



HEALTH

THE ARTS
CHILD POLICY
CIVIL JUSTICE
EDUCATION
ENERGY AND ENVIRONMENT
HEALTH AND HEALTH CARE
INTERNATIONAL AFFAIRS
NATIONAL SECURITY
POPULATION AND AGING
PUBLIC SAFETY
SCIENCE AND TECHNOLOGY
SUBSTANCE ABUSE
TERRORISM AND
HOMELAND SECURITY
TRANSPORTATION AND
INFRASTRUCTURE
WORKFORCE AND WORKPLACE

This PDF document was made available from www.rand.org as a public service of the RAND Corporation.

[Jump down to document](#) ▼

The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world.

Support RAND

[Browse Books & Publications](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore [RAND Health](#)

View [document details](#)

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND PDFs to a non-RAND Web site is prohibited. RAND PDFs are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see [RAND Permissions](#).

This product is part of the RAND Corporation technical report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

TECHNICAL REPORT

A Prototype Interactive Mapping Tool to Target Low Health Literacy in Missouri

Laurie T. Martin, Allen Fremont, Alexandria Felton,
Teague Ruder, Chloe E. Bird, Lisa Miyashiro,
Mark Hanson, Nicole Lurie

Sponsored by the Missouri Foundation for Health

This work was sponsored by the Missouri Foundation for Health. The research was conducted in RAND Health, a division of the RAND Corporation.

The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

© Copyright 2010 RAND Corporation

Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Copies may not be duplicated for commercial purposes. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. For information on reprint and linking permissions, please visit the RAND permissions page (<http://www.rand.org/publications/permissions.html>).

Published 2010 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665
RAND URL: <http://www.rand.org>
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Preface

An estimated 36 percent of American adults have health literacy levels rated at “basic or below,” indicating that they have difficulty obtaining, processing, and understanding basic health information and services. Limited English proficiency and linguistic isolation add to this problem. Households are defined as linguistically isolated if all members 14 years old and over speak a language other than English and speak English less than “very well.” Low health literacy (LHL) is thought to play a key role in racial/ethnic and socioeconomic disparities in health and healthcare.

This report describes a prototype interactive web-based mapping tool designed to help healthcare decisionmakers in Missouri identify neighborhood-level “hotspots” of suboptimal health or healthcare that may be due to LHL. The work is part of a multiphase project to develop a predictive model of health literacy and estimate levels of health literacy in small geographic areas (e.g., census tracts) using geographic information system (GIS) tools. The LHL project and resulting GIS tool are part of the RAND Corporation’s Q-DART effort, which applies emerging analytic and decision tools to better target gaps in the quality of care and health outcomes in diverse populations, helping decisionmakers more wisely allocate scarce resources.

This work was sponsored by the Missouri Foundation for Health and was carried out by RAND Health, a division of the RAND Corporation. More information about RAND Health can be found at <http://www.rand.org/health>.

Contents

Preface	iii
Figures and Tables	vi
Summary	viii
Acknowledgments	x
Abbreviations	xi
CHAPTER ONE	
Introduction	1
Challenges to Addressing Low Health Literacy and Health Disparities	1
Low Health Literacy Contributes to Suboptimal Care and Outcomes	2
Identifying People with Low Health Literacy Is Challenging.....	2
Community and Public Health Literacy	3
A Mapping Tool to Address Low Health Literacy and Health Disparities	4
Report Overview	4
CHAPTER TWO	
Interactive Web-Based Tool to Target Low Health Literacy	5
What exactly is this tool?	5
How will the tool help users?	6
Does this tool cover the entire state of Missouri?	7
How many indicators can the user map at once?	7
What is the technology behind this tool?	7
Why is this tool called a prototype?	8
How do stakeholders obtain this tool?	8
Example Scenarios of the Mapping Tool in Action.....	8
CHAPTER THREE	
Mappable Characteristics and Data Sources	15
Health Literacy Characteristics.....	15
Quality-of-Care Characteristics	16
Neighborhood Sociodemographic Characteristics.....	16
Selected Neighborhood Health Services Data	17
CHAPTER FOUR	
Next Steps	18

APPENDIXES

A. Missouri Health Literacy Mapping Tool: User’s Guide and Case Study:	
The Mapping Tool in Action	21
1. Getting Started	21
2. Main Map View	21
3. Indicator Mapping	23
4. Geographic Levels	30
5. Navigation Map	30
6. Toolbar Functions	31
7. Overview of Map Interactivity.....	37
8. Pop-Up Information Table.....	38
9. Special Information Table Tools	40
10. Customizing, Printing, and Exporting Maps.....	45
11. Customizable Information Tables.....	47
12. Advanced Functions.....	50
13. Case Study: The Mapping Tool in Action	53
B. Estimating Health Literacy	61
C. Data Source and Health Outcomes in Prototype Mapping Tool	66
D. Neighborhood Sociodemographic Characteristics and Health Services Data	68
E. Health Plan Data	70
References	71

Figures and Tables

Figures

2.1.	Sample Color-Coded Map Generated by Mapping Tool	6
2.2a.	Distribution of Diabetics in Missouri, by County.....	9
2.2b.	Number of Diabetics and Percentage of Diabetic Population That Checks Blood Sugar on a Daily Basis, by County	9
2.3.	Mean Health Literacy and Number of Individuals with Basic or Below Basic Health Literacy, by Census Tract.....	10
2.4.	Rates of Colon Cancer Screening, Medically Underserved Areas, and Locations of Medical Facilities in Northwest Missouri.....	11
2.5a.	Distribution of High Cholesterol in Missouri, by County	13
2.5b.	High Cholesterol in the Missouri Bootheel Compared with the State of Missouri	13
2.5c.	Quality of Care Report for Dunklin County	14
A.1.	Overview of Mapping Tool Functions.....	22
A.2.	Indicator Selector with Sample Indicators Chosen.....	24
A.3.	Sample Domain, Theme, and Indicator Selection for Shaded Analysis	25
A.4.	Configure Indicator for Shaded Analysis	26
A.5.	Shaded Analysis Frequency and Distribution Bar Charts.....	27
A.6.	Sample Domain, Theme, and Indicator Selection for Proportional Symbols Analysis.....	28
A.7.	Configure Indicator for Analysis by Proportional Symbols	29
A.8.	Changing Geographic Levels on the Map	30
A.9.	Navigation Map	30
A.10.	Navigation Tools.....	31
A.11.	Geographic Selection Tools.....	32
A.12.	Tools to Save and Reload a Project	33
A.13.	Tool to Import Data	34
A.14.	Map Customization Tools.....	34
A.15.	External Layer (WMS) Tool.....	35
A.16.	Loading a WMS Layer.....	36
A.17.	Selection Overlay Tool	36
A.18.	Pop-Up Box Displaying County Name and Value of Selected Indicator	37
A.19.	Scorecard of Selected Indicator	37
A.20.	Pop-up Information Table for Four Selected Counties.....	38
A.21.	Pop-up Information Table Tools.....	39
A.22.	Sample Report for Morgan County.....	41
A.23.	Report Toolbar Buttons.....	41
A.24.	Exporting Data to a Spreadsheet.....	42
A.25.	Temporary Selections Manager Window	43
A.26.	Subtraction Operation	44
A.27.	Regions Selected for Calculation.....	44
A.28.	Layout Mode for Customizing the Map.....	45

A.29. Annotation Tools to Customize the Map	46
A.30. Customizable Information Tables.....	47
A.31. Exporting Data from the Information Tables.....	48
A.32. Configuration Panel to Add an Indicator to the Information Table.....	49
A.33. Advanced Search Features	50
A.34. Steps to Loading External Data	51
A.35a. Map of the Percentage of the Population That Has Received Colon Cancer Screening	54
A.35b. Map of Counties Where Less Than 50 Percent of the Population Has Received Colon Cancer Screening.....	55
A.36. Map of Colon Cancer Screening and Percentage with Basic or Below Basic Health Literacy	56
A.37. Display of Seven Counties Meeting Search Criteria for Colon Cancer and Health Literacy	57
A.38. Map of Health Professional Shortage Areas	58
A.39. Map of Linguistic Isolation.....	59
A.40. Map of Hospitals.....	60

Tables

B.1. Selected Health Tasks, by Health Literacy Score	62
B.2. Results for the Predictive Models of Health Literacy	65

Summary

Over the past decade, providers and policymakers alike have recognized the need to shift from documenting the existence of gaps in quality of care and health outcomes to doing something about them. Numerous efforts have identified characteristics of individuals who are deemed to be “at risk” for poor health outcomes and lower-quality care, such as belonging to certain minority groups or having low income or low education. In addition, health literacy has emerged as a potentially critical pathway through which education, income, and other fundamental determinants impact healthcare quality and disparities. Health literacy is “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (Ratzan and Parker 2000). Individuals with low health literacy (LHL) have difficulty with tasks ranging from understanding directions for taking medication to navigating the healthcare system.

Many stakeholders recognize that achieving equity in the U.S. healthcare system requires addressing challenges related to LHL. However, efforts to translate such evidence into cost-effective actions and interventions have been only marginally successful. Identifying *geographic areas* with large numbers of people with LHL can help stakeholders target interventions more efficiently and cost-effectively. Such a population-based approach is especially attractive in view of the recent acceleration of interest in public health literacy, defined as “the degree to which individuals and groups can obtain, process, understand, evaluate, and act on information needed to make public health decisions that benefit the community” (Freedman et al. 2009), and the concomitant need to develop more multifaceted and population-based approaches to improving health. The feasibility and success of a population-based approach to addressing LHL and resulting health disparities, however, relies in part on the ability to identify geographic areas where large numbers of at-risk people live in order to determine effective types of interventions and optimal locations for implementation.

A Prototype Interactive Web-Based Tool to Target LHL

Stakeholders are in need of a tool to help them maximize the impact of limited resources available to address LHL and to target those resources toward communities at greatest need. In response, RAND developed a prototype interactive web-based mapping tool to help healthcare decisionmakers in Missouri identify community-level “hot spots” of suboptimal health or healthcare that may be due to LHL. This work is part of a multiphase project, sponsored by the Missouri Foundation for Health, to develop a predictive model of health literacy and to estimate levels of health literacy in small geographic areas (e.g., census tracts). The resulting tool incorporates the following data:

- ***Estimates of community-level health literacy.*** In an earlier phase of this project, we developed predictive models of health literacy using data from the National Assessment of Adult Literacy (NAAL) (Lurie et al. 2010; Martin et al. 2009). These models, when applied to census-derived variables for small geographic areas, provide an estimate of the percentage of individuals within that region with “basic” or “below basic” health literacy skills, as well as their mean NAAL scores.

Additional information on the NAAL and the development of the models can be found in Appendix B.

- **Health outcomes and care quality**, including breast and colon cancer screening and quality of diabetes care. These were obtained from Missouri's County Level Study (CLS).
- **Neighborhood sociodemographic characteristics** were obtained from the 2000 U.S. Census and the 2007 American Community Survey (ACS).
- **Neighborhood health services data** including medically underserved areas (MUAs), health professional shortage areas (HPSAs), and the locations of hospitals and federally qualified health centers (FQHCs), obtained from the American Hospital Association (AHA) and the Health Resources and Services Administration (HRSA).

Using GIS technology, this prototype tool presents the above data in the form of color-coded maps that quickly show stakeholders where individuals with different characteristics reside and where health or healthcare is suboptimal. This GIS mapping tool is part of RAND's Q-DART project, which applies emerging analytic and decision tools to better target gaps in the quality of care and health outcomes in diverse populations, helping decisionmakers more wisely allocate scarce resources.

By simultaneously mapping neighborhood levels of health literacy and low-quality care, stakeholders obtain a more empirically based understanding of the geographic distribution of these problems in and around their communities, helping to reverse the "inverse care law," which states that the availability of quality medical care tends to vary inversely with the need among the population served (Schillinger 2007; Tudor-Hart 1971). As such, this tool may not only help stakeholders target population health interventions in communities of greatest need (Lalonde 1974) but also support the development of tailored approaches to improving health among vulnerable populations (Frolich and Potvin 2008).

The interactive mapping tool allows stakeholders to select the level of geography (e.g., census tract, county), obtain information for and map specific regions of interest, select the characteristics to be mapped, generate tables and reports on the regions and characteristics of interest, import their own data, export data from the tool, and save and print their projects.

The prototype tool is housed on a dedicated RAND website, making it possible for a range of stakeholders, from health plans to community organizations, to access and use the tool to help address healthcare disparities in their communities.

Acknowledgments

The development of this prototype web-based tool would not have been possible without the assistance of individuals who helped to provide us with data on health outcomes and care quality. We appreciate the support and assistance of Janet Wilson and her colleagues at the Missouri Department of Health and Senior Services for providing us with the CLS data.

We are indebted to Mike Benigeri at Geo-Stat for his assistance in the refinement of the web-based tool, Elizabeth Maggio for her expert editing assistance, and Kathryn Derose and Dean Schillinger for their thoughtful review of and insightful feedback on the web-based tool and this report as part of RAND's quality assurance process. Finally, we would like to thank Arthur Culbert, Charles Gasper, and the Missouri Foundation for Health for their continued support of this work and dedication to advancing the field of health literacy.

Abbreviations

ACS	American Community Survey
AHA	American Hospital Association
BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance System
CLS	County Level Study
CEOS	Committee on Earth Observation Satellites
ERDAS	Earth Resources Data Analysis System
FPL	federal poverty level
FQHC	Federally Qualified Health Center
GIS	Geographic Information System
HEDIS	Healthcare Effectiveness Data and Information Set
HPSA	Health Professional Shortage Area
HRSA	Health Resources and Services Administration
LEP	limited English proficiency
LHL	Low Health Literacy
MSA	Metropolitan Statistical Area
MUA/P	Medically Underserved Area/Population
NAAL	National Assessment of Adult Literacy
NASA	National Aeronautics and Space Administration
PUMA	Public Use Microdata Area
SF3	Summary File 3 (U.S. Census)
WMS	Web Map Service

Introduction

To make appropriate decisions about their health, individuals need to be health literate, that is, they need the capacity to obtain, process, and understand basic health information (Ratzan and Parker 2000). Unfortunately, around 36 percent of American adults have health literacy levels classified as “basic or below”; only 12 percent are “proficient” (National Center for Education Statistics 2006). Low health literacy (LHL) remains a formidable barrier to reducing gaps in quality and improving outcomes of care; it costs the nation an estimated \$106 billion to \$236 billion annually (Vernon et al. 2007).

LHL tends to be more prevalent in certain minority groups, the elderly, and those with low income and education (Rudd et al. 2007; Weiss 2005). Consequently, LHL is thought to play a key role in racial/ethnic and socioeconomic disparities in health and healthcare. Related constructs of limited English proficiency and linguistic isolation are also critically important factors for states that have growing immigrant populations because language barriers may also compromise the quality of care individuals receive through decreased access to primary and preventive care services, decreased patient adherence, and diminished patient satisfaction. Households are defined as linguistically isolated if all members 14 years old and over speak a language other than English and speak English less than “very well.”

Challenges to Addressing Low Health Literacy and Health Disparities

Many stakeholders recognize that achieving equity in the U.S. healthcare system requires addressing the challenges related to LHL. However, efforts to translate such evidence into cost-effective actions and interventions have been only marginally successful.

Health departments, health plans, and other community organizations seeking to improve health and healthcare have been uncertain, and at times frustrated, about how to efficiently identify the types of problems contributing to gaps in quality of care and to effectively target appropriate interventions to those who need them most. One issue is the lack of precision of single demographic characteristics (e.g., ethnicity, education) to predict health literacy. Another is related to the administrative burden and inability of existing health literacy measures to estimate health literacy at the population level. As a result of these issues, LHL is largely unaddressed in public health and clinical practice.

Many stakeholders acknowledge that achieving healthcare equity requires eliminating disparities and addressing health literacy. Yet, efforts to use evidence about factors that contribute to disparities and translate that evidence into cost-effective actions and interventions have been only marginally successful. Several key issues have hindered stakeholder efforts to develop and implement disparity-reducing interventions related to LHL. These barriers include (1) lack of data on neighborhood-level health literacy and quality of care, (2) ineffective targeting of prior interventions, (3) lack of collaboration among key stakeholders, and (4) concern that future interventions may not work and thus not yield a positive return on investment. To overcome these barriers to action, stakeholders will need to be able to identify small geographic areas where large numbers of at-risk LHL people live in order to determine optimal locations for and types of interventions.

Low Health Literacy Contributes to Suboptimal Care and Outcomes

LHL may contribute to suboptimal care and outcomes in several ways. Studies have found, for example, that individuals with LHL find it difficult to understand directions for taking medicine and to calculate a dose of an over-the-counter medication (Fang et al. 2006; Kirsch 2001; Kirsch et al. 1993), which may result in poorer adherence to a medication regimen (Gazmararian et al. 2006; Lasater 2003; Win and Schillinger 2003). Individuals with lower reading skills are also less likely to engage in screening programs (Davis et al. 2001; Dolan et al. 2004; Lindau et al. 2002), to follow up after an abnormal test result (Lindau et al. 2006), and to comply with treatment protocols or preoperative instructions (Chew et al. 2004; Schillinger et al. 2002). Finally, individuals with limited literacy face significant challenges in navigating the health system, which involves a range of activities from finding and entering a health facility to making healthcare appointments, filling out needed forms, and giving their consent for procedures (Kirsch et al. 1993; Rudd et al. 2005).

LHL is also related to lower health knowledge. To achieve optimal health, individuals need at least some knowledge about their disease or treatment plan (DeWalt and Pignone 2005). Limited reading skills are not only associated with a limited understanding of the concepts of risk, probability, and chronicity (Arnold et al. 2001) but also with specific health risks, chronic diseases, and their associated treatment protocols (Gazmararian et al. 2003; Kalichman and Rompa 2000; Paasche-Orlow et al. 2005; Schillinger et al. 2002). Poor reading skills are also associated with poor knowledge of medicine, side effects, drug interactions, and dosing instructions (Davis et al. 2006; Fang et al. 2006; Kripalani et al. 2006). Combined, these knowledge gaps contribute to difficulties in effectively managing one's health.

Individuals with LHL may also be less likely to become actively involved in healthcare choices, referred to as participatory decisionmaking (Institute of Medicine 2003). Medical care is intimidating for individuals with low literacy (Baker et al. 1996), and many harbor a sense of shame that makes disclosure of their low literacy more difficult (Institute of Medicine 2004; Parikh et al. 1996). Further, limitations in oral and written communication make full participation difficult, and patients with limited health literacy may be less likely to challenge or ask questions of a provider (Baker et al. 1996; Fang et al. 2009; Paasche-Orlow and Wolf 2007; Schillinger et al. 2004). Finally, individuals with low literacy may have a poorer knowledge of health conditions, which limits their ability to take an active role in their care (Cooper et al. 2005).

Identifying People with Low Health Literacy Is Challenging

Even though a third of the adult U.S. population has health literacy skills that can be classified as basic or below basic, LHL remains a hidden epidemic. Individual-level assessments, including the Rapid Estimate of Adult Literacy in Medicine (Murphy et al. 1993), the Short Test of Functional Health Literacy in Adults (Parker et al. 1995), and the Newest Vital Sign (Osborn et al. 2007), can be time-consuming and resource-intensive to administer. Further, such individual-level assessments largely rely on healthcare system contact and are intended to support individual or facility-level interventions within a clinical or research setting. Such assessments in the healthcare setting do little to address the underlying causes of LHL (Freedman et al. 2009; Goldberg 2007) or to help providers think more broadly about prevention and how to address the social and environmental

conditions that may be placing their vulnerable patients at increased risk of health risks (Frolich and Potvin 2008).

While in isolated cases these assessments are being used to assess community-level literacy, these are massive undertakings, requiring a sophisticated sampling plan, significant resources to conduct in-person assessments of health literacy of a large portion of the community, and a sophisticated methodology to weight the results so that estimates are generalizable to the broader community of interest. Such efforts are not feasible for the majority of communities hoping to address health disparities related to LHL.

Another approach to assessing low health literacy is to identify residential areas that may include large numbers of people with LHL. Such population-based approaches are fast and relatively inexpensive, and they support population-focused interventions that may conserve resources. The tool described herein is a “platform for prevention,” providing opportunities for action so that geographic areas where intervention is a priority can be identified, which may in turn lead to shared interest and responsibility among stakeholders, efficient resource use, and a positive return on investment.

Community and Public Health Literacy

Although typically considered primarily at the level of the individual, health literacy is both an individual- and community-level concept. At the individual level, health literacy relates to individuals’ capacity to read and process information regarding their health and healthcare. At the community level, it describes the prevalence of low health literacy or the average health literacy in a given community or geographic area. Both are important determinants of health. From a constrained-choice perspective (Bird and Rieker 2008), individuals are affected or constrained not only by the upper limits of their own health literacy but also by the level of health literacy in their neighborhood and their social networks. For example, an individual with LHL who lives in an area with relatively high health literacy may benefit from the knowledge and abilities of his friends and neighbors to process health and healthcare information. In contrast, an individual with low health literacy who lives in a neighborhood or community where LHL is prevalent may actually receive counterproductive information from friends and neighbors who themselves may be less informed on current health practices.

Public health literacy has been described as an ethical imperative for public health agencies, organizations, and professionals (Gazmararian et al. 2005). It has been argued that public health literacy is made up of three dimensions: conceptual foundations (basic knowledge needed to fully understand and take action on health issues), critical skills (skills necessary to make public health decisions that benefit the community), and civic orientation (skills and resources necessary to address health concerns through civic engagement) (Freedman et al. 2009).

While there is a need to increase levels of public health literacy, the means by which this will happen remain largely unknown. While our prototype tool was not designed to build critical skills or conceptual foundations among individuals or populations, it does have the potential to promote civic orientation. The tool was designed to support decisionmaking and serve as a guide for appropriately targeting interventions. As a result, it may support the development of specific competencies related to civic orientation, including (1) garnering a better understanding of the ways in which resources, burdens, and benefits are distributed in a community; (2) providing a means to articulate those distributions across communities to other stakeholders and the communities themselves

(e.g., color-coded maps); and (3) addressing those inequities through action, leadership, and dialogue (Freedman et al. 2009).

While the focus of the tool is on health literacy, it provides additional information on neighborhood characteristics, quality of care, and neighborhood health services data. As such, the tool may help stakeholders target population health interventions in communities of greatest need (Lalonde 1974) and support the development of tailored approaches to improving health among vulnerable populations (Frolich and Potvin 2008). It is through the latter approach that stakeholders may work to change social and environmental conditions that cause people in these communities to be at higher risk of risks for poor health, thus decreasing health inequalities (Frolich and Potvin 2008).

In its current stage, the tool serves as a disruptive innovation, providing new insights as well as new questions. What remains to be seen, however, is whether having this information in this format actually leads to an improvement in civic orientation, a reduction in disparities, or an improvement in the health of vulnerable populations. Future work will assess its effectiveness and specific improvements to achieve these goals.

A Mapping Tool to Address Low Health Literacy and Health Disparities

RAND developed a prototype interactive web-based mapping tool specifically to help healthcare decisionmakers target neighborhood-level hot spots of suboptimal health or healthcare that may be due to LHL. This tool is an extension of our previous work for the Missouri Foundation for Health to develop a predictive model of community-level health literacy.

Report Overview

In Chapter Two, we describe the prototype mapping tool in more detail and demonstrate its power to help stakeholders address a wide range of important program and policy questions specific to their topic areas and geographic regions of interest. Although we demonstrate the utility of this prototype tool for Missouri specifically, similar tools can be developed for other states and geographic regions of interest.

Chapter Three provides a brief overview of the types of data included in the mapping tool and their respective data sources.

