Sustainable Financing Models for Community Health Worker Services in Maine

November 2016

Prepared for
Maine Center for Disease Control and Prevention
Maine State Innovation Model Community Health Worker Initiative

Prepared by
University of Massachusetts Medical School
Center for Health Law and Economics

SIM
MAINE STATE INNOVATION MODEL

UMASS MEDICAL SCHOOL
Center for Health Law and Economics
A Commonwealth Medicine Center of Distinction

ACKNOWLEDGEMENTS

This report was prepared by Katharine London, M.S. (principal), Kelly Love, J.D. (senior policy analyst) and Roosa Tikkanen, M.P.H., M.Res. (policy analyst), of the Center for Health Law and Economics, Commonwealth Medicine, University of Massachusetts Medical School, on behalf of the Maine State Innovation Model (SIM) Community Health Worker Initiative (CHWI), under the direction of Barbara Ginley of the Maine Migrant Health Program and Elizabeth Foley of MCH Public Health. Maine's SIM initiative is a state-led, federally funded public-private partnership that seeks to develop, accelerate and test a set of innovations to transform health care delivery and payment. The authors would like to thank Teresa H. Mason, PhD, Carl H. Rush, MRP, and Geoffrey W. Wilkinson, MSW for their advice and feedback on early drafts of this analysis.

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

The State of Maine was awarded a multi-year State Innovation Model (SIM) grant from the federal Centers for Medicare and Medicaid Services. "The Maine SIM intends to achieve the Triple Aim goals of improving the health of Maine's population, improving the experience Maine patients have with their care, and reducing the total costs of care."[1]

The Community Health Worker Initiative (CHWI) is a key component of the Maine SIM project and is focused on achieving three goals:

- Demonstrating the value of integrating community health workers (CHWs) into a variety of health care team(s)/settings
- Implementing and testing care models that can be replicated and emulated across the state
- Expanding on the core group of experienced CHWs in Maine who can provide leadership and community engagement

CHWI engaged the University of Massachusetts Medical School's Center for Health Law and Economics to identify options for sustainable financing of CHW programs, and to compile data and analysis to support widespread adoption of payment models and mechanisms for CHWs' work. CHWI directed that the final product/model should take into consideration the total costs of CHW services and care, be adoptable by private and public payers, and align with other payment reform efforts in Maine. CHWI plans to use this information to develop a recommendation for sustainable financing for the CHW workforce, including a rationale and payment mechanisms.

This report provides examples demonstrating how to apply findings from published literature to construct evidenced-based, cost-effective CHW interventions in Maine. It then recommends steps stakeholders could take to promote sustainable financing for CHW services.

The Maine SIM project also funded four CHW pilots across the state. These pilot projects will be evaluated separately. This report does not include an evaluation of CHW programs currently operating in Maine.

Sustainable Financing

A strong CHW workforce needs sustainable financing funding sources that it can rely on year after year. Currently, most CHW programs in Maine rely on grant funding. When grants are not renewed, as often occurs across the country, programs scramble to find funding and some close down.

There are a number of ways that CHWs can tap into the health care financing system to access sustainable financing for their services through public and private payers. These strategies can be used with fee-for-service, pay-for-performance, bundled payment, global payments, and statewide assessments, as well as alternative payment models currently under consideration.

CHW models

The UMass team worked with CHWI to develop four sustainable models for CHW interventions that are responsive to current needs in Maine. The models are based on actual data, but they are not programs that currently exist in Maine. This report examines results obtained by CHW interventions in other parts of the country, calculates the outcomes that could be achieved if the same interventions were implemented in Maine, and provides program specifications needed to achieve those outcomes.

The UMass team compiled published data and analyses that provide evidence of the expected costs and outcomes for each model. We also interviewed seven employers of CHWs in Maine and collected data on their program costs. We then compiled this data to develop sustainable models for CHW interventions. Each CHW model is built on population and cost data in a particular Maine community, and each model is constructed to be cost-effective in that community.

For each CHW model, the report includes:

- Evidence of a public health concern in the target county.
- Description of a proposed CHW intervention to address that concern.
- Projected number of participants in the proposed CHW intervention based on the number of county residents experiencing the public health concern.
- Estimated budget for the proposed CHW intervention, based on Maine cost data.
- Projected changes in patient outcomes and quality, based on the results of published studies.
- A list of standard quality measures that are expected to improve as a result of the CHW intervention.
- Projected changes in medical costs, based on the results of published studies.
- Projected social return on investment, based on the estimated value of additional days that residents would be able to go to work or school as a result of improved health after participating in the CHW intervention. The value of recovered workdays would be expected to accrue partly to workers in the form of additional wages, and partly to employers in the form of reduced sick time and improved productivity.
- Projected financial return on investment (ROI), the dollars recovered through reductions in medical costs relative to the program cost.

The four CHW models are summarized below. The models each address a specific health concern in a specific location. Each model was constructed to be cost-effective to support sustainable financing, based on the best available evidence. The CHW models target high-need, high-cost patients because most CHW interventions that significantly improved outcomes targeted these populations.

To construct these models, we relied on results obtained by a number of different studies, as no single study provided all the data required for each model. We made assumptions based on the best available evidence, however there is a risk of introducing error when combining results from different studies. If these models are implemented, actual results may differ from projections.

CHW Model 1: Improvements in diabetes control in Washington County

Target population: 82 individuals with poorly controlled diabetes, all ages
CHW employer: Federally qualified health center (FQHC)
Projected cost of CHW Intervention: $390,000 over 3 years
Projected outcomes:

- Average 0.7 percentage point reduction in HbA1c in 10 months
- Average 2.7 mmHg reduction in diastolic blood pressure (BP) in 10 months
- Savings in direct medical costs: $520,000 over three years
- Social return on investment: 11 recovered work days per worker, valued at $1,500 per worker per year
- Financial return on investment: $1.37 for every $1 invested in years 1–3

CHW Model 2: Improvements in asthma control among children in Kennebec County

Target population: 112 children with poorly controlled asthma
CHW employer: Private group practice eligible for bonus payments for meeting asthma improvement targets
Projected cost of CHW Intervention: $220,000 over 3 years
Projected outcomes:

- 46% of participating children have well-controlled asthma (up from 3% at baseline)
- 53% reduction in hospitalizations
- Savings in direct medical costs: $47,000 over three years
- Social return on investment: three school days & one workday recovered per family per year, valued at $170 per family per year
- Financial return on investment: $1.03 for every $1 invested in years 1–3
  Note: ROI is only positive if the practice earns bonus payments for meeting quality targets.

