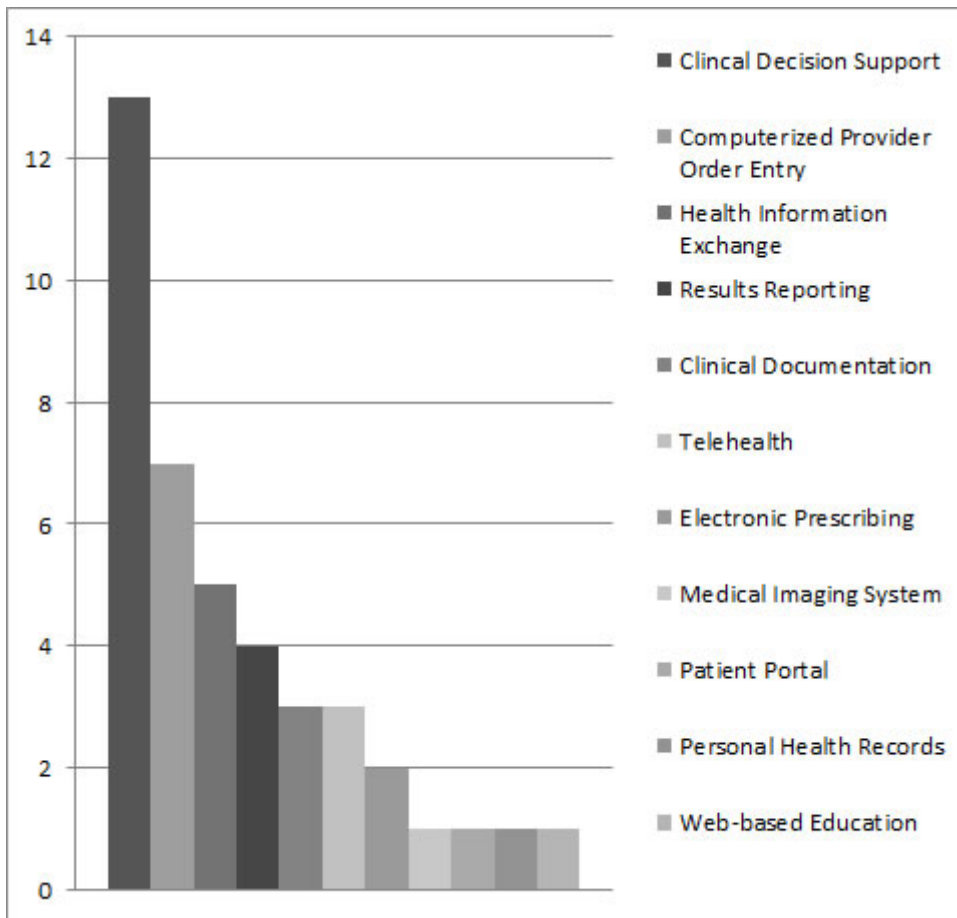


Figure 2