Chapter Four discusses next steps for how the tool may be further developed and refined.

A detailed User's Guide for the Tool is included in Appendix A. At the end of the guide is a case study demonstrating how stakeholders might use the tool to improve colon cancer screening in the state.

This report also includes the following appendixes related to the data selected for inclusion in the tool: Appendix B is a description of RAND's earlier work to develop predictive models of health literacy, on which the prototype interactive web-based mapping tool is based. Appendix C includes additional information on the quality-of-care outcomes and corresponding data sources used in the tool. Appendix D includes a description of neighborhood level sociodemographic characteristics and health services data. Although we did not include clinical quality-of-care data in this prototype tool, Appendix E describes the Healthcare Effectiveness Data and Information Set (HEDIS) data obtained both from health plans in Missouri and from Medicaid and potential next steps for inclusion of these data.

Interactive Web-Based Tool to Target Low Health Literacy

Reducing gaps in quality and improving outcomes of care will require researchers, clinicians, public health workers, and policymakers to address multiple challenges related to LHL. Maximizing the impact of limited resources available to address those challenges, however, requires effectively targeting those resources to individuals and communities in greatest need. In this chapter, we use a question-and-answer format to describe the prototype interactive web-based tool that we designed to assist Missouri stakeholders advance their efforts to address health disparities in the state.

It is important to note that this tool, in its current form, is best thought of as a prototype. Data included in the tool represent only a limited number of health outcomes and quality indicators, neighborhood characteristics, and contextual factors. The tool was not designed to replace local knowledge of the community. Rather, it can help triangulate findings, jump-start dialogues with other stakeholders in the community, and highlight the geographic distribution of LHL and health outcomes that may not have been evident prior to mapping them with the tool.

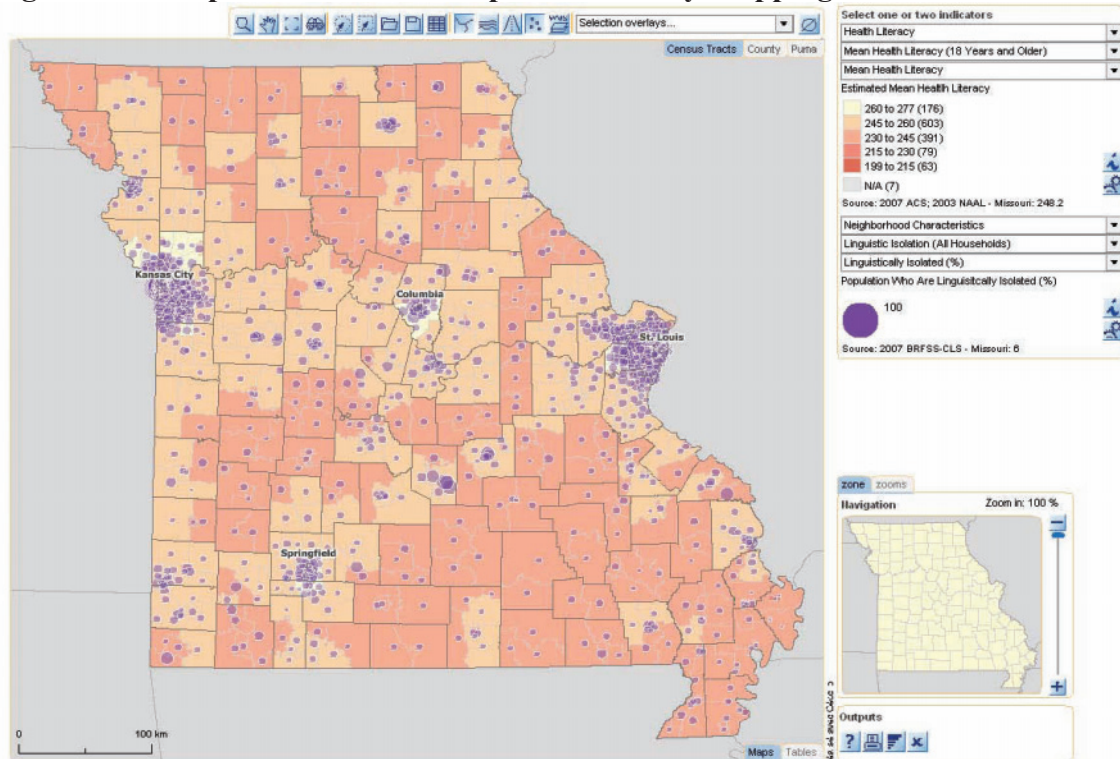
Q: What exactly is this tool?

A: It is a prototype interactive web-based tool that generates color-coded maps to help stakeholders quickly visualize hot spots of LHL and poor-quality care and retrieve information about neighborhood characteristics and access to health services in their communities (see Figure 2.1).

The tool allows users to

- select the level of geography of interest (e.g., census tract, county)
- map and get information for specific regions of interest
- select the characteristics to be mapped
- generate tables and reports on the regions and characteristics of interest
- import their own data into the tool
- export data from the tool
- save and print their projects.

Figure 2.1. Sample Color-Coded Map Generated by Mapping Tool



Q: How will the tool help users?

A: The prototype tool was designed to assist a diverse group of stakeholders answer a wide range of questions relevant to their populations and outcomes of interest. By providing information in the form of color-coded maps and brief tables, the tool also has the potential to engage a wide range of stakeholders (including community members) and to open dialogue around shared goals and potential collaborations. Diverse groups of stakeholders often come together at town hall meetings; serve together on boards of local organizations or task forces; or take part in local, regional, or national collaborative efforts to address LHL or low-quality care. Using the tool or presenting maps and reports generated from the tool at these events may shed light on overlapping service areas and stakeholder priorities in terms of populations, geographic areas, and health outcomes. This, in turn, may lead to conversations around shared goals and objectives and potential collaborations.

It is important to note that the tool was not designed to replace local knowledge of the community. Rather, it facilitates the integration of both local knowledge and formalized data (e.g., census or quality-of-care data). Because the prototype tool is interactive, stakeholders can customize the tool by, for example, setting the thresholds for LHL or quality of care that are most relevant to their population or project scope. This is a significant advantage over static maps or tables, where the thresholds are typically predefined and not modifiable by the user.

At the end of this chapter, we provide several scenarios showing how the tool may facilitate decisionmaking and collaboration. While these examples highlight the flexibility and utility of the tool for a wide range of stakeholders, a more detailed case

study demonstrating how to use many of the features of the tool to produce specific types of maps is presented at the end of the User's Guide in Appendix A.

Q: Does this tool cover the entire state of Missouri?

A. Yes. Information on neighborhood characteristics and health literacy is available for the entire state of Missouri at all geographic levels. Health conditions and risk behaviors are available for the entire state but are not available at the census-tract level. These data come from Missouri's County Level Study (CLS) and were not collected at the census-tract level.

Q: How many indicators can the user map at once?

A: This tool allows the user to simultaneously map two variables (such as mean health literacy and percentage of population receiving colon cancer screening) and overlay them on a third variable (such as a map identifying health professional shortage areas or medically underserved areas).

This map-based approach is quite different from model-building and regression-based approaches. Although regression-based approaches are extremely effective for parsing out the independent effects of individual risk factors overall (e.g., nationally), regression coefficients themselves are not as helpful for thinking about local interventions and initiatives. For example, while regression models using national or regional representative data may show that, on average, individuals with limited English proficiency (LEP) are at significantly higher risk for poor-quality care, an intervention designed to address LEP-related barriers may be irrelevant in a community with few non-English speakers and of utmost importance in communities with a high proportion of recent immigrants.

Given that few individuals outside of academia are comfortable interpreting regression coefficients and thus are unlikely to find them compelling, the tool also provides greater transparency into the process of examining data on the community or region of interest. Thus, part of what makes the tool a potentially disruptive technology is that it moves beyond the common practice of an outside expert analyzing the data and telling a community what they should do and allows stakeholders to work through alternative hypotheses and to map local data. Even when working in concert with an outside expert, the ability of stakeholders or other community members to examine the data and consider alternate scenarios can help make the answers more accessible and thus more convincing.

Q: What is the technology behind this tool?

A: This prototype tool uses a geographic information system (GIS) technology. GIS is a system that stores, manages and presents data that are linked to a location, such as an address. This technology makes it possible to visualize data that have a geographic component, and it is widely used in other applications, such as navigation devices or websites that can provide directions to a destination. Only recently has GIS technology been applied to the health field to help stakeholders think about the geographic distribution of health and potential causes of poor health in a community. This GIS mapping tool is part of RAND's Q-DART project. More information on the Q-DART Toolset and RAND's work in this area can be found at <http://www.rand.org/health/projects/qdart/>.

Q: Why is this tool called a prototype?

A: We call this tool a prototype because it is one of the first interactive web-based tools using GIS technology for health applications. While the tool has several innovative features that allow the user to customize the maps and reports, the technology itself is quite new. We expect that, as this technology rapidly evolves, web mapping with complex health data will be quicker and easier to use and will include additional features for comparing data and customizing map and report layouts.

Q: How do stakeholders obtain this tool?

A: This prototype tool will be publicly available for a minimum of two years (until April 2012), free of charge, from RAND's website:
<http://www.rand.org/health/projects/missouri-health-literacy/>.

This website provides a summary of the project, a link to a copy of this report, and a link to the tool. RAND maintains the website and tool on its servers. Stakeholders are able to access it, work within the tool, and save their projects to their own desktop. These saved projects can then be reloaded into the tool the next time the stakeholder accesses the website. Detailed instructions on how to save projects and upload them into the tool are explained in the User's Guide (Appendix A).

Example Scenarios of the Mapping Tool in Action

Below, we highlight several scenarios demonstrating how the tool may facilitate decisionmaking and collaborations among a wide range of stakeholders.

1. A public health practitioner in Missouri is concerned that many individuals with diabetes are not monitoring their blood sugar on a regular basis. She would like to implement an educational campaign but has limited resources. She wants to know where the campaign will have the biggest impact.

The tool allows the practitioner to map the distribution of diabetics in the state by county using a graduated shading scheme, as shown in Figure 2.2a. Here, the dark red shading indicates the counties with the highest number of diabetics. Using one of the tool's functions, a table can be generated showing both the number of adult diabetics and the percentage of the diabetic population in selected counties who reported checking their blood sugar on a daily basis (Figure 2.2b). This table suggests that Clay and Greene counties might be good candidates for an educational campaign, since only about half of the diabetic population reports daily testing of their blood sugar. Jackson County, on the other hand, has the largest diabetic population in the state (n=56,752); although the percentage reporting daily testing of blood sugar is higher than in other counties (69.5 percent), there are still over 16,000 individuals in Jackson County who are not checking their blood sugar daily. Thus the map and table allow the public health practitioner to see both where diabetes is prevalent and where inadequate monitoring is most common. Using this information, the practitioner might decide to disseminate in these hot spots those components of an educational campaign that have proved most effective in other regions of the country.

Figure 2.2a. Distribution of Diabetics in Missouri, by County

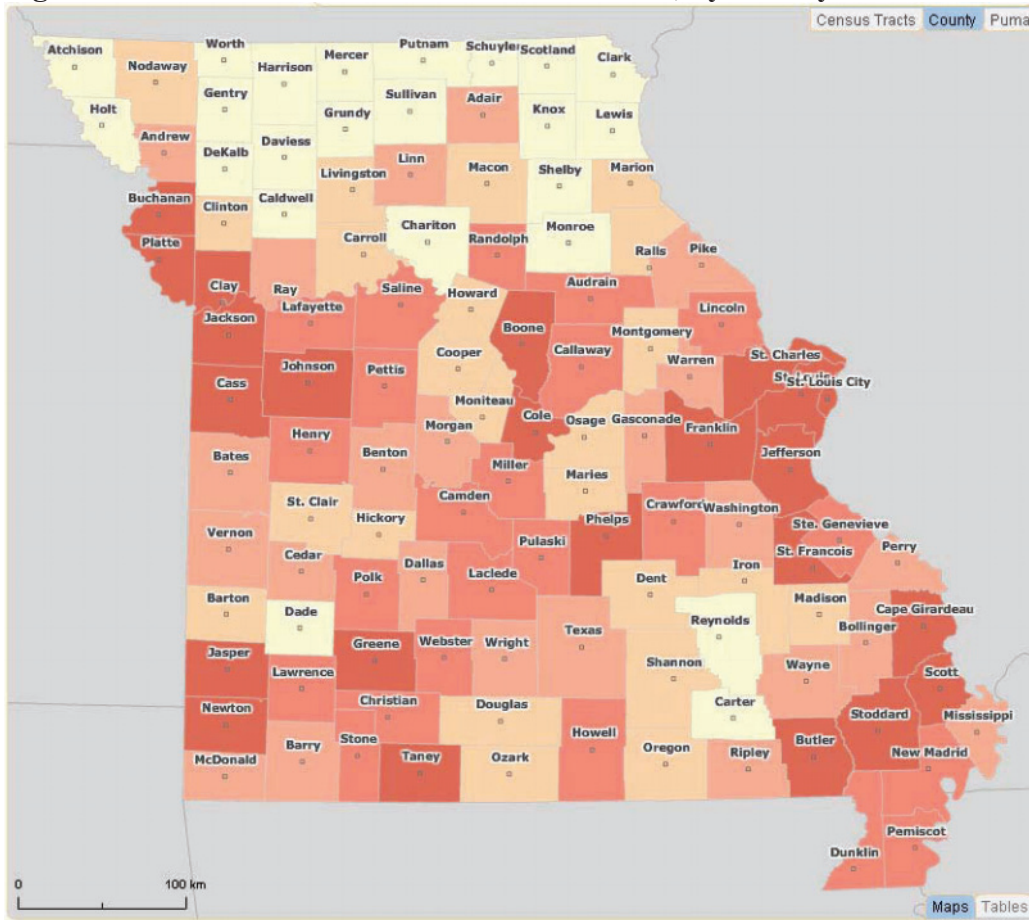


Figure 2.2b. Number of Diabetics and Percentage of Diabetic Population That Checks Blood Sugar on a Daily Basis, by County

Information about selection

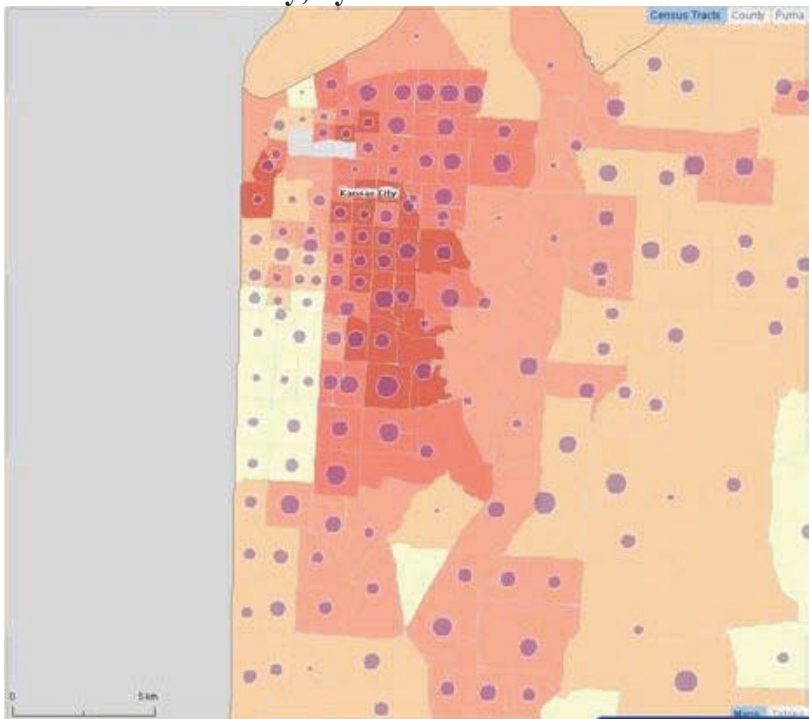
	County	Diabetics (18 Years and Older) (N)	Diabetics, Self-check B. Sugar/Glucose (%)	+
1	St. Louis	72,880	75.9	Detailed report
2	Jackson	56,752	69.5	Detailed report
3	St. Charles	22,217	64.3	Detailed report
4	St. Louis City	21,907	67.5	Detailed report
5	Greene	15,920	53.1	Detailed report
6	Clay	13,508	52.9	Detailed report
7	Jefferson	11,227	65.5	Detailed report
24			1,627	

2. A pharmacy chain in the Kansas City region is interested in pilot-testing a program to help individuals better understand their medication labels and improve medication adherence. The chain would like to determine which pharmacies might be good pilot sites.

With the tool, the pharmacy chain can first map mean health literacy levels by census tract in the Kansas City region. Then the chain can map the absolute number of individuals with basic or below basic health literacy in those census tracts; the numbers will vary dramatically depending on the population size of the tract. Both pieces of information can be superimposed on the same map, as shown in Figure 2.3. The graduated red shading corresponds to mean health literacy scores (the dark red areas identify the census tracts with the lowest scores). The purple circles correspond to the absolute number of individuals with basic or below health literacy (the larger the circle, the larger the number of individuals).

This map now provides powerful insight into data that the pharmacy chain can use to locate those communities that might be good candidates for pilot sites because they likely serve large numbers of individuals with low literacy. Targeting pilot-testing to pharmacies in these areas would be expected to reach the intended population and thus provide more information on the effectiveness of the intervention. Pharmacies in these areas may also be more aware of the need and value of such an intervention, making buy-in and implementation easier. If the intervention is successful, the pharmacies at the pilot sites can also assist with the dissemination and implementation of the intervention to neighboring pharmacies where LHL may be less prevalent and the need for such an intervention less obvious to pharmacy staff.

Figure 2.3. Mean Health Literacy and Number of Individuals with Basic or Below Basic Health Literacy, by Census Tract

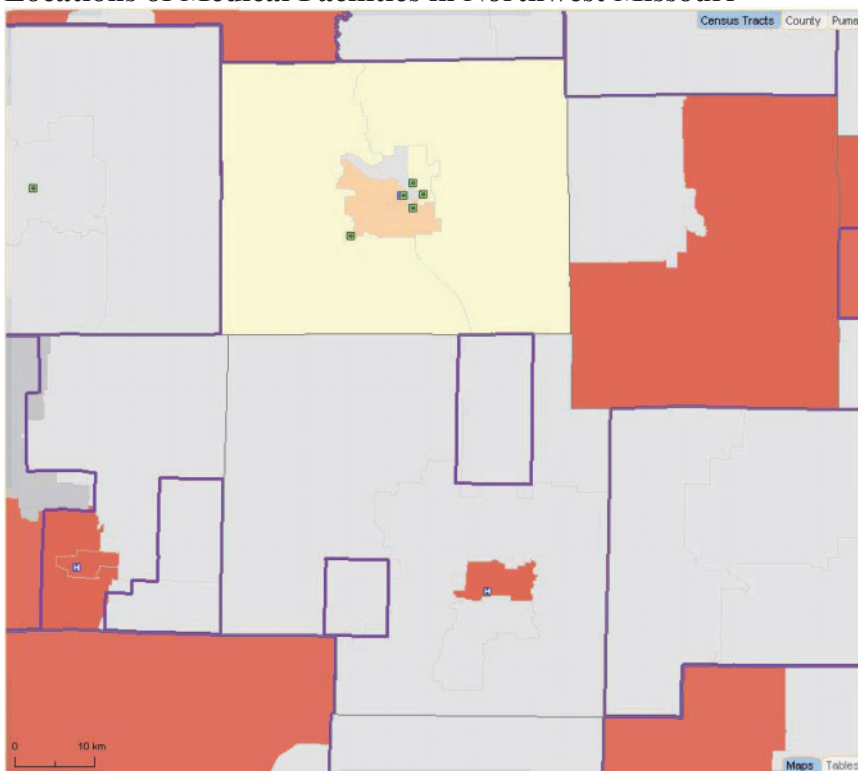


3. A primary care physician working in the rural northern part of the state is frustrated that so few of her patients have been screened for colon cancer. She is looking for insight into where she might focus her efforts to increase screening rates.

While health literacy may be a contributing factor to low colon cancer screening rates, other factors may be an issue, such as the lack of hospitals and other healthcare facilities, especially in this rural part of the state. Health services data can be mapped with the tool. In this case, Figure 2.4 not only shows the census tracts with low rates of colon cancer screening (dark red), it also reveals that there are only a few hospitals (H) or federally qualified health centers (FQHCs) (C) in the physician’s geographic area of interest. Only one region in the northeast with a higher rate of colon cancer screening (light orange) has access to a cluster of FQHCs within close proximity. Furthermore, mapping the location of medically underserved areas (MUAs), defined as geographic regions where residents have a shortage of personal health services (Health Resources and Services Administration 2009), reveals that much of the area of interest to the physician qualifies as MUAs, which are outlined in purple in Figure 2.4.

By sharing these maps with leaders of the FQHCs, hospitals, and other health service providers in the area, the physician may be able to help start a dialogue around access issues and shared accountability for patients. This information-sharing among stakeholders might also encourage health professionals and FQHCs with better success at screening their patients to offer effective strategies and lessons learned to improve rates of colon cancer screening in this rural population.

Figure 2.4. Rates of Colon Cancer Screening, Medically Underserved Areas, and Locations of Medical Facilities in Northwest Missouri



4. Local researchers and their community partners would like to develop an intervention to reduce the rate of cardiovascular disease in the southeasternmost part of the state known as the Missouri Bootheel. In their grant proposal they would like to justify their focus on this particular region of Missouri.

Using the tool to map prevalence rates for high cholesterol shows that the Missouri Bootheel has some of the highest rates in the state (dark red areas in Figure 2.5a). The table in Figure 2.5b shows that the prevalence of high cholesterol in the Bootheel is 63.8 percent compared with the state average of 50.7 percent. The tool also makes it possible to select a specific geographic region—in this case, Dunklin County in the Missouri Bootheel—and generate reports comparing indicators of health, sociodemographic characteristics, and health literacy for the selected county relative to the state average (Figure 2.5c).

Both the map and report can be printed out for inclusion into the grant proposal to strengthen the argument being made by the research partnership that an intervention is needed to address the high cholesterol rates in the Missouri Bootheel. In addition, this information may further strengthen community partnerships around a shared objective to address cardiovascular disease in this region and lead to the development of new partnerships with physicians and healthcare providers, for example, whose buy-in is essential to the successful implementation of the proposed intervention.

Likewise, funding agencies themselves may also use the tool to inform decisionmaking about awarded grants. For example, funding agencies can compare their portfolio of funded projects to statewide need to ensure that the dollars they are spending are being used in communities of greatest need, which will maximize their return on investment.