CHW Model 3: Improving control of chronic conditions for individuals with high health care use in Aroostook County

Target population: 150 individuals with chronic conditions and high medical spending
CHW employer: Three rural health centers
Projected cost of CHW Intervention: $550,000 over 3 years
Projected outcomes:

- 83% reduction in hospitalizations
- 23% increase in diabetic patients receiving eye exams
- Savings in direct medical costs: $1,275,000 over three years
- Social return on investment: up to 11 work days recovered per person, valued at $2,000 per worker per year
- Financial return on investment: $2.31 for every $1 invested in years 1–3

CHW Model 4: Connecting underserved individuals to services in the Lewiston area

Target population: 260 "New Mainers" in the Somali community with language and cultural barriers to accessing health care
CHW employer: Community-based organization working with several health care providers
Projected cost of CHW Intervention: $178,000 over 3 years
Projected outcomes:

- Mammography rates increase 3x and colonoscopy rates increase 2x
- 86% increase in primary care visits
- 46% reduction in ED visits
- Savings in direct medical costs: $274,000 over three years
- Financial return on investment: $1.54 for every $1 invested in years 1–3

The models described in this report are by no means the only sustainable models for CHW interventions. A wide variety of CHW programs currently operate in virtually every state in the United States and internationally. Any of these programs could potentially also provide a model for a CHW intervention in Maine, if they provide evidence of cost-effectiveness.

Recommended Steps to Support Sustainable Financing

Maine community-based organizations, health care providers, public and private payers, and others can use these models to develop sustainable CHW interventions in their own communities. Key public and private stakeholders could take the following steps to promote sustainable financing for CHW services in Maine:

Medicaid

MaineCare could establish an initiative to pay for CHW services. A recent change in federal rules makes it easier for state Medicaid programs to pay for CHW services.[i] To fund CHW services, the state would need to amend its Medicaid State Plan to specify: the CHW services for which the state Medicaid program will pay; which patients can receive these services; the conditions under which the services can be provided; who can bill for these services; what method and rate Medicaid will use to pay for services; and a number of other provisions. Medicaid programs in two states support CHW services directly, while those in a number of other states make monthly payments to clinical practices to cover CHWs and other services.[2]

[i] In July 2013, the Federal Centers for Medicare and Medicaid Services (CMS) adopted a change in the federal regulation (42 CFR 440.130(c)) governing the set of services for which state Medicaid programs can pay. Previously, Medicaid programs could pay for preventive services that were *provided* by a physician or other clinician. The rule change allows Medicaid programs to pay for preventive services *recommended* by a physician or other clinician.

Maine SIM Initiatives

The Maine SIM project could incorporate mechanisms into its key strategies to support sustainable financing for CHW services. For example, if the MaineCare Accountable Communities are continued beyond the SIM grant period, they could be authorized and encouraged to spend Medicaid funds on cost-effective, nontraditional services, including CHW services, as Oregon's Coordinated Care Organizations (CCOs) are.[3]

Health Plans and Accountable Care Organizations (ACOs)

Health plans and ACOs can use predictive analysis to identify their members who could most benefit from CHW services. For example, health plans and ACOs could target CHW services to members with high hospital and emergency department utilization, a diagnosis of one or more chronic conditions, indications of poor control of chronic conditions, and/or high risk because of social determinants of health. These organizations could then hire CHWs directly or contract with a community-based organization or clinic to provide CHW services to these high-risk members. A health plan could include the cost of CHW services in administrative expenses, or it could obtain approval from the purchaser to include CHW service costs as a medical expense.

Health Care Providers

Health care providers, especially networks of hospitals and affiliated clinics, can work together to identify patients who could benefit from a CHW intervention, such as patients who have poorly controlled chronic conditions and face barriers accessing health care and social supports. These health care providers could implement a CHW intervention focused on their patients' needs, perhaps based on one of the CHW models included in this report, and seek funding through alternative payment arrangements with health plans. Health care providers could then hire CHWs directly or contract with a community-based organization to provide the CHW intervention to their patients.

Community-Based Organizations

Community-based organizations (CBOs) often hire and train trusted individuals from the communities with which they work to become CHWs. CBOs can use the models described in this report to initiate conversations with health plans, ACOs, and health care providers about the cost-effective services CHWs can provide in their communities.

2. INTRODUCTION

The State of Maine was awarded a multi-year State Innovation Model (SIM) grant from the federal Centers for Medicare and Medicaid Services. "The Maine SIM intends to achieve the Triple Aim goals of improving the health of Maine's population, improving the experience Maine patients have with their care, and reducing the total costs of care."[1]

The Community Health Worker Initiative (CHWI) is a key component of the Maine SIM project and is focused on achieving three goals:

- Demonstrating the value of integrating Community Health Workers (CHWs) into a variety of health care team(s)/settings
- Implementing and testing care models that can be replicated and emulated across the state
- Expanding on the core group of experienced CHWs in Maine who can provide leadership and community engagement

The CHWI engaged the University of Massachusetts Medical School's Center for Health Law and Economics to identify options for sustainable financing of CHW programs, and to compile data and analysis to support widespread adoption of payment models and mechanisms for CHWs' work. The CHWI directed that the final product/model should take into consideration the total costs of CHW services and care, be adoptable by private and public payers, and align with other payment reform efforts in Maine. The CHWI plans to use this information to develop a recommendation for sustainable financing for the CHW workforce, including a rationale and payment mechanisms.