Figure 2.5a. Distribution of High Cholesterol in Missouri, by County

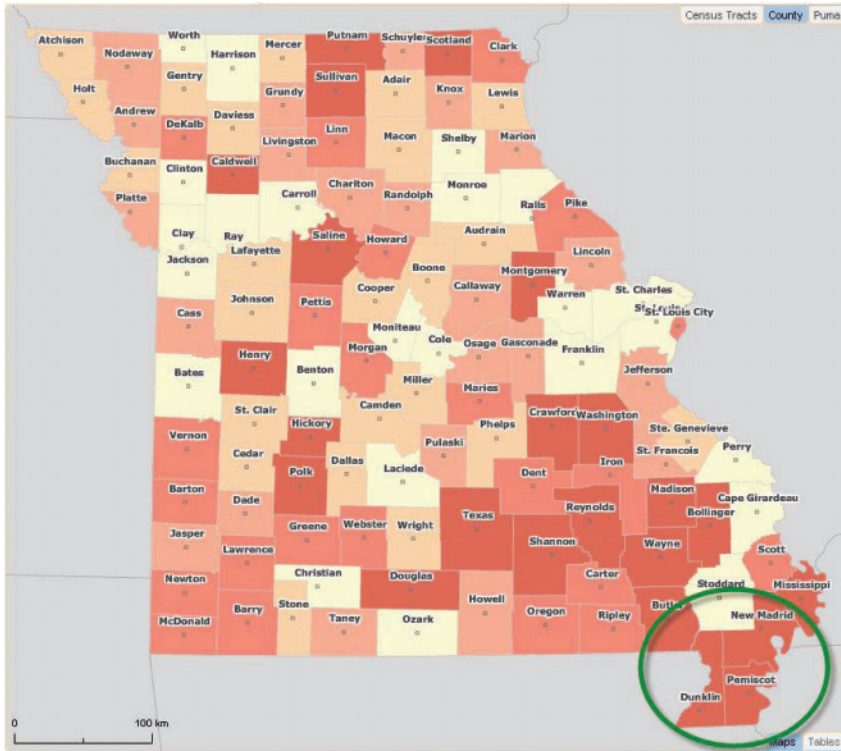


Figure 2.5b. High Cholesterol in the Missouri Bootheel Compared with the State of Missouri

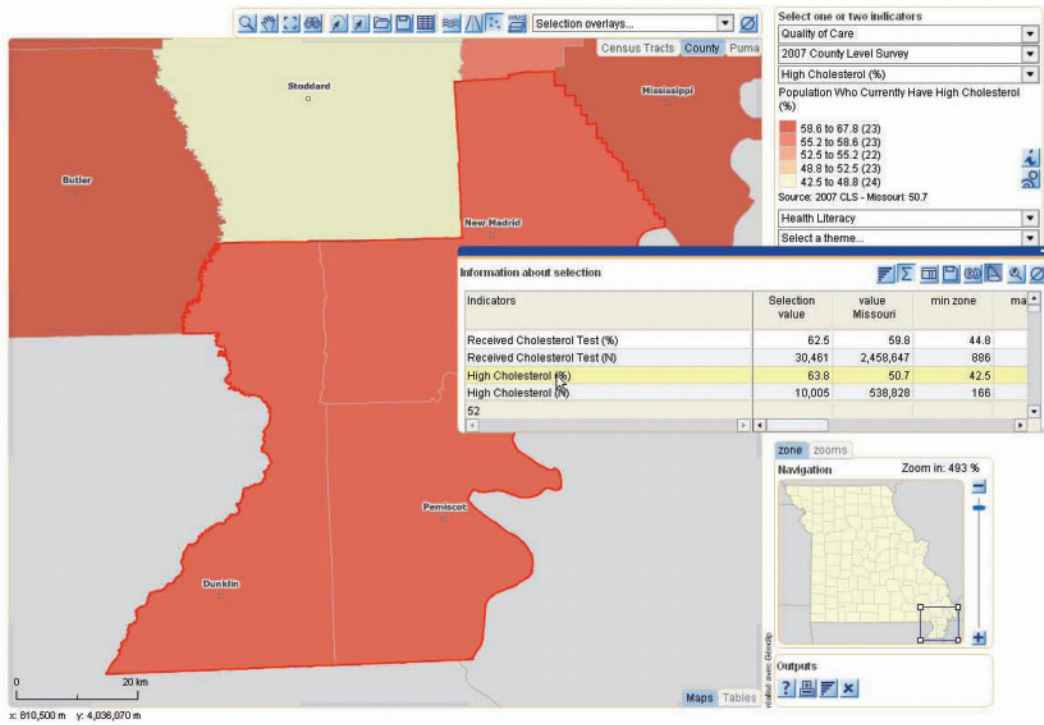
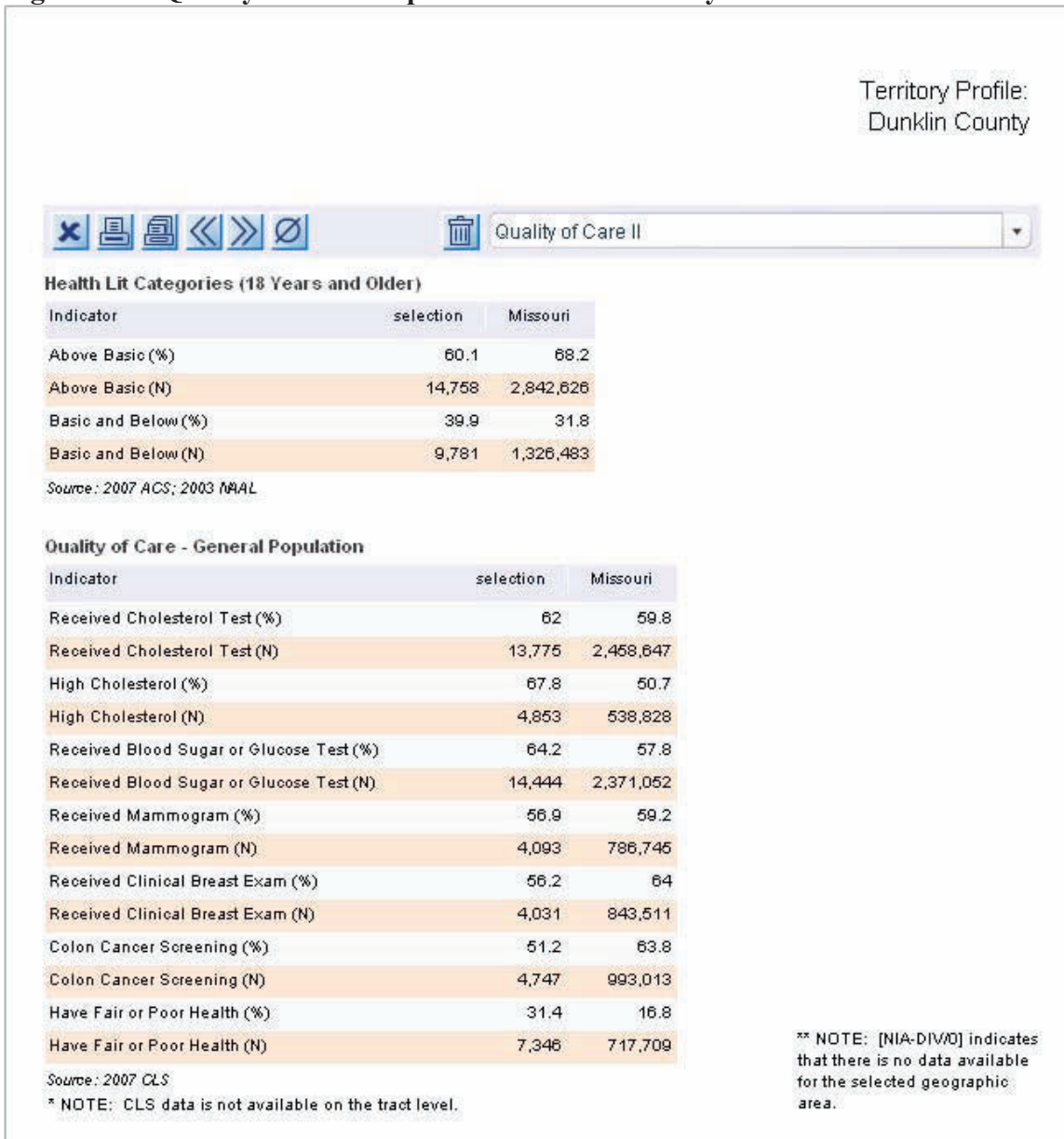


Figure 2.5c. Quality-of-Care Report for Dunklin County



The above examples demonstrate the versatility of the tool to help a wide range of stakeholders think through the selection of interventions to address the current need in their communities. Such actions may occur at the state, county, community, or clinic level. They may include the implementation of educational campaigns; investment in infrastructure; provider training; support services for individuals with LHL, such as patient advocates or navigators; or the development of bilingual materials or materials at a lower reading level, accessible to individuals with LHL. Further, the tool can help stakeholders determine where such initiatives should be implemented to maximize their impact and achieve the desired goals.

Mappable Characteristics and Data Sources

This chapter describes characteristics selected for inclusion in the prototype mapping tool and their data sources. The characteristics are organized around four themes: health literacy, quality of care, and neighborhood sociodemographic factors. In addition, the tool includes selected neighborhood services data, including MUAs, Health Professional Shortage Areas (HPSAs), and the location of hospitals and FQHCs.

Health Literacy Characteristics

Rationale for inclusion

An estimated 36 percent of American adults have health literacy levels rated at “basic or below,” indicating that they have difficulty obtaining, processing, and understanding basic health information and services. LHL is thought to play a key role in racial/ethnic and socioeconomic disparities in health and healthcare. Identifying communities with lower levels of health literacy may help stakeholders to more effectively target interventions to address poor-quality care.

Characteristics included in prototype tool

- **Mean health literacy.** Our estimates of mean health literacy range from 0 to 500 points, following the format used by the National Assessment of Adult Literacy (NAAL).
- **Categorical health literacy.** We include two categorical measures in the tool: percentage of the population with “above basic” health literacy (intermediate and proficient) and percentage of the population with “basic or below” health literacy (basic or below basic). These two measures are exact complements of each other but give the users more flexibility to select and map the measure that best meets their needs.

Data source

The tool’s health literacy characteristics are based on predictive models of health literacy developed by RAND in an earlier phase of this project. These models used data from NAAL (Lurie et al. 2010; Martin et al. 2009). NAAL, an in-person assessment of English-language literacy among English-speaking U.S. adults, was conducted by the U.S. Department of Education (National Center for Education Statistics 2003) and was the first large-scale, nationally representative assessment of health literacy in the adult population of the United States. In addition to assessing general literacy, NAAL included 28 items specific to health literacy that assessed the ability of an individual to effectively use written health-related materials (e.g., a medication label, written directions from doctor, a consent form) (White and Dillow 2005). Because the NAAL was only administered to English-speaking adults, we do not know how well these area-level estimates perform in areas that are primarily non-English speaking or that have a high prevalence of LEP. Additional information on the development and results of the RAND predictive models for health literacy are presented in Appendix B.

Quality-of-Care Characteristics

Rationale for inclusion

County-level data on intermediate health outcomes and quality of care can help stakeholders visualize the geographic distribution of care quality and health outcomes of interest.

Characteristics included in prototype tool

The following self-report characteristics were selected for inclusion in the tool:

- **Breast cancer screening**
- **Colon cancer screening**
- **Diabetes care.** Diabetes care includes both cholesterol and blood sugar testing for diabetics, including both self-monitoring of blood glucose as well as testing of hemoglobin A1c in a provider's office. The tool also includes information on the prevalence of diabetes.
- **Prevalence of screening for cholesterol/blood sugar in general population.**

Data source

These self-reported data come from Missouri's CLS. Additional information on health conditions and quality of care can be found in Appendix C. Additionally, a limited amount of clinical quality-of-care data from a number of health plans with significant market share in Missouri as well as Medicaid are also incorporated into a secure, sponsor-only version of the mapping tool, described in more detail in Appendix E.

Neighborhood Sociodemographic Characteristics

Rationale for inclusion

Information on the sociodemographic characteristics of communities is important for understanding related or underlying causes of disparities or poor care quality. Such information also helps stakeholders to select more appropriate interventions that are likely to resonate with and be better received by the community itself.

Characteristics included in prototype tool:

- **Age**
- **Gender**
- **Race/ethnicity**
- **Educational attainment**
- **Poverty status**
- **Marital status**
- **Language spoken in the home**
- **Linguistic isolation**
- **Length of time in the United States.**

Data source

Data on population characteristics were drawn from the 2000 U.S. Census (for census tracts) and from the 2007 American Community Survey. Additional detail on neighborhood characteristics and data sources can be found in Appendix D.

Selected Neighborhood Health Services Data

Rationale for inclusion

The tool also includes a limited amount of additional contextual information related to neighborhood services data for stakeholders to consider when addressing disparities in care related to LHL. These points of interest help stakeholders identify locations of care delivery and potential community partners to address poor-quality care due to LHL and to find potential settings for interventions.

Characteristics included in prototype tool:

- **medically underserved areas/populations (MUA/Ps)**
- **health professional shortage areas (HPSAs)**
- **general hospitals (excluding military and government-run facilities not accessible to the general population)**
- **federally qualified health centers (FQHCs).**

Data sources

Locations of MUA/Ps, HPSAs, and FQHCs were obtained from the Health Resources and Services Administration. Locations of hospitals were obtained from the American Hospital Association. Additional information on neighborhood health services data can be found in Appendix D.

Next Steps

This interactive web-based tool to target LHL is a prototype, the first step toward a more comprehensive health literacy tool for the state of Missouri. Data included in the tool represent only a limited number of health outcomes and quality indicators, neighborhood characteristics, and contextual factors. This prototype tool was not designed to replace local knowledge of the community or to provide “correct answers” for stakeholder questions about how and where to focus their efforts. Rather, it was designed to help triangulate findings, jump-start dialogues with other stakeholders in the community, and highlight the geographic distribution of LHL and health outcomes that may not have been evident prior to mapping them with this tool. However, the tool demonstrates the powerful capabilities that mapping offers Missouri stakeholders trying to address disparities related to LHL. Below, we discuss potential next steps and refinements to improve the robustness and reliability of the tool, pending additional funding to support such activities.

Q: Do you plan to add additional measures of health, health behaviors, and healthcare quality?

A: Yes. Adding additional measures will further increase the utility of the tool for stakeholders interested in gaining a more thorough understanding of a particular outcome of interest. For example, while the tool includes data on cancer screening, it does not yet include information on related outcomes, including the incidence and prevalence of cancer, stage of cancer at diagnosis, type of cancer, adherence to treatment protocols, hospital discharge data, and risk factors for cancer (e.g., smoking, diet, high body mass index, excess alcohol consumption). Including these measures will not only make the tool more robust, providing insight into the geographic distribution of cancer, its risk factors, and related outcomes, but will also provide insight into opportunities for intervention at many stages, from regular cancer screening to treatment compliance to health self-management during remission.

In addition to cancer, this tool can be used to map any health outcome of interest for which community-level data are available and stakeholders have expressed an interest—for example, quality of care for other diseases or disorders, such as birth outcomes, child obesity, or other issues addressed in the Healthy People goals (U.S. Department of Health and Human Services 2000).

In short, the inclusion of additional related measures has the potential to bring more public health officials, advocacy and consumer organizations, community leaders, and foundations together to address health outcomes, both locally and statewide, using a multipronged approach.

Q: Do you plan to update the tool with more-recent census data when it becomes available? Do you plan to add additional sociodemographic characteristics to the tool?

A: Yes. It is expected that over the next year, updated population estimates will be released from the U.S. Census Bureau. We plan to update this information within the tool and will in turn recalculate our estimates of community-level health literacy.

Other characteristics, such as a neighborhood-level socioeconomic status, could be included that may provide richer information on the socioeconomic status of the community. RAND has developed such a measure as part of the RAND Center for Population Health and Health Disparities, utilizing information from six community-level variables: (1) percentage of adults older than 25 with less than a high school education, (2) percentage of male unemployment, (3) percentage of households with income below the poverty line, (4) percentage of households receiving public assistance, (5) percentage of households with children headed only by a female, and (6) median household income. This measure has shown to predict such outcomes as allostatic load, fruit and vegetable consumption, and coronary heart disease events and may be of use to stakeholders hoping to gain a better understanding of socioeconomic status in their community (Bird et al. In Press; Dubowitz et al. 2008).

Q: Will you add additional characteristics of the built and social environment, beyond locations of hospitals and FQHCs?

A: Yes. This tool is designed to support community-level interventions and to help stakeholders think about health disparities and health literacy from a population perspective. As a result, we hope to include many characteristics of the built and social environment as part of our future work with this tool.

For example, libraries and adult learning centers are natural partners for any effort focused on improving outcomes related to LHL. Not only can they provide resources and expertise on literacy issues, but they also have built trust among the individuals and communities they serve. As another example, the location of pharmacies may also provide insight into certain geographic patterns of health outcomes; stakeholders may also use information on pharmacy locations when thinking about where best to implement an intervention focused on medication adherence.

Environmental and contextual information specific to a given health outcome could also be added to the tool, such as census tract-level data on proximity to grocery stores or fast food restaurants. RAND's previous work in this area demonstrates that food environments are independently associated with body mass index (BMI) and hypertension after accounting for individual-level characteristics and neighborhood socioeconomic status (Fernandes et al. 2008).

Q: Are you planning to work with stakeholders to further refine the tool?

A: Yes. There are two overarching objectives for this tool:

1. To help stakeholders gain a better understanding of the distribution of LHL and poor-quality care so they can maximize the impact of limited resources to address disparities and target those resources toward communities in greatest need.
2. To engage a wide range of stakeholders and to open dialogue around shared goals and potential collaborations.

As a result, a critical next step in the development of this tool is to work with stakeholders to determine whether the tool is achieving its objectives. We are interested in learning what features of the tool stakeholders find the most or least helpful, what they wish the tool could do, what types of data they would like to see included, and the extent to which they have been successful at using the tool to assist with decisionmaking or to

engage other stakeholders within their community around shared goals. Users are encouraged to provide RAND with specific feedback by sending an email to HL_mappingtool@rand.org.

Missouri Health Literacy Mapping Tool User's Guide and Case Study: The Mapping Tool in Action

1. Getting Started

▶ Go to the RAND Health Literacy website:
<http://www.rand.org/health/projects/missouri-health-literacy/>

▶ Click on **Missouri Health Literacy**

▶ Click on **Launch Prototype Interactive Mapping Tool**

System Requirements:

The Missouri Health Literacy Mapping Tool requires Adobe Flash Player 6.0 or higher. Upon opening the tool, users will be prompted to download and install the Adobe Flash Player plug-in automatically if required. Or, visit <http://get.adobe.com/flashplayer>.

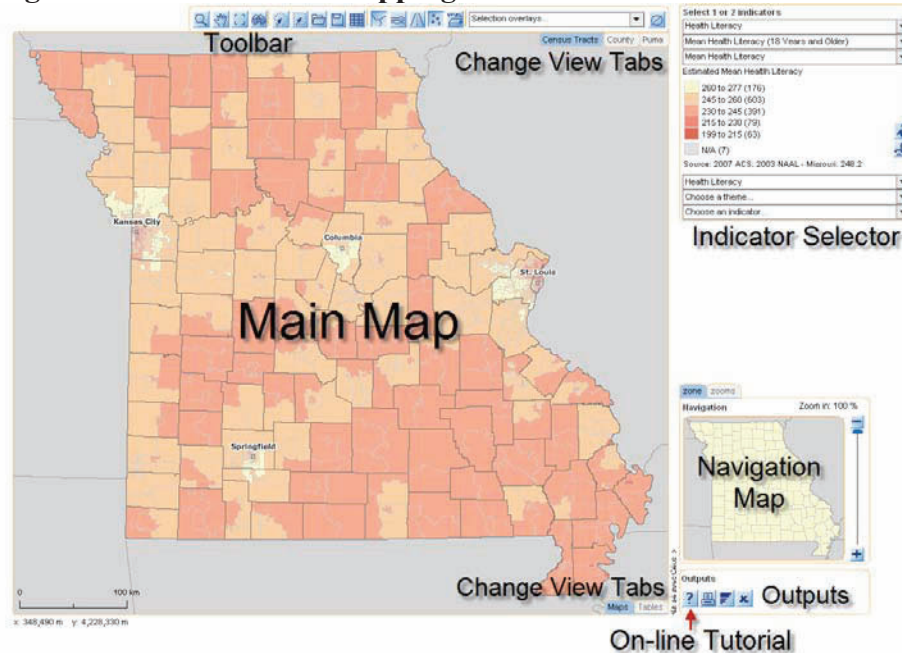
Maps are best viewed at the screen setting of 1024 × 768.

2. Main Map View

On launching the tool, the user will see a map of Missouri divided into counties. In a few seconds, this map will fill with estimates of mean health literacy for all census tracts in Missouri. This User's Guide will show the user how to change this indicator to view and analyze those regions of interest.

This is an **interactive** map with multiple ways of manipulating it. In Figure A.1, we locate and define key functions of the mapping tool. In ensuing sections of this User's Guide, we describe these functions in more detail.

Figure A.1. Overview of Mapping Tool Functions



Main Map: This is the main view where the user can select geographic regions of interest.

Change View Tabs: The map has three tabs in the upper right corner below the toolbar. These tabs allow the map view to be changed to census tracts, counties, and Public Use Microdata Areas (PUMAs). There are also two tabs in the lower-right corner of the map, which allow the user to view either the main map (Map) or customizable information tables of the geographic area (Tables).

Toolbar: This includes buttons for selecting regions; adding roads, waterways, and county names to the map; and uploading supplementary information.

Indicator Selector: Drop-down menus allow the user to select the indicators to be mapped and to view the data sources of the indicators.

Navigation Map: This small map at the bottom right helps the user zoom into a specific county on the main map as well as view selected geographic areas of interest.

Outputs: This provides detailed information on the geographic region of interest and allows the users to create reports, export data, and customize and print maps.

On-line Tutorial: The question mark  provides a brief online tutorial of the mapping tool's features.

3. Indicator Mapping

The mapping tool has already been loaded with data for indicators of interest to Missouri stakeholders. On the map, these data are organized into three *domains*:

1. Health literacy
2. Quality of care
3. Neighborhood characteristics.

Each domain is broken down into specific subsets called *themes*, and each theme is further broken down into the specific *indicators*. Using drop-down menus, users can select the domain, theme, and indicator to be visualized on the map.

► Selecting Indicators for Mapping


There are two ways to display indicators on the map using the Indicator Selector shown in Figure A.2.


1. Use the upper set of drop-down menus to select a domain, theme, and indicator and display the data as shaded geographic areas with the shading intensity corresponding to the values in the displayed legend. This approach is called **shaded (polygonal) analysis**.
2. Use the bottom set of drop-down menus to select a domain, theme, and indicator and display the data as **proportional symbols** (e.g., circles) with the area of the symbol corresponding to the size of the indicator.

For both display types, the user can choose to display the absolute quantity (i.e., number of individuals, N) or the relative quantity (i.e., percentage, %) of the desired indicator. Additionally, both display types can be chosen, with the results superimposed. Shaded analysis and analysis by proportional symbols are described below.

Figure A.2. Indicator Selector with Sample Indicators Chosen

The screenshot shows the 'Indicator Selector' interface with two indicators selected. The first indicator is 'Health Literacy', with a legend showing five categories: '260 to 260' (yellow), '245 to 260 (43)' (orange), '230 to 245 (72)' (red-orange), '215 to 230' (red), and '215' (dark red). The data source is '2007 ACS; 2003 NAAL - Missouri: 248.2'. The second indicator is 'Quality of Care', with a legend showing a single category: '68' (purple circle). The data source is '2007 CLS - Missouri: 60'. Annotations include 'Legend' and 'Data source' pointing to the legend and source information for both indicators, and 'Use this menu for shaded analysis' pointing to the dropdown menus for the first indicator, and 'Use this menu for analysis by proportional symbols' pointing to the dropdown menus for the second indicator.