The Maine SIM project also funded four CHW pilots across the state. These pilot projects will be evaluated separately. This report does not include an evaluation of CHW programs currently operating in Maine.

This report first identifies options for sustainable financing for CHW programs. It then lists steps stakeholders could take to promote sustainable financing for CHW services. Finally, the bulk of this report provides examples of how to translate and apply the published evidence into models that can be used to demonstrate the effectiveness of proposed CHW interventions.

3. BACKGROUND

Who are Community Health Workers?

The Maine CHWI defines a community health worker (CHW) as "a trained and trusted public health worker who is respected by the people they serve and applies his/her unique understanding of the experience, socio-economic needs, language and/or culture of the communities served to act as a bridge between providers and individuals to promote health, reduce disparities, and improve service delivery; and advocate for individual and community needs."[4]

Similarly, the American Public Health Association defines a community health worker as "a frontline public health worker who is a trusted member of and/or has an unusually close understanding of the community served. This trusting relationship enables the worker to serve as a liaison/link/intermediary between health/social services and the community to facilitate access to services and improve the quality and cultural competence of service delivery. A community health worker also builds individual and community capacity by increasing health knowledge and self-sufficiency through a range of activities such as outreach, community education, informal counseling, social support and advocacy."[5]

Typically, CHWs are known community members, who may share ethnicity, culture, language, socio-economic status, and life experiences with the individuals that they serve. CHWs' efforts have been proven to improve patient experience, improve population health outcomes, and reduce costs — the goals of the *Triple Aim*.[6]

Who do Community Health Workers typically serve?

CHWs often work with individuals with complex and unmet health needs, such as those with chronic health conditions. CHWs also work with populations who are not yet connected to the health care system, such as people living in geographically isolated locations, or individuals with language barriers. Often, these individuals feel overwhelmed with the complexity of the health care system and need additional help managing their health. Because CHWs understand where the individuals they work with come from, how they do things, what foods they cook, and what their community expects from its members, CHWs can provide culturally competent coaching to help individuals implement care recommendations from their clinical team and extend the reach of a physician's practice from the office to the home. Integration of CHWs into the primary care team helps to engage underserved populations in a culturally appropriate way to overcome barriers to accessing care.

What do Community Health Workers do?

CHWs can be used by physician practices, hospital systems, and health insurers to work with individuals to find sustainable ways to implement care recommendations such as diet, exercise and medication adherence. CHWs can be used to help individuals implement care strategies to prevent health care crises, such as asthma-sensitive cleaning strategies, and chronic disease action plans. CHWs can also assist individuals in overcoming financial, transportation and linguistic barriers to obtaining

recommended care, and in accessing crucial services that address social determinants of health, such as literacy, domestic violence, housing and unemployment.

The role of CHWs and the specific services that they provide vary depending on the needs of the individuals they serve, and the care model that integrates CHWs as team members. Some common definitions of the core role of a CHW describe CHWs as building individual and community capacity by increasing health knowledge and self-sufficiency through a range of activities such as outreach, community education, informal counseling, social support and advocacy.[7] CHWs also assist individuals and communities with adopting healthy behaviors; providing information on available resources; promoting preventative care and screenings; and providing limited health services such as blood pressure screenings.[8] The CHW Common Core (C3) Project has worked to build national consensus around recognized and agreed-upon roles, skills and qualities for CHWs. In April 2016, they published a report with a list of CHW roles, skills and qualities based on an analysis of existing data and drawing from a consensus of CHW leaders.[9]

CHWs can provide benefits across stakeholders

To individuals

- Delivering culturally sensitive and language-appropriate health care information
- Improving health outcomes
- Improving patient and caregiver quality of life
- Increasing health care literacy and empowerment
- Reducing missed days of work and school, and increasing individual productivity

To providers

- Extending the reach of a physician's practice from the office to the home
- Improving communication between providers and patients
- Improving patients' adherence to treatment regimens and medications
- Helping connect individuals to health care providers and services
- Meeting quality measures that are tied to higher payments, e.g. reduced ED visits/hospitalizations

To society

- Realizing savings to government spending from reductions in preventable health care spending (ED visits, hospitalizations)
- Creating jobs in an allied health field
- Reducing days missed from school and work

To payers

- Realizing savings from reduced hospitalizations and ED visits
- Receiving returns on investment (ROI)[10]
- Improving quality of care scores

4. SUSTAINABLE FINANCING AND PAYMENT METHODS

A strong CHW workforce needs sustainable financing— funding sources that programs can rely on year after year. Currently, most CHW programs in Maine rely on grant funding. When grants are not renewed, as often occurs across the country, programs scramble to find funding, and some close down.

There are a number of ways that CHWs can tap into the health care financing system to access sustainable funding for their services through public and private payers. The strategy for accessing financing depends on the payment methods in use. These strategies can be used with fee-for-service, pay-for-performance, bundled payment, global payments and statewide assessments, as well as alternative payment models currently under consideration.

Fee-for-service

Traditionally, commercial health insurers, Medicare, and Medicaid have paid hospitals, doctors, and other health care providers a fee for every service rendered. One approach to sustainable funding would be for these payers to make CHWs eligible for fee-for-service payments.

In a few states, some payers cover CHW services. For example, state Medicaid programs in Minnesota and Pennsylvania pay fee-for-service for CHW services under certain conditions.[2] A private payer could also cover CHW services on a fee-for-service basis, most likely targeted to a certain patient population.

Pay-for-Performance

Across the country, insurers have been moving away from the traditional fee-for-service payment system toward paying for services in a way that rewards health care providers for delivering better care at lower cost. For example, under fee-for-service a physician may receive high fees for treating complications from poorly controlled diabetes, such as kidney disease and nerve damage, but may not be able to bill for services designed to help patients manage their diabetes. The fee-for-service payment system rewards health care providers for providing more services but not necessarily for providing better care.

Pay-for-performance is one simple way to begin to reward health care providers for delivering better care at lower cost. Under this method, a health plan may agree to make bonus payments to a health care provider that meets certain quality targets, for example, if a greater share of its patients with asthma have well-controlled asthma. The health care provider could engage CHWs to help it meet its quality targets. The health care provider could then use the bonus payments it receives to cover the cost of CHW services and other interventions. There is often a lag, however, between the time when the services are provided and when the provider receives the bonus payment. The provider would need to find alternative funding to defray the cost of CHW services in the short term.

Bundled Payments

Medicaid programs in a number of states, as well as some private payers, make monthly payments to clinical practices to cover a bundle of services such as outreach, case management, health promotion, and connection to social services. Some state Medicaid programs fund these services through a Health Homes initiative, which receives 90 percent of its funding from the federal government, as authorized under the Affordable Care Act of 2010, Section 2703. A number of state Medicaid programs explicitly authorize using these funds to pay for CHW services, together with other required services.[2] The Maine Health Homes initiative authorizes payments to CHWs for services they provide as members of Community Care Teams.[11] Public and private payers in Maine could adopt this approach for funding CHW and other preventive services.

Global Payments

More recently, many payers have begun contracting with Accountable Care Organizations (ACOs) that are at financial risk for managing their patients' care. An ACO typically receives a standard per-member, per-month (PMPM) payment amount, called a global payment or capitation, to care for all its patients. If the health care provider meets its quality targets and its revenues exceed its costs, it keeps the difference, and may even earn an additional bonus payment. This global payment method aims to hold health care providers accountable for providing high-quality care while containing costs.

ACOs have a strong incentive to invest in services that have been shown to improve quality and contain costs. Most ACOs have the technical resources needed to analyze their patient populations and identify patients who could most benefit from CHW services, such as patients with poorly controlled chronic conditions and high emergency department utilization. ACOs could fund a CHW intervention targeted to these high-risk patients.

The Maine Medicaid program could encourage such an approach, as Oregon does. In Oregon, Coordinated Care Organizations (CCOs) are responsible for coordinating care for Medicaid members to improve members' health, improve the quality of health care services, and contain costs. Oregon authorizes CCOs to use a portion of their global payments for "flexible services," defined as health-related non-medical services that are consistent with the member's treatment plan and are expected to improve health outcomes. Some Oregon CCOs are using flexible services funds to pay for CHW services.[3]

Statewide Assessment

Maine could establish a statewide system for financing CHW and other preventive services. For example, Vermont assesses health insurers a fee of $17,500 per every 1,000 patients to support Community Health Teams (CHTs) across the state.[12] The CHTs include CHWs and other health professionals and are responsible for outreach, care coordination, and connecting residents to needed services.[13] Vermont's CHTs have been successful in reducing hospital and emergency department utilization, while improving health and health care.[14]

5. RECOMMENDED STEPS TO SUPPORT SUSTAINABLE FINANCING FOR CHWS

There are a number of steps stakeholders could take to promote sustainable financing for CHW services in Maine.

Medicaid

MaineCare could establish an initiative to pay for CHW services. A recent change in federal rules makes it easier for state Medicaid programs to pay for CHW services.[i] To fund CHW services, the state would need to amend its Medicaid State Plan to specify: the CHW services for which the state Medicaid program will pay; which patients can receive these services; the conditions under which the services can be provided; who can bill for these services; what method and rate Medicaid will use to pay for services; and a number of other provisions. Medicaid programs in two states support CHW services directly, while those in a number of other states make monthly payments to clinical practices to cover CHWs and other services.[2]

Maine SIM Initiatives

The Maine SIM project could incorporate mechanisms into its key strategies to support sustainable financing for CHW services. For example, if the MaineCare Accountable Communities are continued beyond the SIM grant period, they could be authorized and encouraged to spend Medicaid funds on cost-effective nontraditional services, including CHW services, as Oregon's CCOs are.[3]

Health Plans and ACOs

Health plans and ACOs can use predictive analysis to identify their members who could most benefit from CHW services. For example, health plans and ACOs could target CHW services to members with high hospital and emergency department utilization, a diagnosis of one or more chronic conditions, indications of poor control of chronic conditions, and/or high risk because of social determinants of health. These organizations could then hire CHWs directly or contract with a community-based organization or clinic to provide CHW services to these high-risk members. A health plan could include the cost of CHW services in administrative expenses, or it could obtain approval from the purchaser to include CHW service costs as a medical expense.

[i] In July 2013, the Federal Centers for Medicare and Medicaid Services (CMS) adopted a change in the federal regulation (42 CFR 440.130(c)) governing the set of services for which state Medicaid programs can pay. Previously, Medicaid programs could pay for preventive services that were *provided* by a physician or other clinician. The rule change allows Medicaid programs to pay for preventive services *recommended* by a physician or other clinician.

Health Care Providers

Health care providers, especially networks of hospitals and affiliated clinics, can work together to identify patients who could benefit from a CHW intervention, especially patients who have poorly controlled chronic conditions and face barriers to accessing health care and social supports. These health care providers could implement a CHW intervention focused on their patients' needs, perhaps based on one of the CHW models included in this report, and seek funding through alternative payment arrangements with health plans. Health care providers could then hire CHWs directly or contract with a community-based organization to provide the CHW intervention to their patients.

Community-Based Organizations

Community-based organizations (CBOs) often hire and train trusted individuals from the communities with which they work to become CHWs. CBOs can use the models described in this report to initiate conversations with Health Plans, ACOs, and health care providers about the cost-effective services CHWs can provide in their communities.

6. MODEL DEVELOPMENT

The UMass team worked with Maine's Community Health Worker Initiative (CHWI) to develop four proposed sustainable models for CHW interventions that are responsive to current needs in Maine. These models are proposals based on actual data, but are not programs that currently exist in Maine.