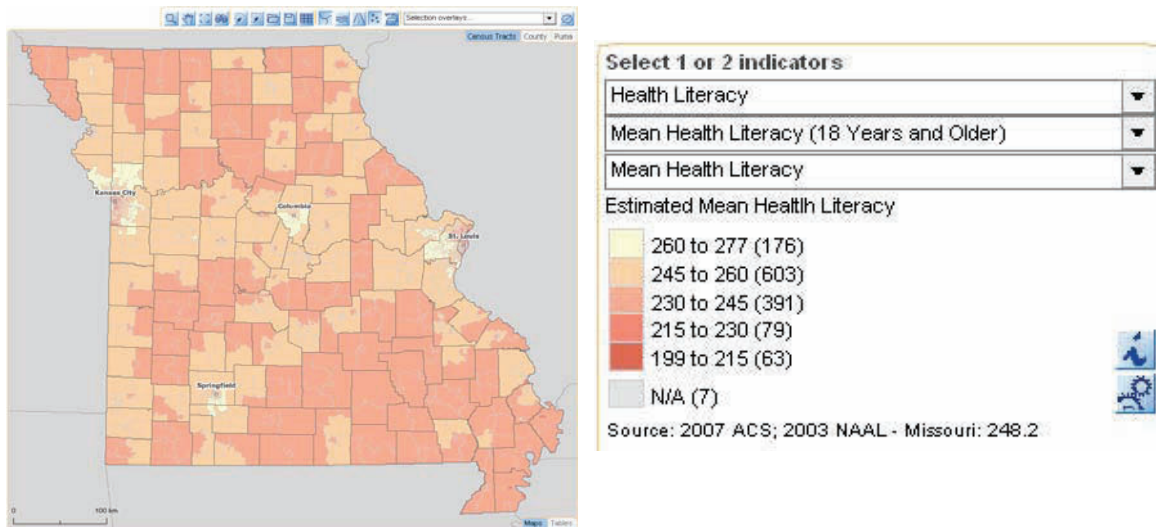
 provides access to additional information and documentation about the chosen indicator. From this box, the user can **export** the value of the indicator into a spreadsheet for all geographic units on the map.

 opens the **Configure Indicator** panel for adjusting the analysis parameters of the indicator. This panel is specific for the type of analysis chosen and is further described below.

► Shaded Analysis

The upper drop-down menu of the Indicator Selector provides shaded analysis (or polygonal analysis). It is used for relative value indicators (percentages) as well as absolute quantity. Figure A.3 describes shaded analysis using a sample domain, theme, and indicator selection.

Figure A.3. Sample Domain, Theme, and Indicator Selection for Shaded Analysis



For shaded analysis, the **legend** shows the **colors** and **thresholds** for each category. The number of geographic units in each category is shown in parentheses. If the selected indicator is not available for a geographic unit, the geographic unit will appear shaded gray (N/A) in the legend and on the map.

Clicking on any of the **colored blocks** in the legend allows the user to see only the geographic units on the map that fall within that category. It will temporarily hide geographic units belonging to other categories.

Configure Indicator for Shaded Analysis


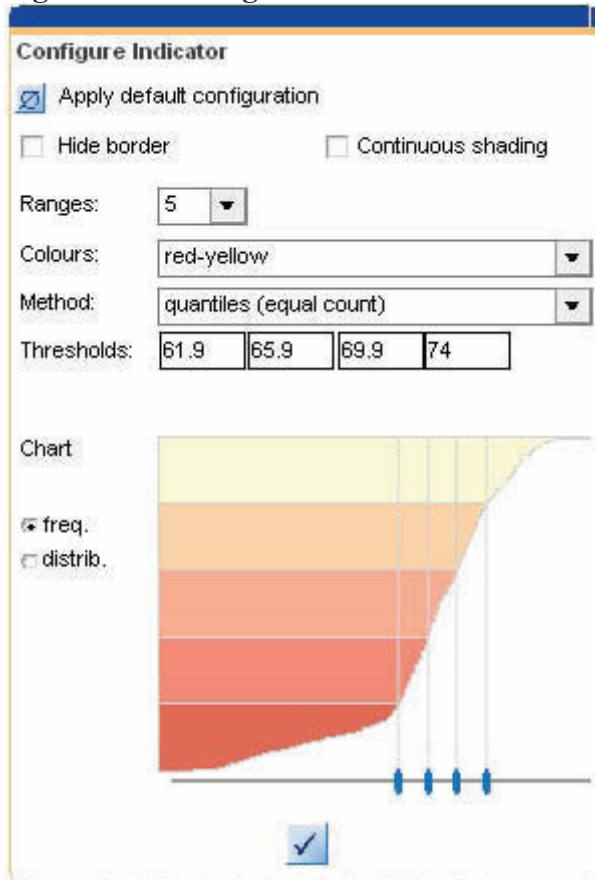
The  button in the legend opens the **Configure Indicator** panel for adjusting the parameters for shaded analysis, as shown in Figure A.4.

Figure A.4. Configure Indicator for Shaded Analysis



Apply default configuration: Clicking this button erases any configurations to the indicator the user has changed and will use the default configurations for the indicator programmed in the tool.

Hide border: When this box is ticked, the boundaries between the geographic units are hidden.

Continuous shading: When this box is ticked, the indicator is not displayed using discrete color categories as in Figure A.4. Rather, the tool uses continuous shading (e.g., any color between yellow and red) to color the geographic unit. The color of the geographic unit is based the value of the indicator relative to the distribution across all geographic units.

The user can modify the following parameters for shaded analysis:

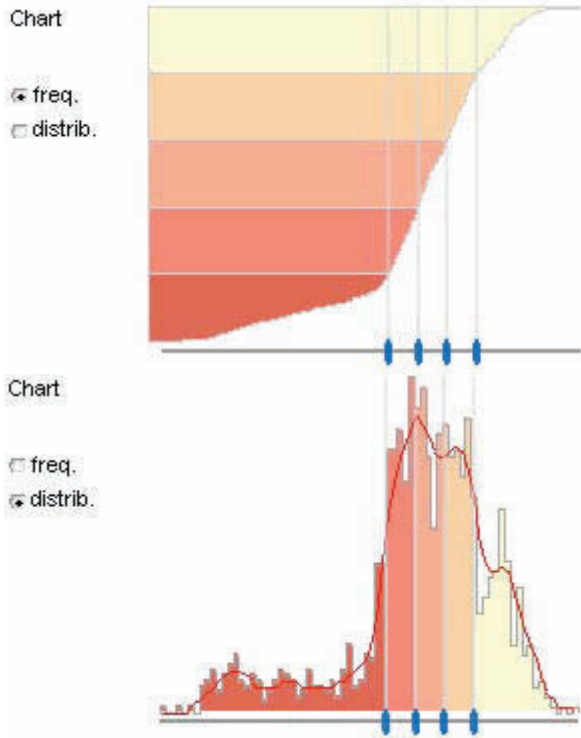
- number of indicator categories (**Ranges**), from 3 to 5
- color palette (**Colours**)
- sorting method (**Method**). The following sorting methods are available:
 - manual*
 - quantiles (equal count)
 - multiples of the standard deviation
 - logarithm plus multiples of the standard deviation
 - Jenks (k-means)

*In manual mode, range **thresholds** can be defined in the text fields or by clicking and dragging the blue lines at the bottom of the chart.

Chart: A frequency bar chart or a distribution bar chart can be selected for display (see Figure A.5).

validates the parameters selected and closes the panel.

Figure A.5. Shaded Analysis Frequency and Distribution Bar Charts



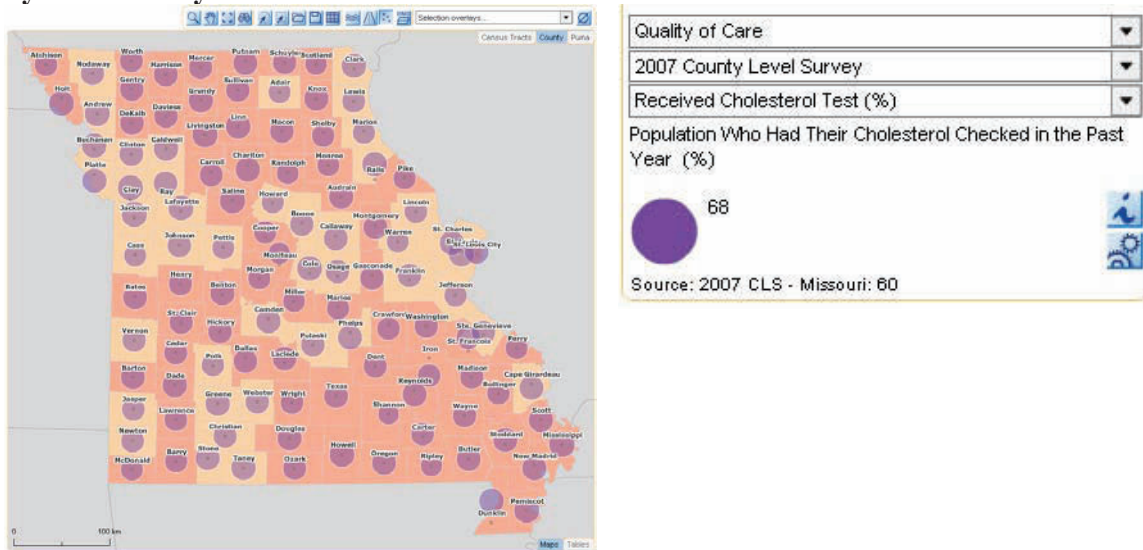
A **frequency bar chart** displays the indicator categories on the y-axis and the values of the indicator on the x-axis. Each horizontal line on the chart corresponds to one geographic unit. Moving the mouse over the bar chart will highlight the corresponding geographic unit on the map by placing a red circle around it.

A **distribution bar chart** displays the indicator value on the x-axis and the number of geographic units corresponding to that value on the y-axis. Thus the bar chart displays the type of distribution for the indicator (normal, asymmetrical, etc.) in visual form. The red line displayed on the chart shows the same data after smoothing.

► Proportional Symbols Analysis

The bottom set of drop-down menus provides **analysis by proportional symbols** (e.g., circles) with the area of the symbol corresponding to the size of the chosen indicator. Analysis by proportional symbols displays absolute quantity (i.e., number of individuals, N) or the relative quantity (i.e., percentage, %) of the desired indicator. Figure A.6 describes analysis by proportional symbols using a sample domain, theme, and indicator selection.

Figure A.6. Sample Domain, Theme, and Indicator Selection for Proportional Symbols Analysis



Configure Indicator for Analysis by Proportional Symbols


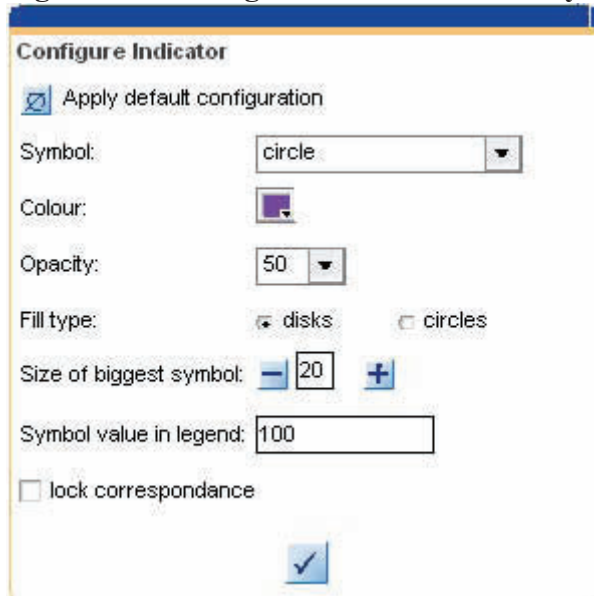

The  button in the legend opens the **Configure Indicator** panel for adjusting the parameters for analysis by proportional symbols, as shown in Figure A.7.

Figure A.7. Configure Indicator for Analysis by Proportional Symbols





Apply default configuration: Clicking this button will erase any configurations to the indicator the user has changed and will use the default configurations for the indicator programmed in the tool.

Symbol: Choose the type of symbol to display on the map (circle, sphere, or box).

Colour:  is used to change the fill color for the symbol.

Opacity: This sets the opacity of the color.

Fill type: A circle symbol can be displayed as a solid disk or an open circle (not available for the other symbol choices).

Size of biggest symbol:  and  increase or decrease the size of the symbols while keeping them in proportion. The **symbol value in legend** is adjusted automatically and displayed in the box.

Lock correspondence: Checking this maintains the correspondence between the symbol size and the indicator value for several successive analyses in order to compare a series of maps.

4. Geographic Levels

The **Change View tabs** at the upper right on the main map, just under the toolbar, allow the user to select different **geographic levels** of analysis (census tracts, counties, or PUMAs). The indicator selected remains active as the user moves from one level to another. The location of these tabs is shown in Figure A.8.

Figure A.8. Changing Geographic Levels on the Map



5. Navigation Map

The small **navigation map** to the lower right of the main map allows the user to move around the main map in different ways, as described in Figure A.9. It also shows the user what geographic region of the state is currently displayed in the main map.

Figure A.9. Navigation Map



By clicking the **zone tab**, the user can change the zoom level on the main map from 100% to 1500% and more. This is done by dragging the slider bar up or down or by clicking on the **+** or **-** buttons. As the user zooms in, a square **viewfinder** appears in the navigation map. This viewfinder highlights the area that is currently displayed in the main map. The user can also move the viewfinder with the mouse or change its size by dragging the corners. Any such action is immediately transferred to the main map.

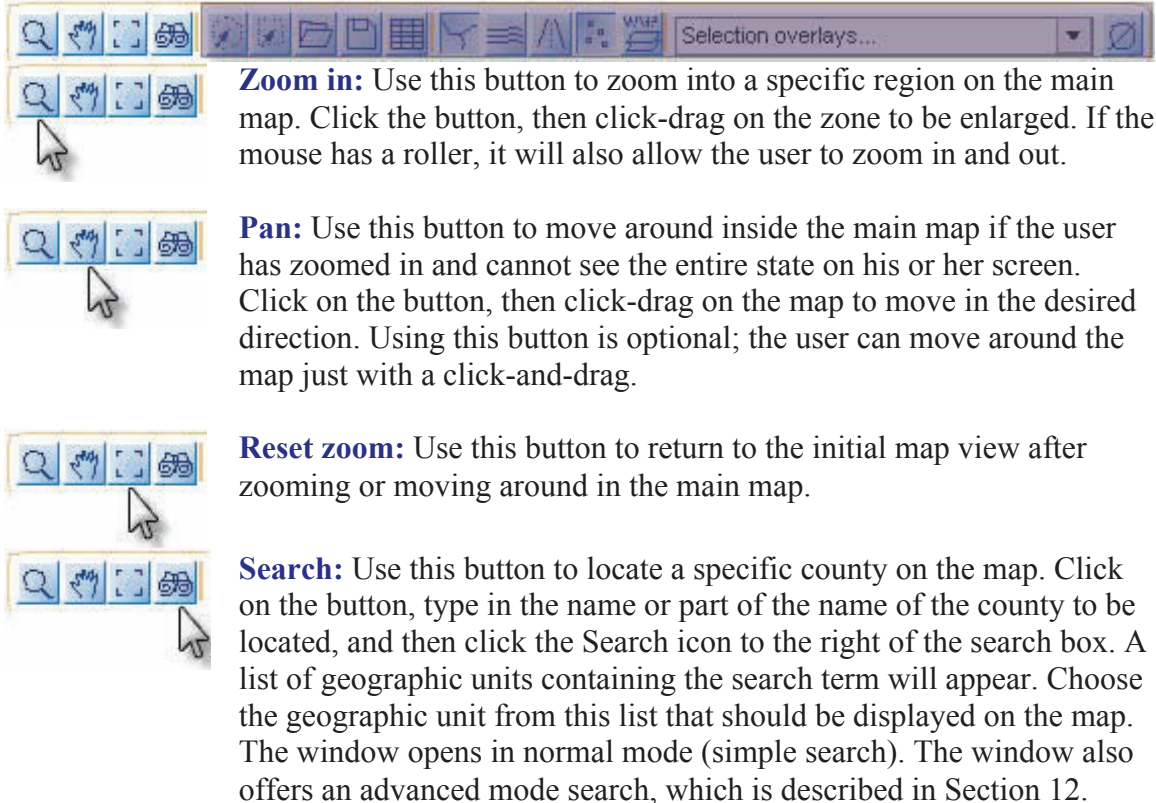
The **zooms tab** allows the user to zoom into a specific county by clicking on the county of interest. The selected county is displayed on the main map.

6. Toolbar Functions

► Navigation Tools

The first four buttons on the toolbar above the main map are tools for moving around the map, as described in Figure A.10.

Figure A.10. Navigation Tools



► Geographic Selection Tools

Since the main map is **interactive**, a geographic unit of interest can be selected by clicking on it on the map to view information about the selection that appears in a pop-up information table (described in Section 8). To select multiple geographic areas simultaneously, hold the shift key down and click on the geographic areas of interest.


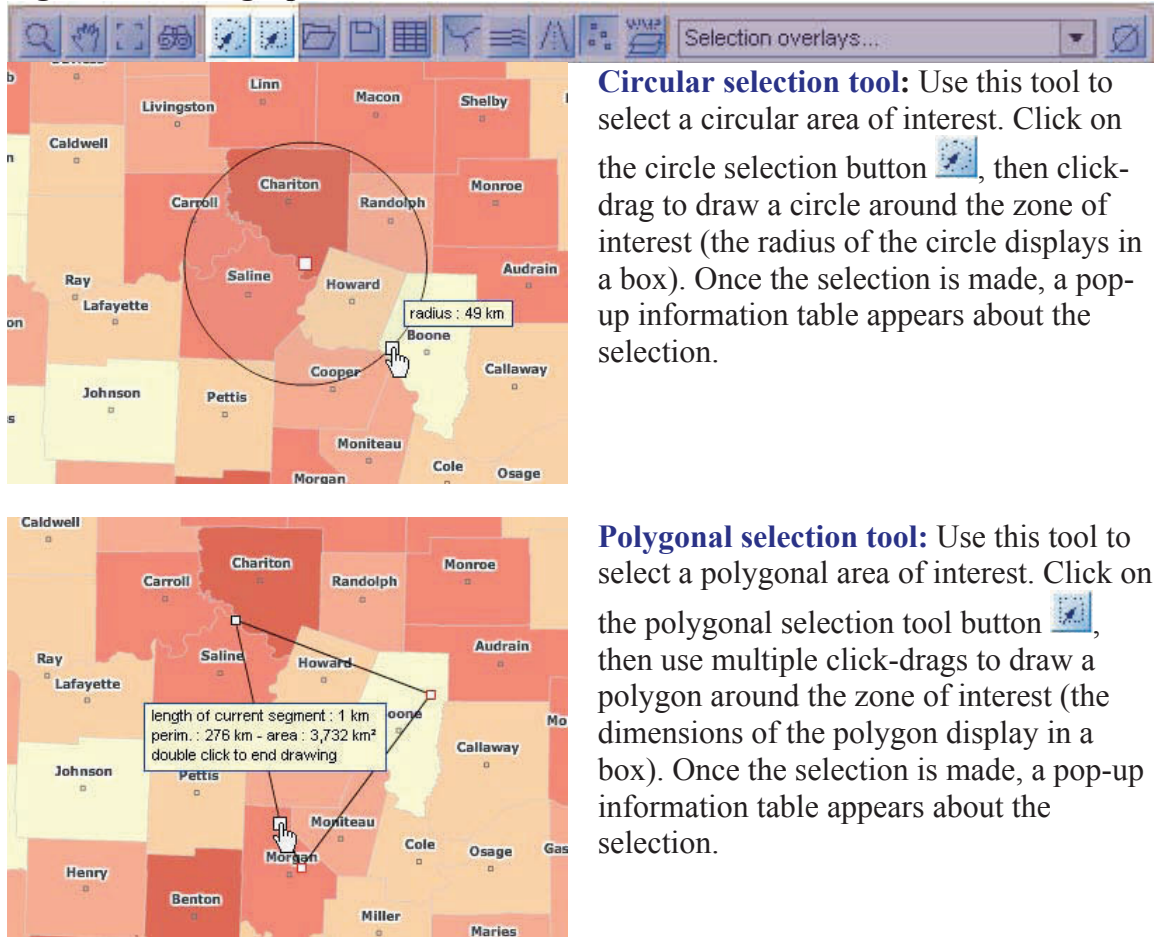


The user can also select geographic units with the search tool , as described in Figure A.10, or with the **circular** and **polygonal selection tools** in the toolbar, as described in Figure A.11.

Figure A.11. Geographic Selection Tools



Circular selection tool: Use this tool to select a circular area of interest. Click on the circle selection button , then click-drag to draw a circle around the zone of interest (the radius of the circle displays in a box). Once the selection is made, a pop-up information table appears about the selection.

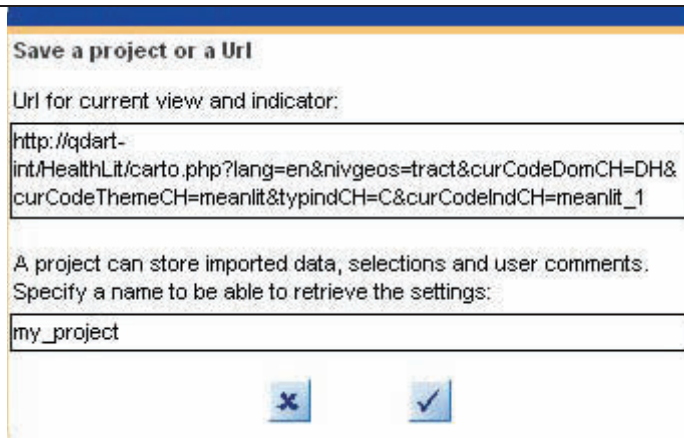
Polygonal selection tool: Use this tool to select a polygonal area of interest. Click on the polygonal selection tool button , then use multiple click-drags to draw a polygon around the zone of interest (the dimensions of the polygon display in a box). Once the selection is made, a pop-up information table appears about the selection.


After selecting the geographic units of interest, the user can use the **save selection** button in the pop-up information table so the selections can be reloaded later (see Section 8).



► Tools to Save and Reload a Project

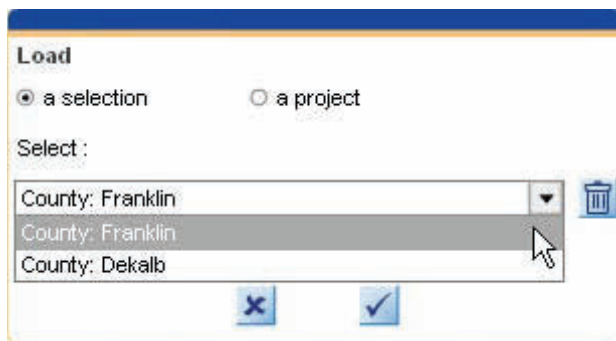
Once the user has selected geographic units of interest, mapped indicators, or generated customized reports or maps, the user can save the work to his or her desktop, share projects with other users, and reload a project into the tool for use at a later time (Figure A.12).

Figure A.12. Tools to Save and Reload a Project






Save a project or a Url: Clicking on the  button will display two options for saving a project. If the user simply wants to be able to retrieve the current map view and indicators without saving any customizations that have been made, the user can copy the URL link provided in the top box.

If the user would like to save a project that contains imported data, specific geographic selections, or user comments on maps and reports, her or she must use the second box to specify a name for the project. Clicking on the  button will save the project as an .XML file on the user's desktop. The  button will close the window without saving the project.



Open a selection or a project:

Use the  button to reload a selection or a project. Clicking on this button will display a window that allows the user to select geographic **selections** or **projects** to reload.

To load a saved geographic selection, first click **a selection** and then select the geographic name from the drop-down menu. Clicking on the  button will load the selection. The  button will close this window without loading a saved selection.

The  button deletes a selection.

To reload a project, select a **project**. The user's computer will open a window for the user to search for an .XML file on his or her desktop.