1. Improving diabetes control in Washington County
2. Improving asthma control among children in Kennebec County
3. Improving control of chronic conditions for individuals with high health care use in Aroostook County
4. Connecting underserved individuals to services in the Lewiston area

We also examined results obtained by CHW interventions in other parts of the country, and calculated the outcomes that could be achieved if the same CHW intervention were implemented in Maine. Below, we provide program specifications needed to achieve those outcomes.

We compiled published data and analyses that provide evidence for the expected costs and effects of each model. We also interviewed seven employers of CHWs in Maine and collected data on their program costs. We then compiled this data to develop sustainable models for CHW interventions. Each CHW model is built on population and cost data for a particular Maine community, and each model is constructed to be cost-effective in that community.

We based these models on interventions implemented successfully elsewhere and documented in peer-reviewed journal articles. Where available, we used studies that both documented a statistically significant effect on health outcomes and reported data on changes in cost and utilization. Most of these successful interventions targeted individuals with poorly controlled chronic conditions and/or high health care costs and utilization rather than providing the intervention to a broad patient population. Entities wishing to develop a CHW intervention should review these studies to obtain more detailed information.

Each CHW model includes:

- Evidence of a public health concern (e.g., asthma, diabetes, hypertension, low cancer screening rates) in a target county.
- A brief description of a proposed CHW intervention to address the specific public health concern.
- Projected number of participants in the proposed CHW intervention based on the estimated number of county residents experiencing the public health concern.
- Estimated budget for the proposed CHW intervention, based on Maine cost data.
- Projected changes in patient outcomes and quality, estimated by applying the results of published studies to Maine data.

- A list of standard quality measures that are expected to improve as a result of the CHW intervention. Entities that receive additional revenue or recognition based on their performance on these measures may secure additional benefit from a CHW intervention.
- Projected changes in medical costs, estimated by applying the results of published studies to Maine data.
- Projected social return on investment, based on the value of participants' additional working days. We measure the value of additional days that residents are able to work as a result of improved health after participating in the CHW intervention. This value would be expected to accrue partly to workers in the form of additional wages, and partly to employers in the form of reduced sick time and improved productivity.
- Projected financial return on investment (ROI): the dollars recovered through reductions in medical costs relative to the program cost.
- Documentation of sources, assumptions and estimates described in the Technical Appendix.
- Clarifying information in footnotes.
- Citations using the American Psychological Association (APA) citation guidelines in endnotes.

Maine community-based organizations, health care providers, public and private payers, and others can use these models to develop sustainable CHW interventions in their own communities.

The models described in this report are by no means the only sustainable models for CHW interventions. A wide variety of CHW programs currently operate in virtually every state in the United States and internationally. Any of these programs could potentially also provide a model for a CHW intervention in Maine, if they provide evidence of cost-effectiveness.

To construct these models, we relied on results obtained by a number of different studies, because no single study provided all the data required to construct a model. We made assumptions based on the best available evidence; however there is a risk of introducing error when combining results from different studies. If these models are implemented, actual results may differ from projections.

In addition, the CHW employers we interviewed noted that clinicians' acceptance of CHWs as nonclinical health care professionals has varied from site to site. At sites with slower acceptance, successful outcomes and cost savings may require more time to realize than the timelines suggested in our model.

Before implementing a CHW intervention, we recommend speaking to administrators of successful CHW interventions, such as those cited in the cost-effectiveness literature, to obtain firsthand information about effective practices. The Institute for Clinical and Economic Review has also recommended best practices for implementing cost-effective CHW interventions.[12]

METHODS

1. Selection of published evaluations of CHW interventions

We based our CHW models on published studies completed in other states. We identified studies of CHW interventions that met all or most of the following criteria:

- Delivered to populations that were similar to our target population, by:
  - Condition
  - Insurance status
  - Disease control
  - Age group
  - Ethnicity
- Completed in similar settings, such as a federally qualified health center (FQHC) or a community-based organization (CBO).
- Published relatively recently, ideally within the past five years.
- Conducted randomized controlled trials where control groups did not receive CHW services. Where these were not available, we used studies that reported a pre-post effect on a general population.
- Found a statistically significant effect on health outcomes.
- Reported the effect of the CHW intervention on health care costs or health care utilization, including emergency department use and hospitalizations.

2. Target population

To arrive at the number of individuals in our proposed target population, we first researched the burden of disease in the target county. Second, we estimated the size of the entire population in the county that met eligibility criteria for our proposed CHW intervention, for example by age group or insurance status. Third, we estimated the number of patients that would be realistically served to capacity in our target setting, for example at a CBO or an FQHC. Fourth, we estimated the number of participants who would enroll for our proposed CHW intervention, and the number of participants who would persevere for the full duration of the intervention, based on data reported in published studies. Where several different measures were available, we used an average of those measures.

3. Budget development

We developed model budgets based on data we collected from Maine organizations that currently employ CHWs (see further details in Section 7). We supplemented this data with program cost data reported in published studies and line items in the Maine SIM CHW Pilot Project Budget. For each CHW model, we report three-year program costs, with each future year's cost being trended forward using a 2 percent adjustment.

Each budget includes the costs of core training and ongoing training incurred by the CHW employers we interviewed. Their training costs were offset by grant funding. CHW employers who do not have access

to grant–funded CHW training should budget another $1,000 to $2,000 per CHW for training courses. Most CHW employers also arrange for CHWs to receive frequent informal training provided free of charge by local partners.

4. Outcomes

The size of effect of our proposed CHW intervention on health outcomes was based on the effect size among individuals who received CHW services, as documented in published studies. If we were able to obtain evidence from a randomized controlled study, we used pre-post changes in the control group to model changes in health outcomes in the absence of an intervention. If the best evidence available came from a study that did not include a control group, we assumed no change to underlying health status in the absence of CHW services.

Where available, we used actual data for our target population in the target county to model baseline rates of the metric of interest (e.g. asthma hospitalizations). If county-specific data was not available, we used actual data for the state of Maine, or, as a last resort, estimates drawn from published studies for comparable populations.