► Tool to Import Data


It is possible for users to import **their own data** into the tool using the  button in the tool bar (Figure A.13). Data uploaded into the tool can then be mapped using the Indicator Selector. The domain name for imported data is **imported data**. Directions for how to load external data into the tool are described in Section 11.

Figure A.13. Tool to Import Data



► Map Customization Tools

Tools for customizing the map are on the right-hand side of the toolbar, as described in Figure A.14.

Figure A.14. Map Customization Tools



County: Displays county borders on the main map.



Water: Displays major rivers on the main map.



Highways: Displays major highways on the main map.



Cities: Displays major city names (Columbia, Kansas City, Springfield, and St. Louis) on the main map when in the census tract and PUMA views. County names are displayed when in the county view.

► External Layer (WMS) Tool

Figure A.15. External Layer (WMS) Tool



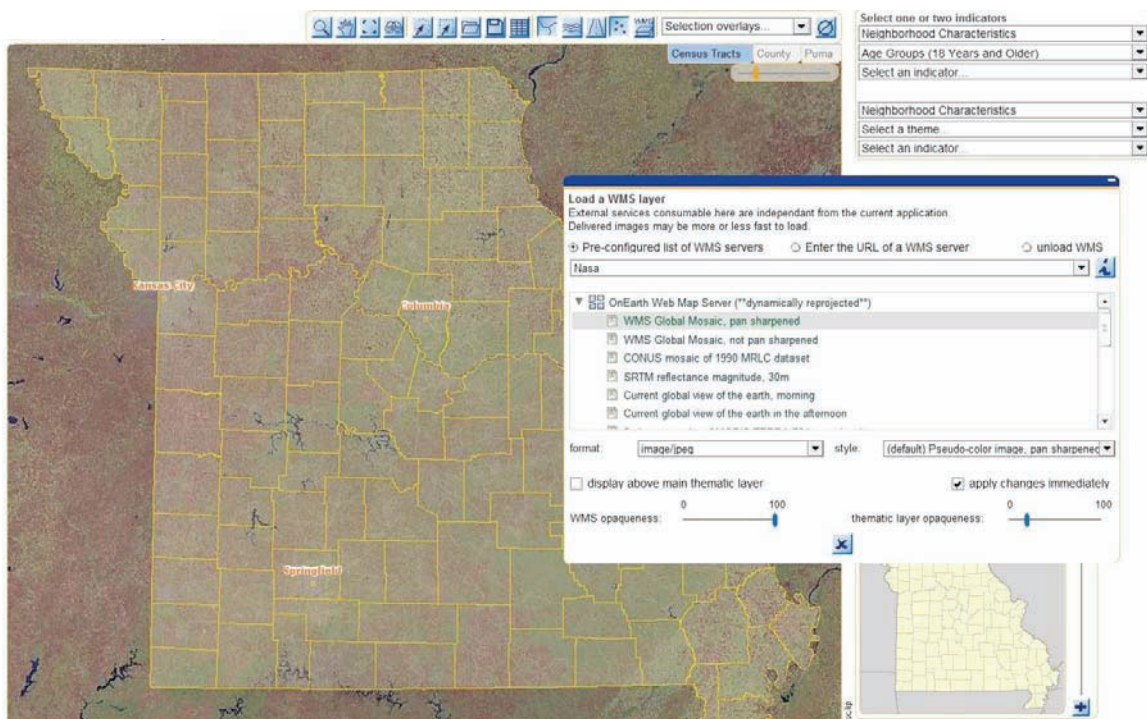
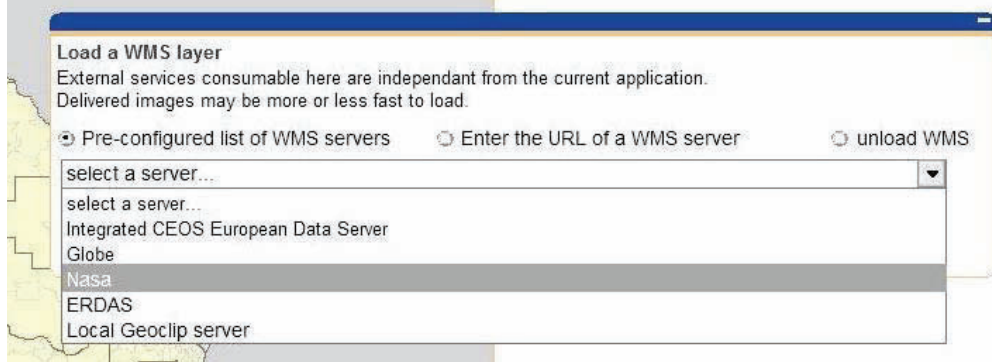
The Web Map Service (WMS) Button opens a panel that allows users to load a WMS and add a layer, such as a satellite image, to enhance the map view of the state, as shown in Figure A.16.

This tool gives the user a choice between selecting from a menu of preconfigured WMS servers that are already linked to the tool and entering the URL of a WMS server of the user's choice. Preconfigured WMSs are

- Integrated CEOS (Committee on Earth Observation Satellites) European Data Server: satellite and topography images
- Globe: satellite and topography images
- NASA (National Aeronautics and Space Administration): satellite and topography images
- ERDAS (Earth Resources Data Analysis System): satellite and topography images
- Local Geoclip server: default map images that are automatically displayed in the tool.

Once a WMS server is selected, a second drop-down menu appears with the available map layers displayed in a tree. Clicking on a layer will overlay the selected layer onto the map. When a layer is loaded onto the map, users can change the **opaqueness** of the map layers. The WMS panel provides a button to unload, or take off, any WMS layers that the user no longer wants.

Figure A.16. Loading a WMS Layer



► **Overlay Selection Tool**

The **overlay selection tool** is a drop-down menu that displays on the main map a transparent overlay of county boards, PUMAs, HPSAs, or MUAs (Figure A.17). Which overlays are available depend on the map view (census tract, county, or PUMA).

Figure A.17. Selection Overlay Tool



The  button to the right of the overlay selection tool erases the overlay.

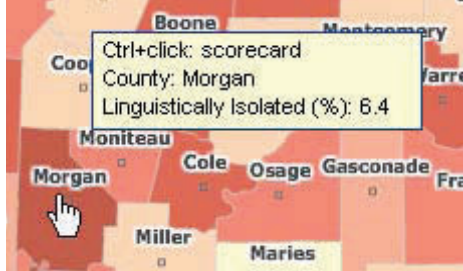
7. Overview of Map Interactivity

The main map is **interactive**. It has three levels of interactivity.

► Pop-Up Box

Moving the mouse over a geographic region displays the name and values of the selected indicator(s) for that region in a **pop-up box** (Figure A.18).

Figure A.18. Pop-Up Box Displaying County Name and Value of Selected Indicator

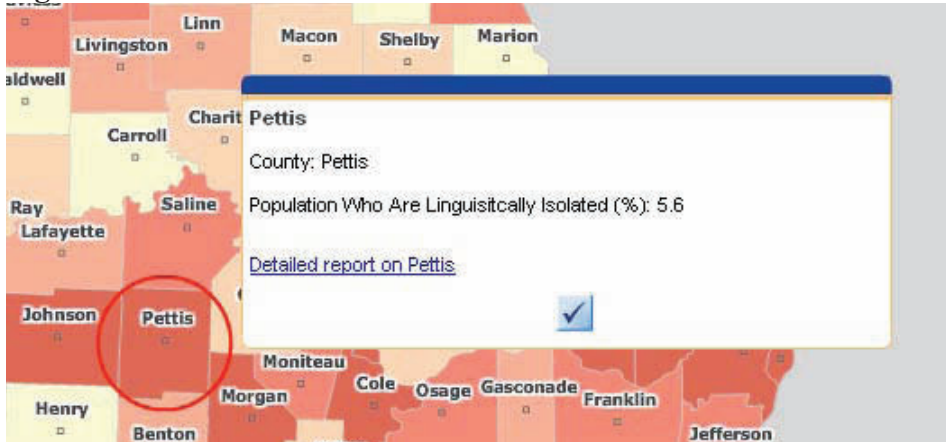


► Scorecard

A second level of interactivity of the tool can be initiated by holding down the control button and clicking on the geographic region of interest (census tract, county, or PUMA). This will open a **scorecard** (Figure A.19). The scorecard provides a summary of the indicator(s) selected.

Note: Macintosh users must enable pop-ups to use this feature.

Figure A.19. Scorecard of Selected Indicator



► Pop-Up Information Table

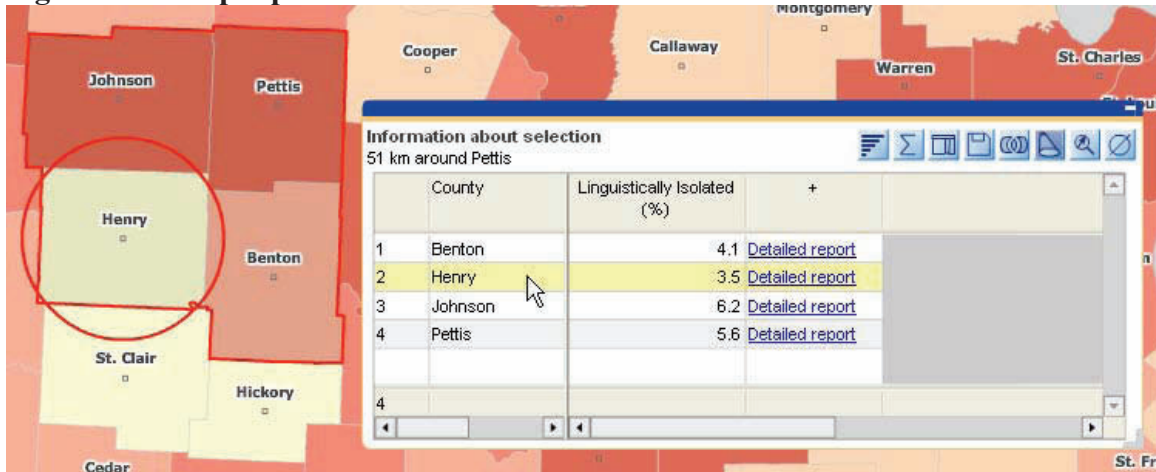
A third level of interactivity, a **pop-up information table**, will be displayed automatically each time a geographic region is selected. More information about the information table and its features can be found in Section 8.

8. Pop-Up Information Table

Clicking on a geographic unit or set of units (by holding down the shift key and making selections) opens a **pop-up information table** about the selection. The geographic unit(s) displayed in the table are highlighted on the map with a thick red line. Figure A.20 shows the information table for four selected counties. The information table can be

- minimized/maximized by clicking the small white icon in the upper right corner
- resized (by clicking and dragging lower-right corner)
- moved to a different location on the main map (by clicking the top of the table and dragging).

Figure A.20. Pop-Up Information Table for Four Selected Counties











Other information table features include the following:

- The table interacts with the map. Moving the mouse over a line in the table highlights the corresponding geographic unit on the map with a red circle, as shown for Henry County in Figure A.20. Conversely, placing the cursor on one of the selected units highlights the corresponding line in the table.
- The rows in the table list the geographic units that make up the selection. The columns in the table display the selected indicators and their values for each geographic unit. By clicking on a column header, the user can sort the table in ascending or descending order.

Tools specific to the information table are found in the upper right-hand corner of the table. These tools are described in Figure A.21. Where indicated, more-detailed descriptions follow in Section 9.

Figure A.21. Pop-Up Information Table Tools




-  This **report about selection** button opens a report window for the selected unit(s) and chosen indicator, as shown in Figure A.20 for health literacy. The report window features are described in Section 9.
-  This **summary** button provides detailed information on the selected domain category. For example, if Quality of Care was selected, the table will display all health outcome and quality-of-care indicators obtained from the data source (in this case, CLS). Data are presented for the selected geographic region (summed and averaged across geographic units if more than one is selected) and for the state of Missouri.
-  This button allows the user to **export data to a spreadsheet**. Instructions on how to export data are described in Section 9.
-  This **saves the selection** button allows the user to name and save the current selection of geographic units to the user's desktop. The user can save multiple selections by providing a unique name for each one. The saved selections can be reloaded into the tool at a later time, as described in Section 6.
-  The **temporary selections manager** button combines selected geographic units by intersection, union, inversion, or subtraction. More information on this feature can be found in Section 9.
-  The **highlights selection** button zooms in on the selected geographic unit(s) and highlights them while darkening surrounding units that are not part of the selection.
-  This button makes it possible to **zoom in on the selection(s)**.
-  This button **deselects** the selection and closes the table.

9. Special Information Table Tools

Three tools on the pop-up information table have special functions that are described in this section.

► Generating Reports

Reports about one or more selected geographic units can be generated by selecting the **reports** button  in the pop-up information table toolbar. (The same button is also found in the lower-right corner of the screen, just under the navigation map, as part of a toolbar labeled **Outputs**.)

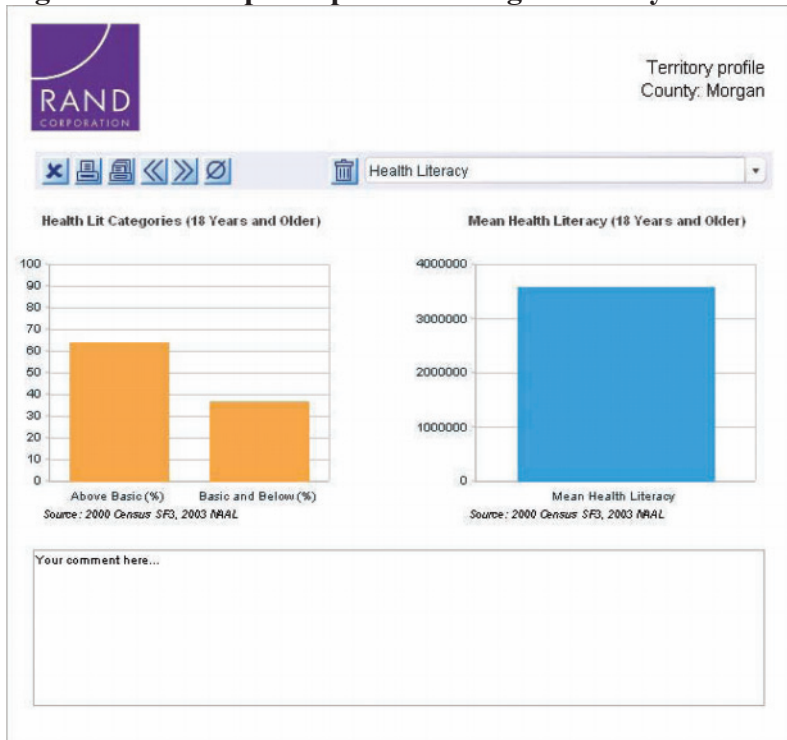
Clicking on the report button opens a new window. The first report to display summarizes health literacy for the selected geographic unit or units in bar chart form, as shown in Figure A.22. If more than one geographic area is selected, the report button generates a single report that combines and averages data across the units. For a report on one specific geographic unit, click on the **detailed report** link in the last column of the table.

Reports for other categories of interest are selected from the drop-down menu, which includes two selections for quality of care and four selections for neighborhood characteristics (described below). Each of these subsequent reports is in table format and includes information on health literacy at the top of each page for reference:

- Quality of Care I—diabetic population
- Quality of Care II—general population
- Neighborhood Characteristics I—age and gender
- Neighborhood Characteristics II—race/ethnicity and language at home
- Neighborhood Characteristics III—linguistic isolation, length of time in United States, marital status
- Neighborhood Characteristics IV—educational attainment, household income.

For each report, the name of the geographic selection (census tract, county name, or PUMA number) is displayed in the upper-right hand corner if only one unit is selected; if more than one unit is selected, the phrase “**Give a name to your selection**” will display. To change the name of the selection, highlight the phrase, delete it, and type in a new name. User notes can be entered into the comment box at the bottom of the page. Each page can be printed using the print button on the report toolbar, which is described next.

Figure A.22. Sample Report for Morgan County



Report Toolbar

The buttons on the report toolbar are shown and described in Figure A.23.

Figure A.23. Report Toolbar Buttons



This button **closes** the report and returns to the map.



The first **print** button will print the page currently displayed. The second button, **print all**, will print all report pages. The toolbar is hidden during printing.



These buttons allow the user to flip to the **previous page** and to the **next page**.



This button **deletes comments** added by the user in the comment box.



This button temporarily **deletes a selected page** of the report prior to printing.

► Exporting Information Table Data to a Spreadsheet


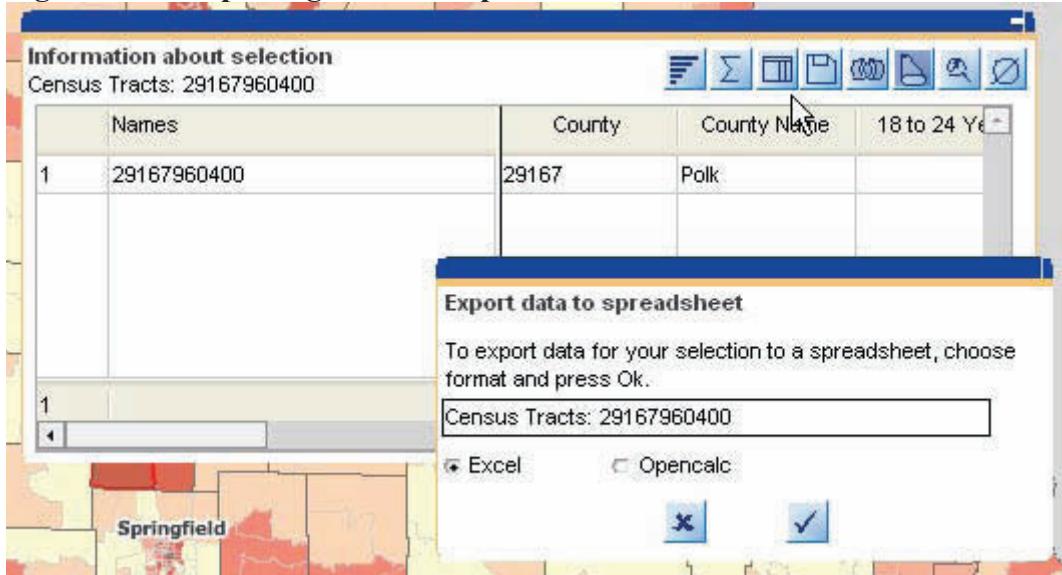
The **export data to a spreadsheet** button  on the pop-up information table toolbar exports data on the geographic selection to a spreadsheet. The user will be asked to select either Excel or Opencalc (Figure A.24). The user is given the opportunity to name the selection by typing the name in the box prior to exporting the data. Clicking the check mark will launch the selected spreadsheet program.


Figure A.24. Exporting Data to a Spreadsheet



For either program (Excel or Opencalc), the results are displayed in a multi-tabbed spreadsheet, with tabs labeled as follows:

- **Indicator 1**, which presents data for all indicators of the first selected theme (e.g., from the top set of drop-down menus in the Indicator Selector on the main map view). Data from each geographic unit in the selection are presented in their own row with the indicators displayed in the columns. A legend describing each variable name is presented at the bottom of the page.
- **Indicator 2**, which presents data for all indicators of the second selected theme.
- **Summary data**, which allow a comparison of the selected indicators between the geographic region(s) of interest and the state of Missouri. State mean, minimum, and maximum values for each indicator are presented in separate columns.

► Managing Geographic Selections

The **Temporary Selections Manager** button  on the pop-up information table toolbar allows the user to use more-advanced features to combine selected geographic units by intersection, union, inversion, or subtraction. This feature may be helpful in identifying overlapping service areas where stakeholders may wish to work together to address poor-quality care.

Once the temporary selections manager has been opened, the user can **record the current selection** (saves the current selection) or **invert the current selection** (this deselects the current selection and selects all other areas) and name the selection (see Figure A.25). Clicking on the check mark will automatically close this window, and a pop-up box will appear confirming that the selection has been recorded. After closing the pop-up box, the user will be back at the main screen, where the user can select another geographic unit or set of units and repeat the process to record another selection. All **recorded selections** are listed in the recorded selections box, as shown in Figure A.25.

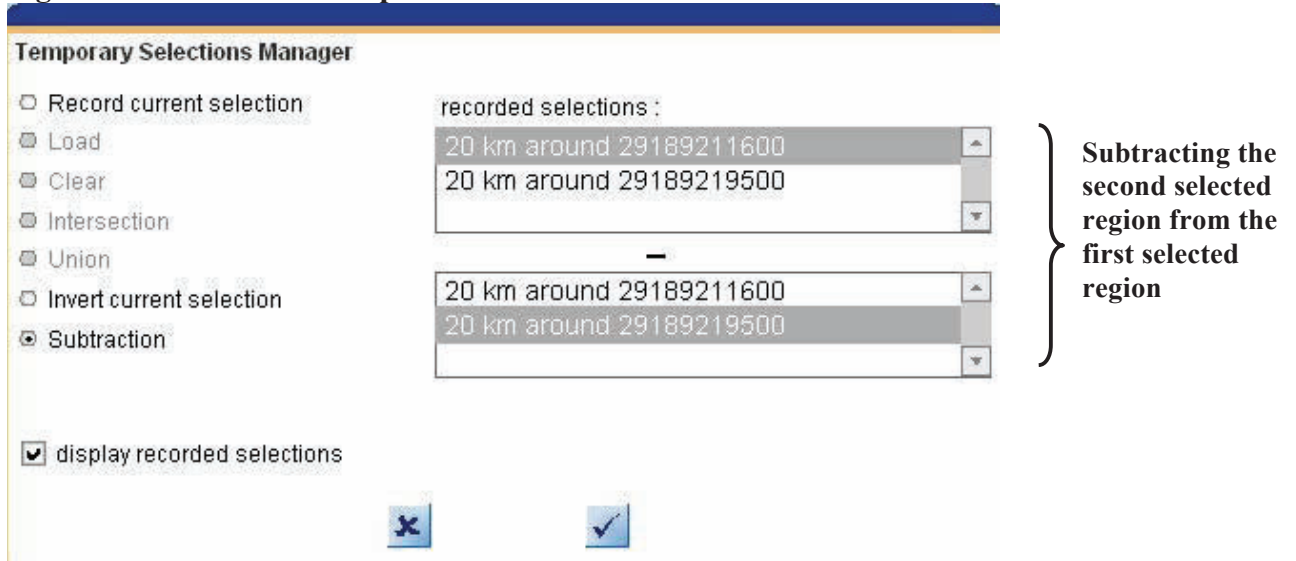
Figure A.25. Temporary Selections Manager Window



To perform basic geographic calculations on the selections, highlight the selections of interest using Control + Click from among the list of recorded selections. The options on the left-hand side will now be active (text color changes from gray to black). Select the option or calculation the user would like to perform and execute it by clicking on the check mark. Figure A.26 shows how the subtraction operation is performed.