5. Quality measures affected by proposed CHW intervention

We searched nationally recognized measure sets, listed below, to identify the standard measures likely to be affected by each CHW intervention.

- *The ACO Shared Savings program* puts an emphasis on quality data reporting and quality measurement. ACOs must ensure that they meet annual quality performance standards before they can share in any savings generated. The ACO quality measures encompass four quality domains: Patient/Caregiver Experience, Care Coordination/Patient Safety, Preventive Health, and At-Risk Population.
- *The Uniform Data System* is a reporting requirement for grantees of the Health Resources and Services Administration (HRSA) primary care programs. These measures are used to review the operation and performance of health centers receiving grants from HRSA.[15] These outcome measures are used to create a list ranking health centers and comparing them to health centers nationally for each of the clinical performance measures.[15]
- *The Agency for Healthcare Research and Quality* (AHRQ) developed the AHRQ Quality Indicators for use by program managers, researchers, and others at the federal, state and local levels. They include multiple sets representing various aspects of quality: Prevention Quality Indicators, Inpatient Quality Indicators, Patient Safety Indicators, and Pediatric Quality Indicators. These measures are commonly used to highlight potential quality concerns, identify areas that need further study and investigation, and track changes over time.
- *AHRQ's Prevention Quality Indicators* (PQIs) are a set of measures that can be used with hospital inpatient discharge data to identify quality of care for ambulatory care sensitive conditions. They measure the impact of preventative care in reducing complications, more severe disease, and hospitalizations. The PQIs are used to help flag potential health care quality problem areas

that need further investigation; provide a quick check on primary care access or outpatient services in a community by using patient data found in a typical hospital discharge abstract; and help public health agencies, state data organizations, and health care systems take action to improve health care quality.

- *The National Committee for Quality Assurance* (NCQA) developed the Quality Compass to be used as a national source of comparable performance results from the Healthcare Effectiveness Data and Information Set (HEDIS) and Consumer Assessment of Healthcare Providers and Systems (CAHPS) to compare health plans.[16] Some common uses for this tool include providing ratings to help individuals in selecting a health plan, examining quality improvement and benchmarking plan performance.

6. Cost modeling

Our projected savings from medical costs relied on the availability of data in published studies. Where sufficient data was reported in published studies, we modeled cost savings based on reductions in emergency department (ED) visits and inpatient hospitalizations, applying average Maine-based rates to each visit type, adjusted for insurance type and trended to current and future rates using health cost–specific trend rates published by the Centers for Medicare and Medicaid Services.[17] Where ED visit and hospitalization data were not available, we modeled savings from overall reductions in per-capita health care costs, using published sources. We adjusted costs using a ratio of the average payment rate in the state where the published study was conducted, to the average payment rate in Maine, using Kaiser Family Foundation's State Indicators (expenses per inpatient day) data.[18] In other words, we estimated health care cost savings resulting from reductions in ED visits, hospitalizations, and/or per-person overall health care costs, depending on what was reported in our example study, adjusting all costs to Maine and current-day rates.

7. Social return on investment

The social return of our proposed CHW interventions was measured based on the value of days of work recovered by individuals participating in our proposed CHW intervention or their caretakers, as reported in published studies. We also report school days recovered, where that data is available, but we do not assign a dollar value to those days. Where days lost from school or work were not reported, we modeled the associated reductions based on the improvement in health outcomes described in published sources that report missed work days by health outcome (e.g. level of glycosylated hemoglobin control). The dollar value of days recovered from work was calculated by multiplying the number of work days recovered with the average weekly wage (converted to daily wages by dividing by five) reported for that county by the New England Office of the Bureau of Labor Statistics,[19] trended forward to the applicable year using inflation rates (1 percent per year). The value of recovered days of work would be expected to accrue partly to workers in the form of additional wages, and partly to employers in the form of reduced sick time and improved productivity.

8. Financial return on investment (ROI)

The financial return on investment (ROI) is the amount returned in savings for every dollar spent on the intervention. We calculated ROI by dividing the total dollar savings from medical costs by the program costs. A positive ROI indicates that the program yields savings that are greater than the program costs. A negative ROI (less than 0) indicates that the intervention does not recover the invested program costs. For all CHW models, we projected three-year savings and ROIs (2017–2019).

For further details on data sources, estimates and assumptions for each CHW model, see Technical Appendix.

CHW MODELS

CHW model 1: Improvements in diabetes control in Washington County

Health Issue:	Poorly controlled diabetes
Intervention goal:	Improved diabetes control
CHW intervention:	Home visits, accompanied clinic visit, diabetes educational classes
Target population:	Individuals with diabetes, of all ages
Area:	Washington County
Time frame:	Baseline year: 2016 Intervention year: 2016 (one year) Outcome years: 2017–2019 (three years)
CHW Employer:	Federally Qualified Health Center (FQHC) / Patient Centered Medical Home (PCMH)

KEY EXPECTATIONS OF CHW INTERVENTION

An average 0.7 percentage point reduction in Hb1Ac in 10 months

An average 2.7 mmHg reduction in diastolic BP in 10 months

Financial return on investment: $1.37 for every $1 spent during years 1–3

Social return: 11 recovered work days, valued at $1,500 per person per year

Need for intervention

Uncontrolled diabetes increases the risk of early mortality, cardiovascular disease, chronic kidney disease, retinopathy and neuropathy, as well as increasing the likely need for multiple prescription drugs to treat multiple complications.[20] Good glycemic control has been shown to be beneficial in terms of reducing diabetic complications, with various national and international guidelines routinely recommending intensive blood glucose control as an essential element of diabetes management.[21] In addition to glycemic control, the American Diabetes Association recommends controlling cardiovascular risk factors such as cholesterol and blood pressure among diabetes patients, since cardiovascular disease is the leading cause of morbidity and mortality among diabetics and the largest contributor to the overall cost of diabetes.[22]

Risk factors for chronic conditions such as diabetes tend to be higher in rural areas such as Washington County. A recent report by the New England Health Roundtable highlighted higher rates of diabetes, heart attacks, strokes, and chronic heart disease in rural areas, compared to metro areas.[23] Accordingly, Maine CDC identified rural residents of Maine as a priority population group in its Maine Cardiovascular Health and Diabetes Strategic Plan for 2011–2020.[24] In the strategic plan, age is noted as a contributing

factor to the higher risk factors and disease burdens for diabetes and cardiovascular events, and they note that the proportion of elderly residents increases with rurality, with the proportion of elderly living in isolated rural areas 23 percent greater than in non-rural areas.[24]

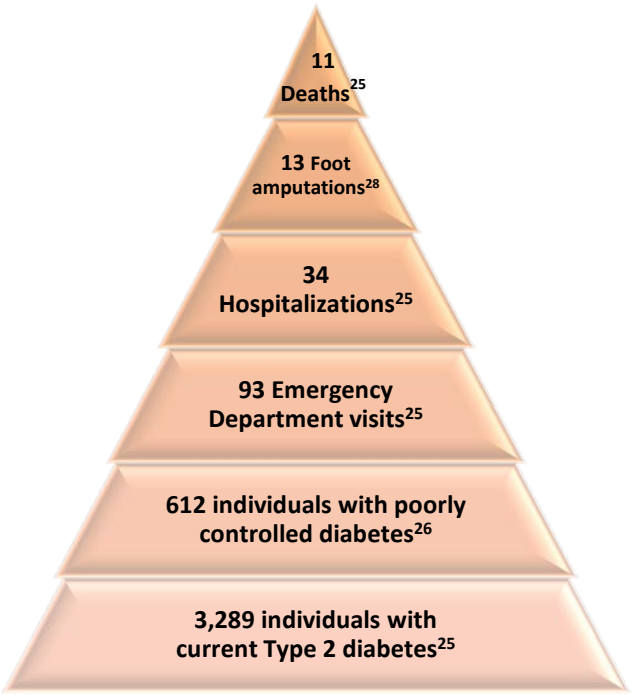
BURDEN OF DIABETES IN WASHINGTON COUNTY[25-28]

One in ten Washington County residents, approximately 3,300 individuals, currently have diagnosed Type 2 diabetes.[25]

Just over one in five individuals with diabetes in Washington County have poor control.[i,26] Uncontrolled diabetes can lead to life-threatening complications, such as:

- End-stage renal disease (43% of cases related to diabetes)[27]
- Limb amputation (more than 60% of cases related to diabetes)[27]
- Blindness (diabetes is leading cause)[27]
- Heart disease (26% of hospitalizations are related to diabetes)[27,28]

In Washington County, poorly controlled diabetes is estimated to contribute to approximately 11 deaths and 13 amputations annually. Diabetes is the primary cause of 34 hospitalizations, and 92 ED visits each year.[25]



These serious complications from diabetes can be prevented through self-management, education, and regular blood glucose level testing. However, many people with diabetes in Maine are not accessing preventive care and/or are not taking all recommended steps to reduce the risk of complications:

- Although recommended twice a year, nearly one in ten (8%) have never had or heard of an HbA1c test[28]
- One in seven (15%) never check their blood glucose levels[28]
- One-quarter (26%) check their glucose levels less than once a day[28]
- Nearly one in three (29%) do not get an annual eye exam[25]
- Nearly one in five (17%) do not get an annual foot exam[25]

[i] Poor control (HbA1c > 9%), definition by the National Committee for Quality Assurance (NCQA).

Description of proposed intervention

The University of Texas Community Outreach (UTCO) intervention is a community-based diabetes education and self-management program that partners with Mercy Clinic in Laredo, Texas. This program trained CHWs to connect with individuals who had an HbA1c above the range of good glycemic control (7 percent).[29] The primary goal of this intervention was to enroll low-income Hispanic adults with poorly controlled Type 2 diabetes in a culturally sensitive lifestyle modification program led by trained peer CHWs. A study of this CHW program found it to be a cost-effective way to improve health, especially for individuals with high glycemic levels (HbA1c above 9 percent).[29]

The 18-month UTCO CHW intervention included: home-based CHW visits, classroom health education classes, nutrition classes, exercise classes, and counseling sessions. The mean number of program components attended was 8.3 health education classes (all participants attended at least one), 4.2 exercise classes (for the 77 percent who attended at least one), and 4.3 counseling sessions (for the 33 percent who attended at least one). CHWs made an average of seven to eight home visits to each individual and provided schedules of upcoming classes, guidance on which sessions individuals should prioritize and assistance in overcoming barriers related to effective diabetes management.

Classes and counseling sessions were taught by a combination of CHWs, a nurse practitioner assigned to the program and several volunteers, including a dietician and a Zumba instructor. Topics for the classes focused on developing new diabetes management skills, establishing social supports for physical activity, and targeting guidance on individual issues in managing diabetes. Although not included in the study that is the basis for this model, another similar CHW program emphasized using community members with lived experience who spoke the same language as individuals attending the classes; this study concluded that using trained peers to educate program participants enhanced diabetes care interventions.[30]

CHWs received training through the University of Texas's Health Science Center School of Public Health, and were state-certified through the Texas Department of Health and Human Services. The diabetes self-management education programs used several different curricula. One site used the Diabetes Empowerment Education Program (DEEP) curriculum, another site used Merck's Journey for Control curriculum, and another used a locally developed program, Si Yo Puedo Controlar Mi Diabetes; some classes included materials from more than one of these curricula.[31] These education programs were not nationally accredited by the American Association of Diabetes Educators (AADE) and the American Diabetes Association (ADA).[32]

We based our CHW model on two studies that reported high-quality data, and included a sufficient level of detail about the interventions used: the University of Texas Community Outreach intervention model,[29] and another intervention delivered at federally qualified health centers (FQHCs) in San Diego County, California.[30] We chose to project some outcomes of our CHW model based on this second study, because it provided good outcome data and was delivered in an impoverished community that was comparable to our target population in Washington County.[30] This study found that culturally tailored diabetes interventions were cost-effective and were successful in improving the health of socially

disadvantaged minorities who bear a disproportional burden of Type 2 diabetes.[30] While both published studies are based on interventions delivered in urban settings, similar programs have also been completed in impoverished, rural communities. For example, in rural Starr County, Texas, a research program focused on diabetes self-management that spans several decades has demonstrated improved outcomes and health care cost savings.[33]

We projected the likely outcomes of applying this model at two FQHCs in Washington County. Washington County includes farming and fishing communities; therefore, we assumed CHWs would require additional resource time to contact these difficult-to-reach populations.