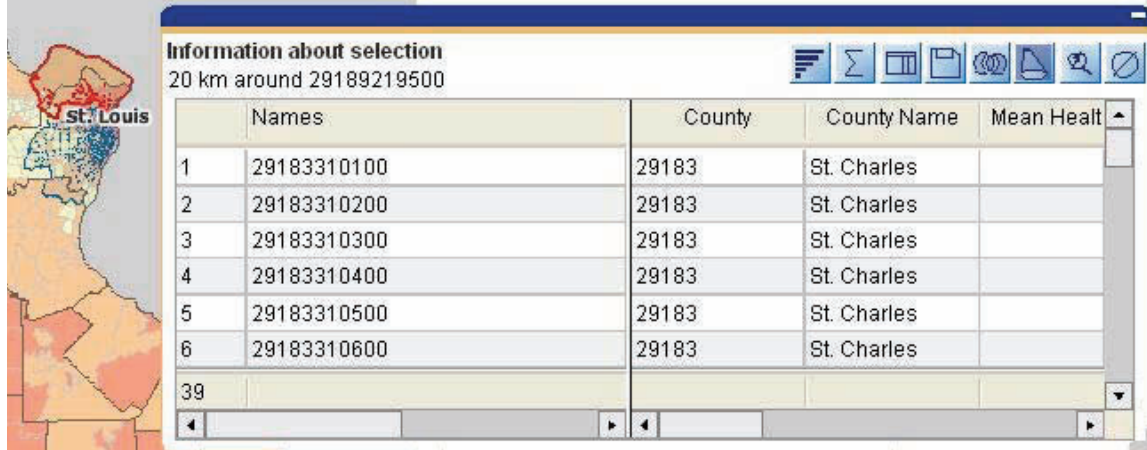
- **Record current selection:** Saves the user's current selection.
- **Load:** Loads the saved selection to the user's Information Table and outlines the selection in red on the main map.
- **Clear:** Clears the highlighted selection from the user's list of recorded selections.
- **Intersection:** Selects the geographic units where the user's selections overlap.
- **Union:** Merges the user's selections into one selection.
- **Invert current selection:** Deselects the current selection and selects all other units.
- **Subtraction:** Selects all geographic units where the selections do not overlap. This is the opposite of Intersection.

Figure A.26. Subtraction Operation



The resulting table in Figure A.27 shows the regions selected for the subtraction operation. The map at left in this figure also displays the selected regions—the red selected area around St. Louis is what was left of the selection after the blue area was subtracted.

Figure A.27. Regions Selected for Calculation



Any new geographic regions created as part of these options can also be saved as a recorded selection by clicking on the Temporary Selections Manager button and repeating the steps described above.

10. Customizing, Printing, and Exporting Maps

► Customizing the Map


The user can customize the map to add labels, insert text, and highlight geographic regions on the map. These customizations are done in **layout mode**. Clicking on the **print/export** button  in the Outputs toolbar at the bottom-right corner of the main map view under the navigation map automatically brings the map into layout mode. In layout mode, the main toolbar and Indicator Selector drop-down menus are hidden.

Figure A.28 shows a map in layout mode, which includes a palette of **annotation tools** that are described in Figure A.29. The annotation tool buttons are not displayed when a map is printed.

Figure A.28. Layout Mode for Customizing the Map

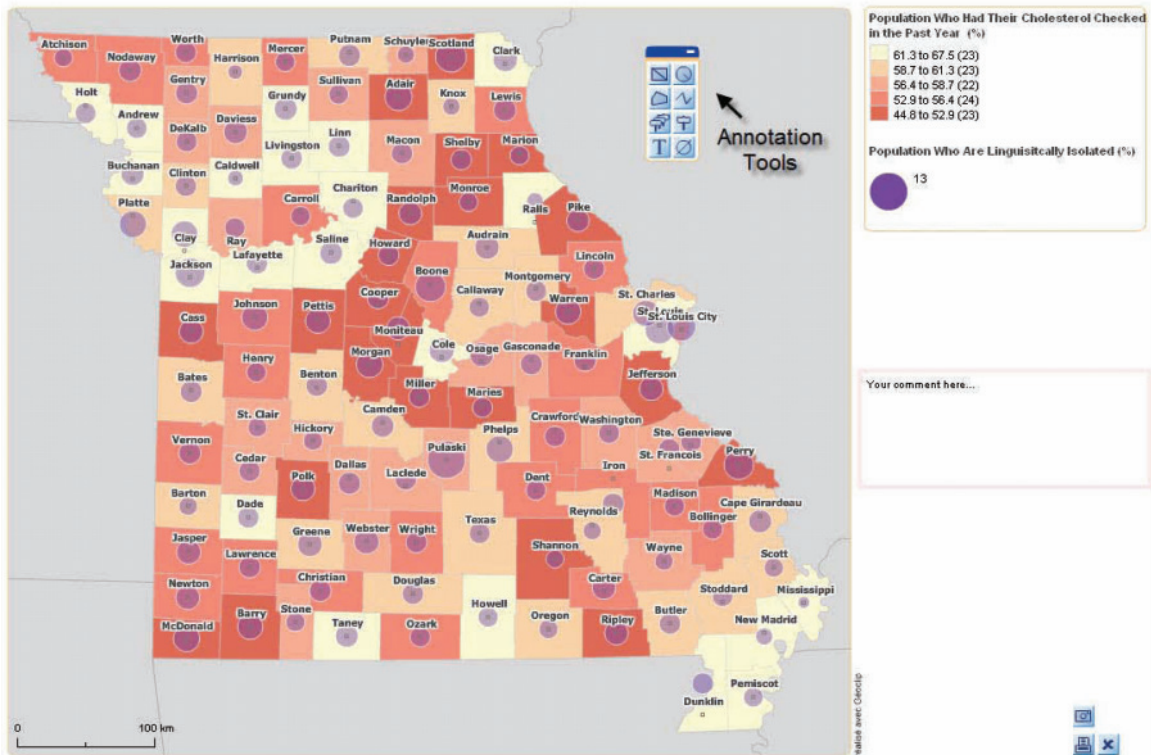


Figure A.29. Annotation Tools to Customize the Map



Draws a **rectangle**.



Draws a **circle**.



Draws a **polygon**.



Draws a **polyline**, a series of connected lines.



Auto label inserts census tract numbers, county names, or PUMA numbers into the map, depending on the level of geography displayed. To preserve readability, the tool will only generate 100 automatic labels and will request that the user zoom in on the map to automatically label a region with more than 100 units.



Allows the user to **label a feature**. This label is populated by the tool and includes the name or number of the geographic unit as well as the values for the mapped indicator(s).



Text allows the user to insert text onto the map. To insert text, click on this button and then click on the map where the user wants to insert the text.



Deletes all customizations.

► Printing and Exporting a Map

Once the user is satisfied with the look and customizations of the map, the user can print or export the map using the icons at the bottom right side of the layout page.

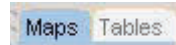
Use the  button to **print** the map in high resolution. We recommend using landscape mode when printing.

Use the  button to **export** the map. A drop-down menu will be displayed to select the export format. Formats include

- AGG-JPEG Anti-alias
- PDF
- PNG
- GIF
- JPG 780 × 550
- JPG 12,000 × 850
- JPG 1,500 × 1,050
- Photo.

11. Customizable Information Tables

In addition to the pop-up information tables described in Section 8, the user can create customizable, more-detailed tables about a geographic region by changing the view from Maps to Tables (using the tab in the bottom-right corner of the main map view window).




The table is configured with the geographic units presented in the rows and the indicators in columns (Figure A.30). If a geographic selection has already been established in the map area, it is saved in this table. Otherwise, data will display for the entire state of Missouri at the level selected on the main map (i.e., census tract, county, or PUMA).


Figure A.30. Customizable Information Tables





A screenshot of the 'Customizable Information Tables' interface. At the top, there are tabs for 'County', 'perc_income_1', 'iso', and 'all_cholchk_y', followed by '+' and '-' buttons. Below this is a text input field labeled 'Define the table title...'. The main table has four columns: 'County (115 units)', 'Households Below Federal Poverty Level (%)', 'Linguistically Isolated (%)', and 'Received Cholesterol Test (%)'. The table contains data for several counties, including Adair, Andrew, Atchison, Audrain, Barry, Barton, and Bates. At the bottom, there is a 'total' row and a '+ -' button. On the right side of the table, there are icons for statistical indicators and shaded layers for each column.

County (115 units)	Households Below Federal Poverty Level (%)	Linguistically Isolated (%)	Received Cholesterol Test (%)
29001 - Adair	24.4	6.6	50.8
29003 - Andrew	9	3.8	64.8
29005 - Atchison	12	3	53.5
29007 - Audrain	12.9	5.3	61.2
29009 - Barry	15.4	5.8	52.4
29011 - Barton	14.6	3	60.2
29013 - Bates	14.7	4.4	59.6
total			

To change the geographic level of the table (e.g., census tract, county), click on the green button at the top left of the table that specifies which geographic level is currently displayed. This will generate a pop-up box in which the geographic level of interest can be selected.

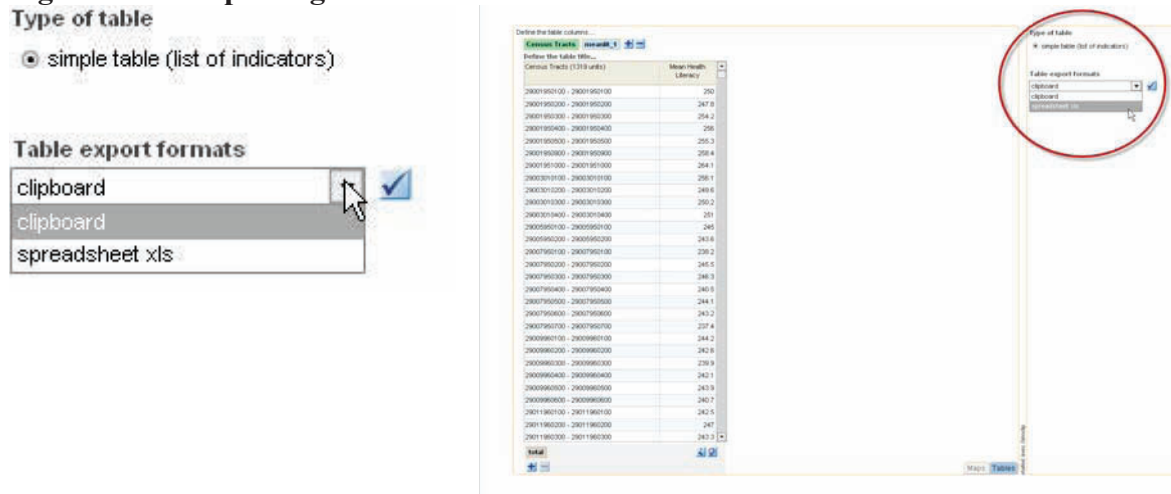
The  button at the base of each column provides the **statistical indicators**: minimum, maximum, average, variance, standard deviation.

The  button at the base of each column reconstructs the map area with the data of the column selected represented as the **shaded** layer.

The  and  buttons *at the bottom* of the table (under the first row) are used to add or remove a reference area (e.g., state of Missouri) to the table. If selected, the reference area is displayed as another row in the table. The  and  buttons *at the top* of the table are different and configure the table columns. This is described in more detail below.

The data in the table can be **exported** to a clipboard or an Excel spreadsheet through the panel located on the right-hand side of the table area (Figure A.31).

Figure A.31. Exporting Data from the Information Tables



► Configuring Columns in a Table

Use the **+** and **-** buttons *at the top* of the table to add or remove an indicator. The **+** button will launch a **configuration panel** in which the user can select a new indicator (Figure A.32). The **-** button launches another pop-up window to select the indicators that are to be removed from the table.

Figure A.32. Configuration Panel to Add an Indicator to the Information Table

In this panel, the user can select an existing indicator from the drop-down menus, just as in the Indicator Selector area of the main map.

A **mathematical formula** can also be defined using existing indicators. The formula label and description can also be added.

Computed statistic: Selects the type of statistic (e.g., value, percentage, ranking) for the mathematical formula.

Sorting indicator: The table can be sorted by up to three variables. The sorting indicator notes whether this variable is being used to sort the table and, if so, whether it is the first, second, or third variable. It also lists whether the sort is in ascending or descending order.

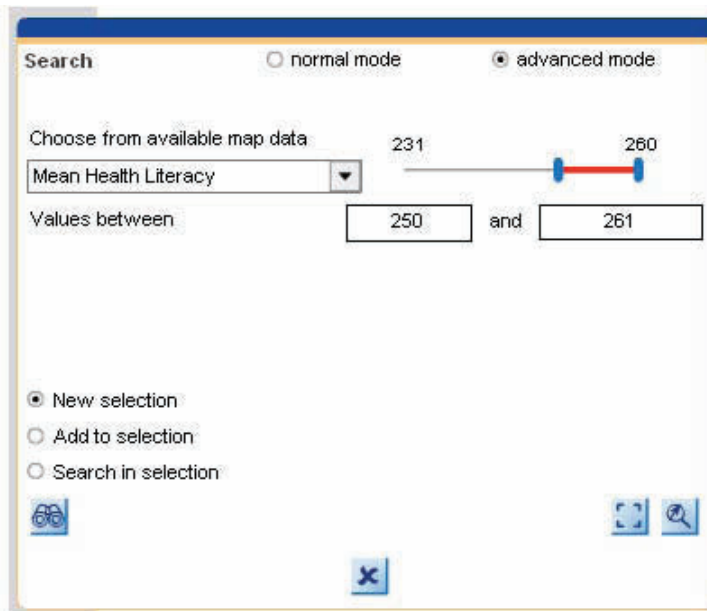
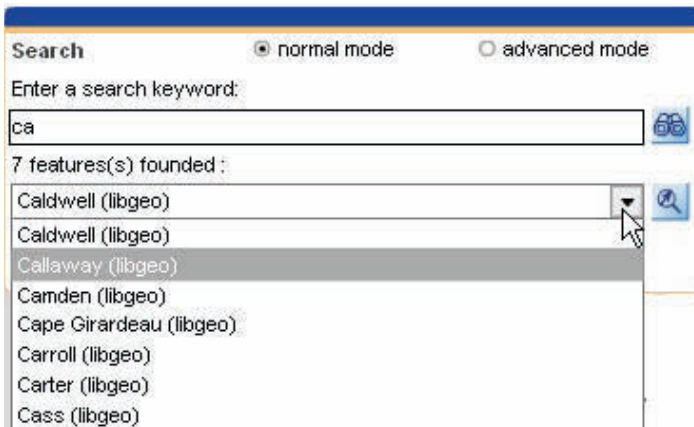
Compute total for column: If the box is ticked, the sum will be computed for that column.

The user can change the order of the columns by clicking and dragging the blue boxes above the table (refer to Figure A.30). These boxes contain the variable names that correspond to the indicators tabled.

12. Advanced Functions

► Simple and Advanced Searches

Figure A.33. Advanced Search Features



Use the **search** button in the toolbar above the main map view to search for geographic units. This toolbar is shown in Section 6.




Normal mode (simple search by name): Search for geographic units using their names (or part of their names). Click on the name of the unit in the drop-down menu to select it.

Advanced mode (search by value): Search for geographic units that meet a condition for one or more of the variables shown. For example, search for geographic regions in which the mean health literacy of the population is between 250 and 261.

The user can expand the results by clicking **add to selection** and conducting another search—this will include geographic units that meet either search criteria.

The user can narrow the results by clicking **search in selection** and performing another search—this will leave only those geographic units that meet both search

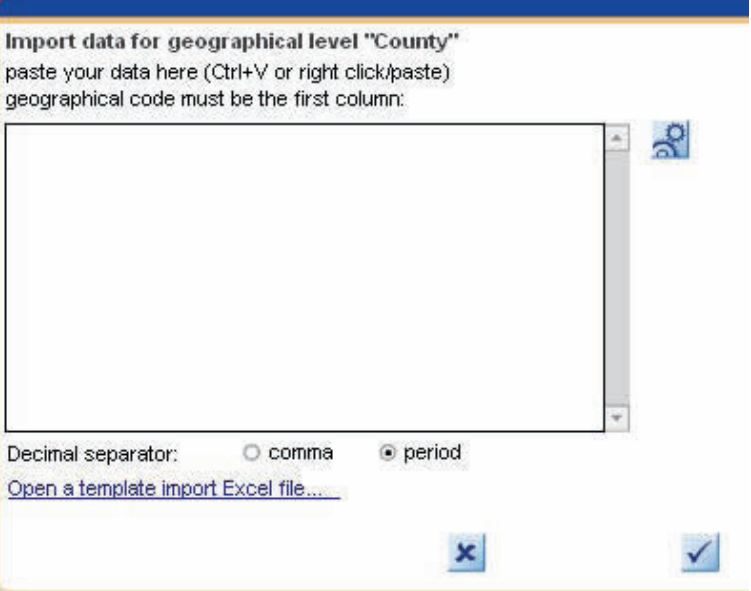
criteria.


-  performs the search.
-  restores the initial map frame following a zoom.
-  zooms in on the selection.

► Loading External Data

It is possible for users to load **their own data** into the mapping tool. Uploaded data can then be accessed using the Indicator Selection tool on the main map view in the same manner as other indicators. Figure A.34 describes the steps to import data.

Figure A.34. Steps to Loading External Data




Step 1. Select the geographic level corresponding to the user's data (e.g., census tract, county). Then click the **load external data** button  on the toolbar in main map view. This button launches a panel allowing the user to import data and specify the representation modes for the maps.

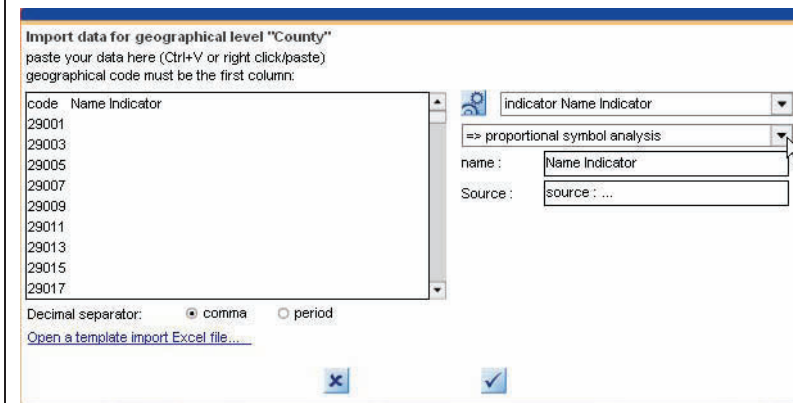
Step 2. Click on the link "Open a template import Excel file" located at the bottom of the pop-up box.

	A	B	C
1	import file model		
2			
3	fill in and copy/paste range begining with column 'code'		
4	columns name must be included		
5			
6	name	code	Describe your
7	Adair	29001	
8	Andrew	29003	
9	Atchison	29005	
10	Audrain	29007	
11	Barry	29009	
12	Barton	29011	
13	Bates	29013	
14	Benton	29015	
15	Bollinger	29017	
16	Boone	29019	
17	Buchanan	29021	
18	Butler	29023	
19	Caldwell	29025	
20	Callaway	29027	
21	Camden	29029	

Step 3. An Excel file will appear, with the names of regions and codes specific to that geographic level (e.g., it will list all county names and numbers if working in the county level). The third column, labeled **“Describe your own data here,”** is where users enter or paste their data. The data must include the name of the variable on the first line (replacing “describe your own data”), with the corresponding values entered below.

Step 4. Highlight and copy columns B and C with the geographic unit codes (supplied by the tool) and the user’s data. Paste these two columns into the panel in the tool that was launched in step 1.

Step 5. Click on the **import data** button  to launch the analysis of imported data.



Step 6. Select the representation for the data from the drop-down menu and **refine the definitions as needed.** By default, the variables with decimal values are presented as shaded regions, while the variables with integers are shown as symbols.

Step 7. The user may also specify the **name** of the indicator and the data **source.** The uploaded data can be accessed under the **Imported Data domain** and the **Imported Data theme** on the **Indicator Selector drop-down menu** on the main map view. The

indicator will be labeled what it was named when the data were imported. Adjustments to the display of the indicator are done directly in the map legend.

Step 8. Import the data into the tool by clicking on the  button.

The uploaded data can be accessed at any time during the session. They can also be saved for future access using the **save a project** function, as described in Section 8.

13. Case Study: The Mapping Tool in Action

Identifying Overlapping Hot Spots of Low Health Literacy and Colon Cancer Screening

This case study demonstrates step-by-step how Missouri stakeholders might use the mapping tool to improve colon cancer screening in areas of the state with low health literacy.

Step 1: Map the percentage of colon cancer screening.

It is helpful to see the geographic distribution of colon cancer screening across Missouri. Since this is a CLS variable, it is not available at the census-tract level, so we examine the county-level distribution of colon cancer screening.

- First, make sure **county** is selected as the geographic unit using the change view tab at the top right of the main map view.
- Using the upper drop-down menu on the Indicator Selector, select **colon cancer screening** as the indicator to be mapped. This is done by selecting *Domain: Quality of Care; Theme: 2007 County Level Survey; Indicator: colon cancer screening (%)*. (Note: this operation cannot be performed if **tract** is selected as the geographic unit.)

The result is a map (Figure A.35a) displaying the percentage of the population that has received colon cancer screening. The map legend shows that there are 23 counties where less than half (≤ 50.9 percent) of the population has had appropriate screening—these are highlighted dark red on the map. **Tip:** Clicking on the dark red box in the legend highlights only these 23 counties on the map for easier viewing; the rest of the map turns white (Figure A.35b). Clicking again on the dark red box in the legend restores the original view.

Figure A.35a. Map of the Percentage of the Population That Has Received Colon Cancer Screening

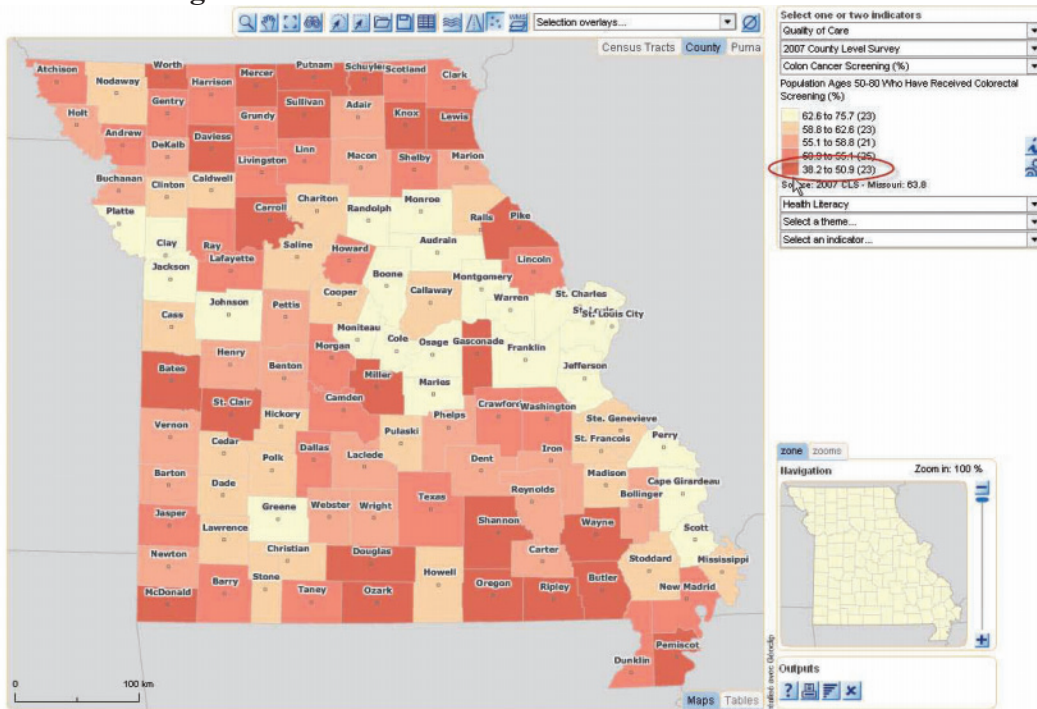
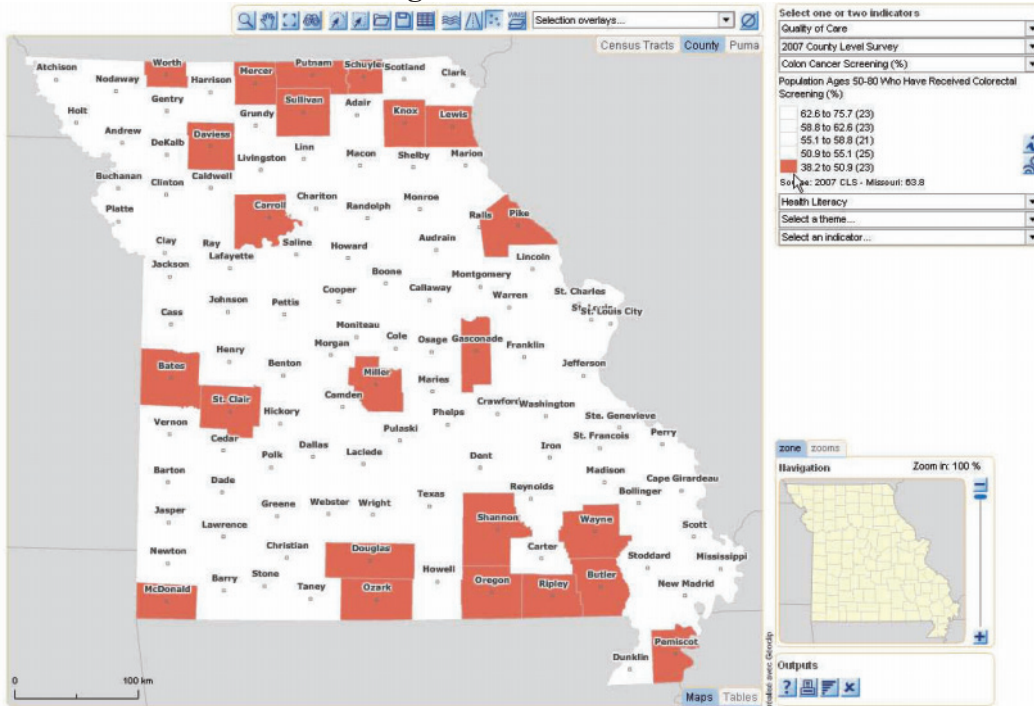


Figure A.35b. Map of Counties Where Less Than 50 Percent of the Population Has Received Colon Cancer Screening

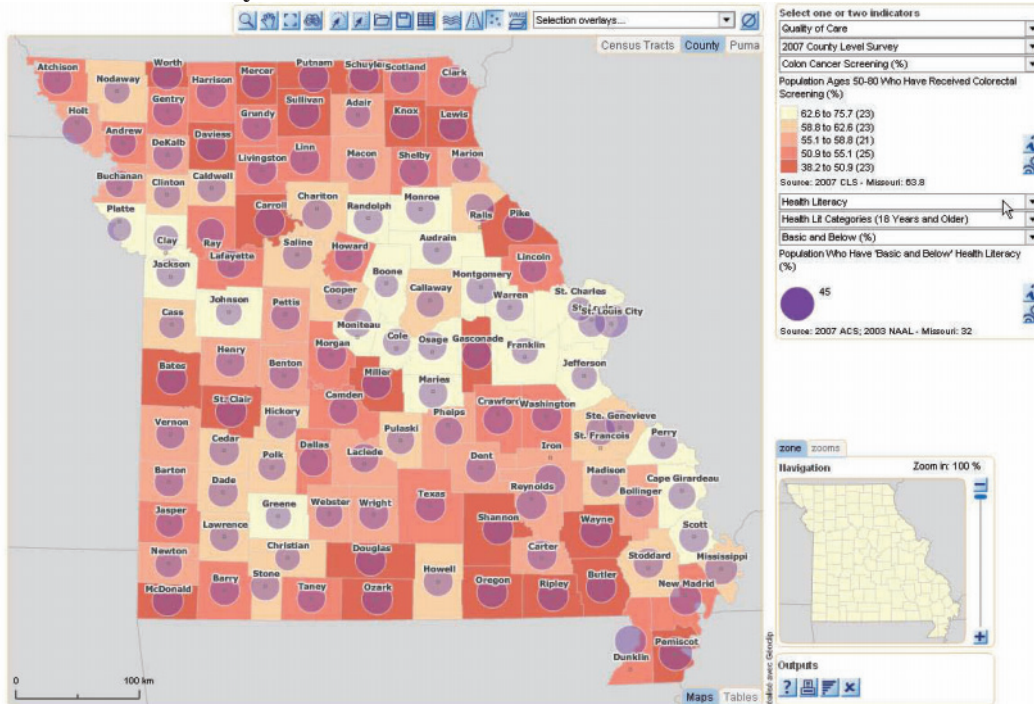


Step 2: Map the percentage of the population with basic or below basic health literacy.

- Using the lower drop-down menu on the Indicator Selector, select *Domain*: health literacy; *Theme*: Health Lit Categories; *Indicator*: Basic or Below (%).

The result is a map, superimposed on the first map (Figure A.36), showing the percentage of the population with basic or below basic health literacy using proportional symbols (circles). Counties with larger circles have a higher proportion of their population with basic or below basic health literacy.


Figure A.36. Map of Colon Cancer Screening and Percentage with Basic or Below Basic Health Literacy



Step 3: Identify counties with LHL and low rates of colon cancer screening.

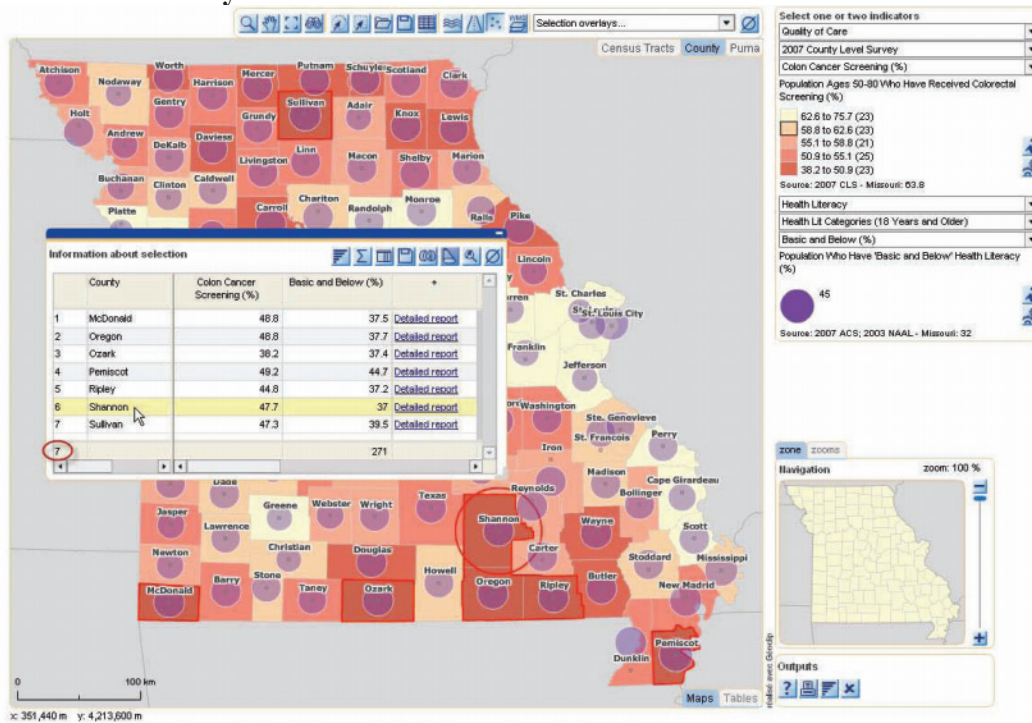
Moving the cursor over each county displays a box showing the percentage of the population in that county that has received colon cancer screening and the percentage of the population with basic or below basic health literacy.

The user can also identify potential overlapping hot spots of low colon cancer screening rates and LHL by using the advanced search function:

- Leaving the map and indicators as is, click on the **search button**  in the toolbar at the top of the page.
- Click on “advanced mode.”
- Select colon cancer screening from the drop-down menu. Then set the values for the range of colon cancer screening of interest by either sliding the scale ends or directly inputting the numbers into the boxes. For this case study, the values are set between 38.2 percent (the lowest in the state) and 49.9 percent.
- Click “new selection” and then the search button. An information table will pop up showing the 16 counties in Missouri meeting these criteria. For each county, the table provides information on colon cancer screening and health literacy and a link to access detailed, printable reports.
- Next, while still in search mode, select “basic and below” from the drop-down menu and again set the values of interest. For this case study, we select counties that have at least 37.0 percent of their population with basic or below basic health literacy.

- Click “search in selection” and the search button, and the tool will look for geographic areas that meet the specified health literacy criteria *within* those counties that also met the criteria set for colon cancer screening rate.
- Seven counties remain that meet both criteria (less than half of the eligible county has been screened for colon cancer, and at least 37.0 percent has health literacy classified as basic or below). These seven counties— McDonald, Oregon, Ozark, Pemiscot, Ripley, Shannon, and Sullivan—are shown in Figure A.37.
- Those seven counties are highlighted on the map with a thick red outline. The table and map interact with each other; if the cursor is placed over a county name in the table, a corresponding red circle will be drawn around the county on the map.

Figure A.37. Display of Seven Counties Meeting Search Criteria for Colon Cancer and Health Literacy



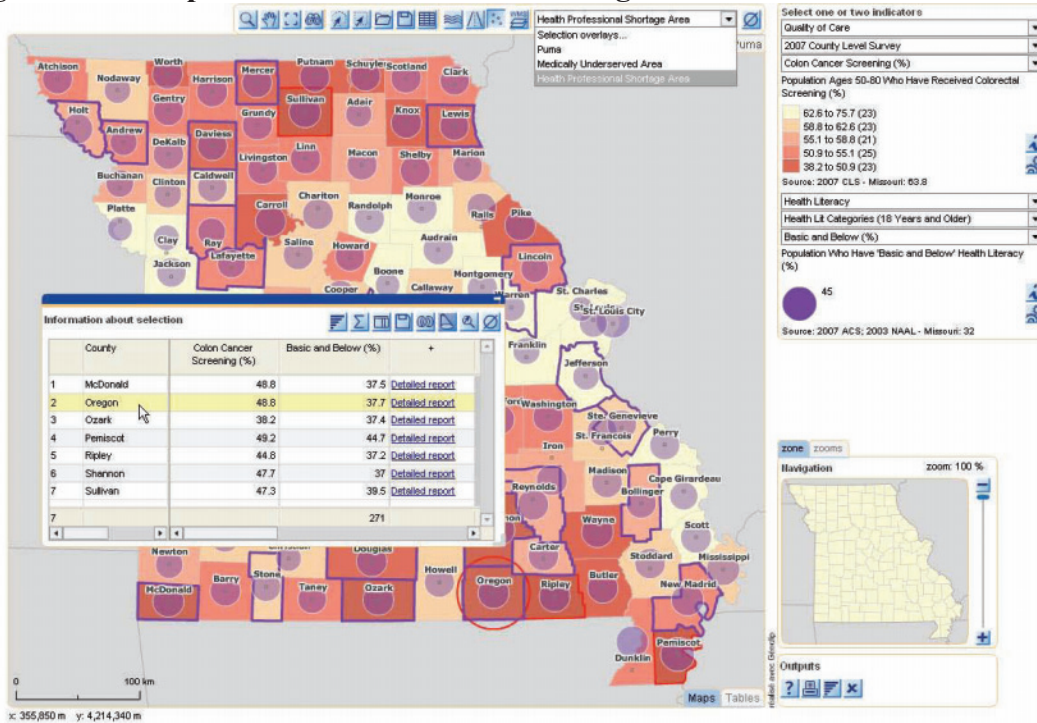
Step 4: Map contextual information to inform decisionmaking.

Although the seven counties identified in the previous step have large proportions of their population with basic or below basic health literacy skills, other reasons for the low rates of colon cancer screening may be important for stakeholders to consider prior to implementing an intervention. In this case study, stakeholders might consider whether a shortage of health professionals is a contributing contextual factor.

- This issue is examined by selecting “Health Professional Shortage Areas” from the **selection overlay** drop-down menu in the toolbar at the top of the map, as shown in Figure A.38. This step outlines the HPSAs in dark purple.

This resulting map shows that several counties of interest are highlighted as HPSAs, suggesting that the shortage of health professionals in these areas may contribute, in part, to the low rates of colon cancer screening. The user can see which of the seven selected counties also are HPSAs by moving the cursor over the counties listed in the selection table. As the user moves the cursor up and down the list, the corresponding county will be highlighted with a red circle. The user can then identify by visual inspection whether the counties of interest are also HPSAs (e.g., Oregon County in Figure A.38).

Figure A.38. Map of Health Professional Shortage Areas

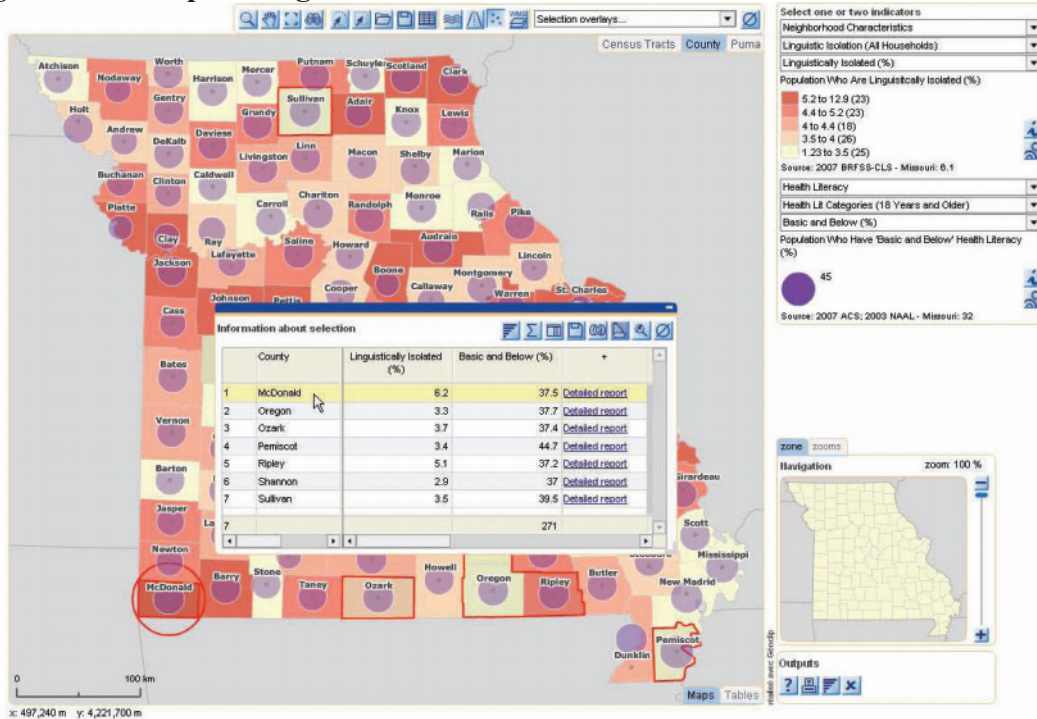


Neighborhood characteristics, such as linguistic isolation, may also contribute to low rates of colon cancer screening, and they may have significant implications for the type of intervention selected for a given area.

- To examine linguistic isolation in the seven counties of interest, replace “colon cancer screening” with “linguistic isolation” in the upper drop-down menu of the Indicator Selector.

The resulting map and pop-up information box in Figure A.39 show us that McDonald County has a relatively high rate of linguistic isolation (6.2 percent), suggesting that stakeholders working in this region may benefit from addressing potential language barriers in addition to general health literacy.

Figure A.39. Map of Linguistic Isolation

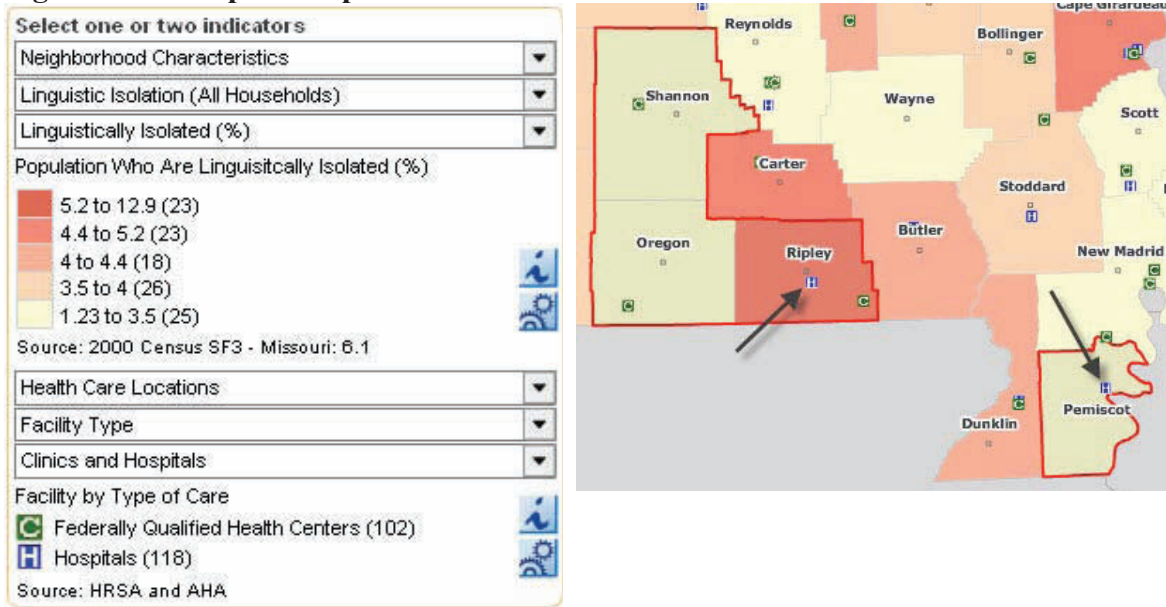


A lack of hospitals within a region may also contribute to the lower rate of colon cancer screening.

- To examine facility type, select “health care locations” from the lower drop-down menu on the Indicator Selector.

As shown in Figure A.40, only three of the seven counties of interest contain hospitals (H). Two of those three counties are displayed in Figure A.40.

Figure A.40. Map of Hospitals



Summary

This case study demonstrates only a few of the many features of the mapping tool that make it flexible and customizable. Definitions of *low-quality care* or *LHL*, for example, should be made on a case-by-case basis by stakeholders because they are likely to vary significantly depending on the scope of the problem, project resources, and other factors, such as geographic or jurisdictional boundaries.

It is important to note that, in its current form, this tool is best thought of a prototype. Data included in the tool represent only a limited number of health outcomes and quality indicators, neighborhood characteristics, and contextual factors. This prototype tool was also not designed to replace local knowledge of the community. Rather, it can help triangulate findings, jump-start dialogues with other stakeholders in the community, and highlight the geographic distribution of LHL and health outcomes that may not have been evident prior to mapping them with this tool.

Estimating Health Literacy

Estimates of community-level health literacy included in the prototype mapping tool are based on work completed during an earlier phase of this project to develop two predictive models of health literacy using data from the National Assessment of Adult Literacy (Lurie et al. 2010; Martin et al. 2009). These models, when applied to census-derived variables for small geographic areas, provide an estimate of the percentage of individuals within a region with “basic” or “below basic” health literacy skills, as well as mean health literacy scores. This appendix provides an overview of the development of the RAND predictive models of health literacy.

Data Sources

Primary data source

Health Literacy Data from the National Assessment of Adult Literacy. NAAL is an in-person assessment of English-language literacy among a nationally representative sample of English-speaking U.S. adults age 16 and over. NAAL was conducted by the U.S. Department of Education (National Center for Education Statistics 2003) and was the first large-scale, nationally representative assessment of health literacy in the adult population of the United States. The goal of the NAAL was to measure general literacy by assessing the extent to which individuals could understand and use written materials encountered in everyday activities (e.g., reading a bus schedule or newspaper editorial). In addition to assessing general literacy, the NAAL included 28 items specific to health literacy that assessed the ability to effectively use written health-related materials (e.g., a medication label, written directions from a doctor, a consent form) (White and Dillow 2005). Responses to these items were used to create our predictive models of health literacy. More information about the NAAL, its sampling, and scoring procedures can be found in the 2006 National Center for Education Statistics report (National Center for Education Statistics 2006).

Secondary data sources

American Community Survey (ACS). We used Public Use Microdata from the 2007 American Community Survey (U.S. Census Bureau 2008) to produce estimates of health literacy for the 41 PUMAs within Missouri. The ACS is conducted by the U.S. Census Bureau and collects census information every year instead of every ten years. A PUMA has a population of approximately 100,000 individuals and is the smallest sub-state geographic area currently available with *individual* demographic data in the ACS.

U.S. Census 2000. To enable the prediction of health literacy at the census-tract level, we used *aggregate* demographic data from the 2000 Census Summary File 3 (SF3) (U.S. Census Bureau 2002a; U.S. Census Bureau 2002b; U.S. Department of Commerce et al. 2004). Census tracts are small, relatively permanent statistical subdivisions of a county, with approximately 2,500 to 8,000 people residing in each tract.

Definitions of Study Variables

Health Literacy. *Health literacy* is defined as the “degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (Ratzan and Parker 2000). The NAAL measured health literacy on a scale ranging from 0 to 500 points, with a national mean of 245 points. In addition to the continuous scores, four performance levels were created by the National Research Council to reflect an individual’s ability to successfully complete tasks of a given difficulty: proficient, intermediate, basic, and below basic (see Table B.1) (National Center for Education Statistics 2006).

Table B.1. Selected Health Tasks by Health Literacy Score

NRC Performance Levels and Corresponding NAAL Health Literacy Scores	Percentage of Population	Activity
Proficient (310–500)	12	<ul style="list-style-type: none"> • Calculating one’s personal share of employer health costs using a table • Finding definitions for complex medical terms • Interpreting legal documents and applying the information to specific healthcare situations
Intermediate (226–309)	53	<ul style="list-style-type: none"> • Determining a healthy weight range for one’s height based on a BMI graph • Finding the age range for certain childhood vaccines using a recommendation chart • Determining the times at which one can take a medication, based on instructions on the prescription label • Identifying three substances that may interact negatively with an over-the-counter drug to produce side effects, based on the information provided on the package
Basic (185–225)	22	<ul style="list-style-type: none"> • Interpreting a clearly written pamphlet to determine two reasons a person should be tested for a disease even without symptoms • Explaining how a chronic disease may be asymptomatic based on a one-page article about the medical condition
Below Basic (0–184)	14	<ul style="list-style-type: none"> • Interpreting a clearly written pamphlet to determine how often one should have a certain medical test • Identifying what one can and cannot drink before a medical test based on a short set of instructions • Circling the date of a medical appointment on an appointment slip

SOURCE: Kutner et al. 2006.

Sociodemographic characteristics. To maximize the utility of the models to stakeholders hoping to advance action on health literacy, we restricted sociodemographic characteristics to those available in the 2000 Census and the 2007 American Community Survey. We included age, gender, race/ethnicity, education, marital status, poverty status, language spoken in home, linguistic isolation, and years residing in the United States. For all variables except race/ethnicity, characteristics were calculated for individuals age 18 and over residing in the geographic region. For race/ethnicity, we used the distribution of the entire population because the census tables do not provide information on the distribution of race/ethnicity by age.

Analytic Approach

Two predictive models of health literacy were developed. The first was a linear model that predicted the mean (average) health literacy score. The second was a linear probability model that predicted the percentage of the population scoring at the “above basic” level of health literacy (i.e., health literacy in the intermediate or proficient range). We modeled “above basic” literacy so that the coefficients between the two models were consistent in their direction. In other words, for both models, positive coefficients are related to higher health literacy.

Once the predictive models had been developed, we used information about the demographic makeup of each PUMA or census tract (e.g., 47 percent female, 53 percent male) obtained from the ACS or 2000 Census to generate an estimate of health literacy for a given geographic area. Given that the ACS utilized individual-level data, probability weights were used to compute weighted summary statistics representative of the population in each PUMA.

We derived the standard error of the health literacy estimates in three stages. First, we addressed the sampling error in the NAAL by taking the NAAL replicate weights into account when producing the within-imputation variance. Second, we accounted for uncertainty in individual scores arising from the use of plausible, or imputed, values by including the between-imputation variance in the standard error formulation. Finally, we addressed the sampling and nonsampling error in the secondary data sources (e.g., the ACS, the 2000 Census) through the use of design effect adjustments in the Census SF3 files and replicate weights in the ACS.

Results and Discussion

Table B.2 presents the models predicting mean health literacy score in column 2 and the probability of having “above basic” health literacy in column 3. All variables, with the exception of living in a Metropolitan Statistical Area (MSA) and language spoken at home, contributed significantly to the models. The adjusted R^2 of the models suggests that they account for about 30 percent and 21 percent, respectively, of the variance in health literacy scores.

While the results of these models are consistent with previous work in this area, several findings merit further comment. First, the strength of the association between race/ethnicity and health literacy was somewhat surprising. It may be explained in part by unmeasured factors, such as quality of education. Schools serving a high proportion of

minority students, for example, are less likely to offer advanced placement courses and to have effective teachers in terms of years of experience and number of teachers with certifications in their primary teaching field (Rueben and Murray 2008). Given that racial/ethnic minorities tend to cluster in both inner-city and rural areas where the quality of education may be lower, this may help to explain the observed racial/ethnic differences in health literacy.

Somewhat surprising was the lack of association between language spoken in the home and health literacy. Results from our models suggest that recent immigration to the United States, rather than language spoken at home per se, is a stronger predictor of health literacy. Note, however, that our models were based on NAAL data, which assess health literacy in the English language. Therefore, people's health literacy skills may be higher in their native language than estimated by our models. While we do not know how well these area-level estimates perform in areas that are primarily non-English speaking or that are new-immigrant destinations, we note that, at least in Missouri, new-immigrant destination areas are also areas of low health literacy.

No difference in health literacy was found between those living in rural and urban locations. Results, however, may be limited by the only available measure of rurality in the NAAL: a dichotomous measure of MSA. It is more likely that health literacy follows an inverse U-shaped curve in which health literacy is lower, on average, among individuals residing in rural or urban areas and higher, on average, among individuals in suburban areas.

Table B.2. Results for the Predictive Models of Health Literacy

Characteristic	Mean Health Literacy β (SE)	Percentage Above Basic β (SE)
Constant	299.8 (2.31) **	1.058 (0.023) **
Age		
18–24	Reference	Reference
25–39	–3.8 (2.00)	–0.051 (0.019) *
40–49	–13.8 (2.23) **	–0.110 (0.021) **
50–64	–19.2 (2.38) **	–0.175 (0.024) **
65–74	–41.1 (2.33) **	–0.330 (0.024) **
75+	–51.9 (2.71) **	–0.439 (0.029) **
Education		
Still in high school	–35.2 (6.41) **	–0.185 (0.059) **
Less than high school	–43.1 (2.42) **	–0.270 (0.017) **
High school/GED	–32.8 (1.58) **	–0.204 (0.015) **
Some college	–13.8 (2.19) **	–0.075 (0.013) **
College degree or more	Reference	Reference
Sex		
Male	–7.4 (1.08) **	–0.052 (0.010) **
Female	Reference	Reference
Language Spoken at Home		
English	Reference	Reference
Other language	1.8 (2.39)	0.007 (0.023)
Marital Status		
Married, Living together	Reference	Reference
Never married	–4.1 (1.54) *	–0.028 (0.014) *
Divorced, separated, widowed	–4.1 (1.56) *	–0.020 (0.016)
MSA		
MSA	Reference	Reference
Non-MSA	–2.4 (1.68)	–0.024 (0.016)
Income		
No income data	–3.0 (1.83)	–0.025 (0.015)
< 100% FPL	–8.7 (1.58) **	–0.074 (0.016) **
≥ 100% FPL	Reference	Reference
Race/Ethnicity		
White	Reference	Reference
Black	–33.4 (1.96) **	–0.270 (0.016) **
Hispanic	–33.7 (2.46) **	–0.253 (0.032) **
Asian/Pacific Islander	–18.7 (5.12) **	–0.132 (0.053) *
American Indian	–22.3 (10.27) *	–0.192 (0.114)
Multiracial	–21.9 (5.12) **	–0.175 (0.045) **
Time in United States		
< 5 years	–21.0 (4.05) **	–0.158 (0.045) **
6–10 years	–19.5 (4.47) **	–0.137 (0.035) **
> 10 years	–14.5 (2.25) **	–0.108 (0.026) **
Born in U.S.	Reference	Reference

NOTES: FPL = federal poverty level; ** p < 0.05; * p < 0.01.

Data Source and Health Outcomes in Prototype Mapping Tool

The prototype mapping tool focuses on three major health outcomes: breast cancer screening, colon cancer screening, and quality of diabetes care. It also has a limited number of health outcomes for the general population, including self-rated health, as well as blood sugar and cholesterol screening and outcomes. Data on health outcomes for the public-access version of the mapping tool come from Missouri's 2007 County-Level Study. This data source and respective health outcomes are described below.

Additionally, limited data from two Missouri health plans with significant market share and from Medicaid are also incorporated into a secure, sponsor-only version of the mapping tool, described in more detail in Appendix E.

Missouri County-Level Study (CLS)

Missouri's 2007 County-Level Study (CLS) was designed to produce county-level prevalence of behavioral risk factors, chronic diseases and conditions, and preventive practices among adults age 18 and older in the state (Missouri Department of Health and Senior Services 2007). This survey and a similar effort in 2003 were completed by the Missouri Department of Health and Senior Services and funded by the Missouri Foundation for Health, using methods and techniques standardized by the U.S. Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System (BRFSS).

Despite similarities between the BRFSS and the CLS, they are separate surveys, and they differ significantly on sample construction. The BRFSS is designed to create uniform, state-level measures; thus, the sample is too small to support most county-level estimates. In contrast, the CLS, which in 2007 interviewed 49,513 individuals in Missouri, instituted thresholds for sample sizes in all counties to ensure accurate county-level estimates.

Health outcomes from the CLS are described below.

For the general population:

- Self-reported health as fair or poor
- Received cholesterol test within the past year
- Currently have high cholesterol
- Received blood sugar/glucose test within the past year
- Diagnosis of diabetes by health professional.

For diabetics:

- Received cholesterol test within the past year
- Ever had high cholesterol
- Currently have high cholesterol
- Received blood sugar/glucose test within the past year

- Perform self-checks on blood sugar/glucose at least once per day.

For women over age 40:

- Received a mammogram within the past year
- Received a clinical breast exam within the past year.

For men and women age 50–80:

- Received colon cancer screening (blood stool test within the last year or sigmoidoscopy or colonoscopy within the last 10 years).

Nighborhood Sociodemographic Characteristics and Health Services Data

In this appendix, we describe sources of data on neighborhood sociodemographic characteristics and on a limited amount of contextual information related to neighborhood services.

U.S. Census 2000 and 2007 American Community Survey

To allow neighborhood characteristics to be estimated at the census-tract level, we used *aggregate* demographic data from the 2000 Census Summary File 3 (SF3) (U.S. Census Bureau 2002a; U.S. Census Bureau 2002b; U.S. Department of Commerce et al. 2004). Census tracts are small, relatively permanent statistical subdivisions of a county, with approximately 2,500 to 8,000 people residing in each tract, and they are the smallest area for which reliable demographic counts are available. One challenge with using the 2000 Census is that the data are somewhat dated and do not capture recent demographic shifts in Missouri, particularly among the Hispanic population in the southwest corner of the state. However, using data from the 2000 Census ensures consistency within the tool because health literacy for census tracts is estimated using the 2000 Census (see Appendix B).

More-recent demographic data are available through the 2007 ACS Public Use Microdata Sample (PUMS). However, the smallest sub-state geographic area currently available in PUMS is the Public Use Microdata Area (PUMA), which has a population of approximately 100,000. Therefore, for the mapping tool, the 2000 Census was used to estimate neighborhood characteristics for census tracts and counties, while the 2007 ACS was used to estimate neighborhood characteristics at the PUMA level.

How were population characteristics defined?

- **Age** was classified into six categories (18–24, 25–39, 40–49, 50–64, 65–74, and 75 and older).
- **Race** was categorized into six categories (non-Hispanic white, non-Hispanic black or African American, Asian or native Hawaiian, American Indian or Alaska native, other race/ethnicity, and two or more races).
- **Ethnicity** was categorized as Hispanic or Latino, and non-Hispanic.
- **Educational attainment** was classified into four categories (less than high school, high school graduate or equivalent [GED], some college or associates degree, and bachelors degree or higher).
- **Marital status** was grouped into three categories: married/living as married, never married, and widowed/divorced/separated.
- **Poverty**. Given that the NAAL, ACS, and 2000 Census collected data in different years, and to maximize the utility of the predictive models in years to come, we represented income as a percentage of the federal poverty level (< 100% of FPL, 100% of FPL or higher).
- **Language spoken in home** was classified as English or not English.

- **Length of residence in the United States** was classified as born in the United States, in the United States for 1–5 years, in the United States for 6–10 years, and in the United States for more than 10 years.
- **Linguistic isolation** was defined as characteristic of a household in which all members 14 years old and over speak a language other than English and speak English less than “very well.” Households were classified as linguistically isolated or not linguistically isolated.

Selected Neighborhood Health Services Data

The mapping tool also includes a limited amount of additional contextual information related to neighborhood services data for stakeholders to consider when addressing disparities in care related to low health literacy. These points of interest help stakeholders identify locations of care delivery, potential community partners to address poor-quality care due to low health literacy, and potential settings for interventions. Neighborhood health services in this prototype tool include the following:

- **Medically Underserved Areas or Populations (MUA/Ps).** MUA/Ps are areas or populations designated by the Health Resources and Services Administration (HRSA) as having too few primary care providers, high infant mortality, high poverty, and/or high elderly population (Health Resources and Services Administration 2009).
- **Health Professional Shortage Areas (HPSAs).** HPSAs are designated by HRSA as having shortages of primary medical care, dental, or mental health providers. These areas may be geographic (a county or service area), demographic (low-income population), or institutional (comprehensive health center, federally qualified health center, or other public facility) (Health Resources and Services Administration 2009).
- **General hospitals** (excluding military and government-run facilities not accessible to the general population).
- **Federally Qualified Health Centers (FQHCs).** FQHCs include all organizations receiving grants under Section 330 of the Public Health Service Act, certain tribal organizations, and FQHC Look-Alikes. FQHCs qualify for enhanced reimbursement from Medicare and Medicaid, as well as other benefits. FQHCs must serve an underserved area or population, offer a sliding fee scale, provide comprehensive services, have an ongoing quality assurance program, and have a governing board of directors (Rural Assistance Center 2009).

Health Plan Data

Originally, we had planned to include clinical quality-of-care data in the publicly accessible mapping tool. As part of this effort, we obtained Healthcare Effectiveness Data and Information Set (HEDIS) data from several health plans, including Missouri Medicaid, to provide a more objective view of the geographic distribution of care quality. HEDIS data are collected annually by health plans from administrative claims data and chart record reviews conducted using a systematic protocol.

Although we have received and pooled HEDIS data from commercial and public health plans in Missouri, we have chosen at this time not to publicly release these data. Because the market share of these plans did not always overlap, we did not have sufficient data in many regions of the state to ensure that the health plan data remained confidential and not linkable to a specific health plan. Thus, we also created a secure, sponsor-only version of the mapping tool that includes HEDIS data on quality of diabetes care, cardiovascular disease, breast cancer screening, and colorectal cancer screening.

We are currently continuing discussions with other plans interested in participating in the mapping tool initiative. We expect that this prototype tool will also help plans that are not currently participating in this initiative to see the value in sharing their data and to understand how their data will be used. Further, given the interest of many health plans in improving health and reducing disparities, we expect that this tool will encourage plans to become more active stakeholders in the communities they serve because the tool can make their participant data more actionable. Health plans are often overlooked as potential stakeholders but can be powerful allies, as they have access to physician networks and patients in given markets, which, for example, could be of value when enrolling communities or populations of interest into interventions to address health disparities.

References

- Arnold C, Davis TC, Berkel H, Jackson R, Nandy I, London S (2001): Smoking status, reading level, and knowledge of tobacco effects among low-income pregnant women. *Prev Med* 32:313–320.
- Baker DW, Parker R, Williams MV, Pitkin K, Parikh N, Coates W, et al. (1996): The health care experience of patients with low literacy. *Arch Fam Med* 5:329–334.
- Bird C, Rieker P (2008): *Gender and Health: The Effects of Constrained Choices and Social Policies*. New York: Cambridge University Press.
- Bird C, Seeman T, Escarce J, Basurto-Davila R, Finch B, Dubowitz T, et al. (In Press): Neighbourhood socioeconomic status and biological “wear and tear” in a nationally representative sample of U.S. adults. *J Epidemiol Community Health*.
- Chew L, Bradley K, Flum D, Cornia P, Koepsell, TD (2004): The impact of low health literacy on surgical practice. *Am J Surg* 188:250–253.
- Cooper L, Beach M, Cleve S (2005): Participatory decision-making in the medical encounter and its relationship to patient literacy. In: Schwartzberg J, VanGeest J, Wang C editors. *Understanding Health Literacy: Implications for Medicine and Public Health*. USA: American Medical Association.
- Davis TC, Dolan N, Ferreira M, Tomori C, Green K, Sipler A, et al. (2001): The role of inadequate Health literacy skills in colorectal cancer screening. *Cancer Invest* 19:193–200.
- Davis TC, Wolf MS, Bass PF, Middlebrooks M, Kennen E, Baker DW, et al. (2006): Low literacy impairs comprehension of prescription drug warning labels. *J Gen Intern Med* 21:847–851.
- DeWalt DA, Pignone MP (2005): Health literacy and health outcomes: Overview of the Literature. In: Schwartzberg J, VanGeest J, Wang C editors. *Understanding Health Literacy: Implications for Medicine and Public Health*, USA: American Medical Association.
- Dolan N, Ferreira M, Davis TC, Fitzgibbon M, Rademaker A, Liu D, et al. (2004): Colorectal cancer screening knowledge, attitudes, and beliefs among veterans: Does Literacy make a difference? *J Clin Oncol* 22:2617–2622.
- Dubowitz T, Heron M, Bird C, Lurie N, Finch B, Basurto-Davila R, et al. (2008): Neighborhood socioeconomic status and fruit and vegetable intake among whites, blacks, and Mexican-Americans in the United States. *Am J Clin Nutr* 87:1883–1891.
- Fang M, Machtinger E, Wang F, Schillinger D (2006): Health literacy and anticoagulation-related outcomes among patients taking warafin. *J Gen Intern Med* 21:841–846.
- Fang M, Panguluri P, Machtinger E, Schillinger D (2009): Language, literacy, and characterizations of stroke among patients taking warfarin for stroke prevention: Implications for health communication. *Pat Educ Couns* 75:403–410.

- Fernandes M, Bird C, Escarce J, Griffin B, Eibner C, Margolis K, et al. (2008): Neighborhood retail food environment, nutrient intake and behavioral risk factors for coronary heart disease: A longitudinal analysis of the Women's Health Initiative Study. *American Academy of Health Behavior Annual Meeting*. Oxnard, CA.
- Freedman D, Bess K, Tucker H, Boyd D, Tuchman A, Wallston K (2009): Public health literacy defined. *Am J Prev Med* 36:446–451.
- Frolich K, Potvin L (2008): The inequality paradox: The population approach and vulnerable populations. *AJPH* 98:216–221.
- Gazmararian J, Kripalani S, Miller M, Echt K, Ren J, Rask K (2006): Factors associated with medication refill adherence in cardiovascular-related diseases: A focus on health literacy. *J Gen Intern Med* 21:1215–1221.
- Gazmararian JA, Curran G, Parker R, Bernhardt J, DeBuono B (2005): Public health literacy in America: An ethical imperative. *Am J Prev Med* 28:317–322.
- Gazmararian JA, Williams MV, Peel J, Baker DW (2003): Health literacy and knowledge of chronic disease. *Patient Educ Couns* 51:267–275.
- Goldberg D (2007): Justice, health literacy and social epidemiology. *Am J Bioethics* 7.
- Health Resources and Services Administration (2009): *Shortage Designation: HPSAs, MUAs, and MUPs*, Vol 2010. Washington, DC.
- Institute of Medicine (2003): *Priority Areas for National Action: Transforming Healthcare Quality*. Washington, DC: National Academies Press.
- Institute of Medicine (2004): *Health Literacy: A Prescription to End Confusion*. Washington, DC: National Academies Press.
- Kalichman S, Rompa D (2000): Functional health literacy is associated with health status and health-related knowledge in people living with HIV-AIDS. *J Acquir Immune Defic Syndr* 25:337–344.
- Kirsch I (2001): *The International Adult Literacy Survey (IALS): Understanding What Was Measured*. Princeton, NJ: Statistics and Research Division of the Educational Testing Service.
- Kirsch I, Jungeblut A, Jenkins L, Kolstad A (1993): *Adult Literacy in America: A First Look at the Results of the National Adult Literacy Survey*. Washington, DC: National Center for Education Statistics, U.S. Department of Education.
- Kripalani S, Henderson L, Chiu E, Robertson R, Kolm P, Jacobson T (2006): Predictors of medication self-management skill in a low-literacy population. *J Gen Intern Med* 21:852–856.
- Kutner M, Greenberg E, Jin Y, Paulsen C (2006): *The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy*. Washington, DC: National Center for Education Statistics.
- Lalonde M (1974): A new perspective on the health of Canadians: Ministry of Supply and Services Canada.

- Lasater L (2003): Patient literacy, adherence, and anticoagulation therapy outcomes: A preliminary report. *J Gen Intern Med* 18 (Supplement 1):179.
- Lindau S, Basu A, Leitsch S (2006): Health literacy as a predictor of follow-up after an abnormal pap smear: A prospective study. *J Gen Intern Med* 21:829–834.
- Lindau S, Tomori C, Lyons T, Langseth L, Bennett C, Garcia P (2002): The association of health literacy with cervical cancer prevention knowledge and health behaviors in a multiethnic cohort of women. *Am J Obstet Gynecol* 186:938–943.
- Lurie N, Martin L, Ruder T, Escarce J, Ghosh-Dastidar B, Sherman D, et al. (2010): *Estimating and Mapping Health Literacy in the State of Missouri*. Santa Monica CA: RAND Corporation.
- Martin L, Ruder T, Escarce J, Ghosh-Dastidar B, Sherman D, Elliott M, et al. (2009): Developing predictive models of health literacy. *J Gen Intern Med* 24:1211–1216.
- Missouri Department of Health and Senior Services (2007): Missouri County-Level Study (CLS).
- Murphy P, Davis T, Long S, Jackson R, Decker B (1993): Rapid Estimate of Adult Literacy in Medicine (REALM): A quick reading test for patients. *Journal of Reading* 37:124–130.
- National Center for Education Statistics (2003): *National Assessment of Adult Literacy (NAAL)*.
- National Center for Education Statistics (2006): *The Health Literacy of America's Adults: Results from the 2003 National Assessment of Adult Literacy*. Washington, DC: U.S. Department of Education.
- Osborn CY, Weiss BD, Davis TC, Skripkauskas S, Rodrigue C, Bass PF, et al. (2007): Measuring adult literacy in health care: Performance of the newest vital sign. *Am J Health Behav* 31:S36–S46.
- Paasche-Orlow MK, Parker R, Gazmararian JA, Nielsen-Bohlman L, Rudd R (2005): The prevalence of limited health literacy. *J Gen Intern Med* 20:175–184.
- Paasche-Orlow MK, Wolf MS (2007): The causal pathways linking health literacy to health outcomes. *Am J Health Behav* 31:S19–S26.
- Parikh N, Parker R, Nurss JR, Baker DW, Williams MV (1996): Shame and health literacy: The unspoken connection. *Patient Educ Couns* 27:33–39.
- Parker R, Baker D, Williams M, Nurss J (1995): The Test of Functional Health Literacy in Adults: A new instrument for measuring patients' literacy skills. *J Gen Intern Med* 10:537–541.
- Ratzan S, Parker R (2000): Introduction. In: Selden C, Zorn M, Ratzan S, Parker R editors. *National Library of Medicine Current Bibliographies in Medicine: Health Literacy*. Bethesda, MD: National Institutes of Health, U.S. Department of Health and Human Services.
- Rudd R, Anderson J, Oppenheimer S, Nath C (2007): Health literacy: An update of public health and medical literature. In: Comings J, Garner B, Smith C editors.

- Review of Adult Learning and Literacy, Volume 7.* Mahway, NJ: Lawrence Erlbaum Associates, pp 174–204.
- Rudd R, Renzulli D, Pereira A, Daltroy L (2005): Literacy demands in health care settings: The patient perspective. In: Schwartzberg J, VanGeest J, Wang C editors. *Understanding Health Literacy.* USA: American Medical Association.
- Rueben K, Murray S (2008): Racial disparities in education finance: Going beyond equal revenues. *Tax Policy Center Conference: “Race, Ethnicity, Poverty and the Tax-Transfer System on Racial Inequality and the Tax System.”* Washington, DC: Urban Institute.
- Rural Assistance Center (2009): *Federally Qualified Health Centers.*
- Schillinger D (2007): Literacy and health communication: Reversing the “inverse care law.” *American Journal of Bioethics* 7:15–18.
- Schillinger D, Bindman A, Stewart A, Wang F, Piette J (2004): Health literacy and the quality of physician-patient interpersonal communication. *Pat Educ Couns* 3:315–323.
- Schillinger D, Wang F, Grumbach K, Daher C, Palacios J, Diaz-Sullivan G, et al. (2002): Association of functional health literacy with glycemic control among diabetes patients. *JAMA* 288.
- Tudor-Hart J (1971): The inverse care law. *Lancet* 297:405–412.
- U.S. Census Bureau (2002a): Census 2000 Summary File 3 Technical Documentation.
- U.S. Census Bureau (2002b): Census 2000 Summary File 3 Technical Documentation: Table C—Standard Error Design Factors for Missouri.
- U.S. Census Bureau (2008): American Community Survey, Vol 2008. Washington, DC.
- U.S. Department of Commerce, Bureau of the Census, Research I-uCfPaS (2004): Census of Population and Housing, 2000 [United States]: Block Group Subset from Summary File 3.
- U.S. Department of Health and Human Services (2000): *Healthy People 2010: Understanding and Improving Health.* 2nd Edition. Washington, DC: U.S. Government Printing Office.
- Vernon J, Trujillo A, Rosenbaum S, DeBuono B (2007): *Low Health Literacy: Implications for National Health Policy.* Washington, DC: George Washington University.
- Weiss BD (2005): Epidemiology of low health literacy. In: Schwartzberg J, VanGeest J, Wang C editors. *Understanding Health Literacy: Implications for Medicine and Public Health.* USA: American Medical Association, pp 17–40.
- White S, Dillow S (2005): *Key Concepts and Features of the 2003 National Assessment of Adult Literacy.* Washington, DC: U.S. Department of Education, Institute of Education Sciences.

Win K, Schillinger D (2003): Understanding of warfarin therapy and stroke among ethnically diverse anticoagulation patients at a public hospital. *J Gen Intern Med* 18 (Supplement 1):278.