We first estimated the number of participants, as shown in Table 1.1.

Table 1.1. Projected number of participants per year

Population	Estimate	Rate	Data source for estimate
Number of patients per FQHC	3,275		Average at 4 Washington County–based FQHCs in 2014.[26]
With Type 2 diabetes	436	13%	Average at 4 Washington County–based FQHCs in 2014 (13%).[26]
With poor control (HbA1c > 9%)	81	19%	Average for diabetics treated at 4 Washington County–based FQHCs in 2014 (19%).[26]
Number of patients enrolled in Year 1	96		Estimated based on number of CHW hours required for 2 CHWs working from 2 FQHC sites.
Number of patients engaged at Year 1 end	82	85%	Estimated 15% participant dropout/lost to follow-up rate, average rate from 3 CHW intervention studies to improve diabetes control.[30,34,35]

For further details on calculations and data sources, please see Technical Appendix.

Nearly 3,300 individuals in Washington county are estimated to have Type 2 diabetes and the majority (60 percent) are treated at FQHCs. Approximately one in five of these individuals have poorly controlled diabetes. We estimate outcomes and savings for 82 such individuals, treated by two CHWs at two FQHC sites.

Estimated costs of proposed intervention

We estimate that two CHWs working at two FQHCs will have sufficient hours to enroll 96 individuals and to provide home visits (including travel), clinic visits, phone calls, and classes over the course of one year. We assume 14 individuals will drop out during the course of the intervention and will use fewer resources than the 82 who complete the program. Our cost estimate includes time for a registered nurse and registered dietitian to provide diabetes self-management and nutrition classes.
Table 1.2 shows an overview of the estimated costs of our CHW intervention. Annual costs were estimated to be between $126,000 and $131,000, with a total cost of approximately $385,600 over three years. We assume that the two CHW employees will continue to be employed over three years (no CHW staff turnaround in years 1–3), seeing 82 patients each year. Therefore, we do not include costs for core training in years 2 and 3, however ongoing training costs are included in these years.

Table 1.2: Estimates of CHW intervention costs[i]

Budget Item	Estimate	Assumptions
Target number of participants	82	
Number of FTEs required	2	
Costs per CHW (per worker/year)		
Salary	$38,900	$19/hour (Median full-time CHW wage)
Fringe	$10,900	28%
Travel costs	$2,100	400 miles/month at $0.44/mile (Maine state rate)
Supplies		
Office supplies	$600	$50/month
Computer	$300	One-time purchase of cloud-based low-cost laptop
Cell phone	$400	$35/month
Training	$400	$200 for core CHW and supplemental diabetes training, $200 for ongoing training
TOTAL costs per CHW	**$53,600**	
TOTAL CHW COSTS	**$107,300**	
Supervision costs	$6,500	Salary $24.50/hour (Maine median CHW supervisor wage) + fringe 28%, valued at 0.1 FTE/CHW.

[i] Data compiled from interviews conducted by authors (see Section 7) and Maine SIM grant CHW pilot project budget. The estimated costs of training are calculated based on average responses provided in interviews of Maine organizations that employ CHWs. These training costs were noted to be heavily subsidized by grants; for this reason, actual costs of training may be higher than the budgeted amount in our table above.

Budget Item	Estimate	Assumptions
Nurse/dietitian educator costs	$6,000	Based on median of average RN ($30.21) and RD ($27.38) hourly wages in 2015 trended to 2016, at 2.5h RN/RN time per participant/year.[36]
TOTAL COST – YEAR 1	**$126,000**	
Cost per participant, Year 1	$1,500	
TOTAL COST - YEARS 1–3	**$386,000**	Year 2 costs = Year 1 costs, less laptop purchase and core training, plus 2% cost-of-living adjustment Year 3 costs = Year 2 costs plus 2% cost-of-living adjustment

FTE=full-time equivalent. Total costs are rounded to the nearest thousand, other costs to the nearest hundred. All costs have been adjusted for inflation.

The estimated costs of the CHW intervention are between $126,000 and $131,000 in years 1–3, with a total cost of approximately $385,600 over three years.

Projected improvements in patient outcomes and quality measures

While most studies of CHW interventions have reported statistically significant effects for HbA1c control only, a study in San Diego County, California, also reported an effect on blood pressure. Compared to no intervention, individuals with poor diabetes control experienced a 0.7 percentage point greater improvement in HbA1c levels, and a 2.7 mmHg greater improvement in diastolic blood pressure within the first year.[30] Table 1.3 below summarizes these results. The effects of CHW interventions on reducing HbA1c levels have been shown to last for up to 18[29] and 24 months.[37] Although we assumed CHWs would continue to work with participants in years 2 and 3 and could potentially help more participants to bring their diabetes under control, we assumed no change in HbA1c levels after year 1.

Table 1.3: Projected improvements in patient outcomes and quality in Year 1[30]

	Baseline	Reduction	Post-intervention	CHW intervention effect compared to no intervention*
HbA1c (%, average)	10.5%			
4 months		-1.7	9.0%	0.6 greater reduction (vs. -1.1 in control), p=0.02
10 months		-1.5	9.1%	0.7 greater reduction (vs. -0.8 in control), p=0.02
Diastolic blood pressure (mmHg, average)	74.8			
4 months		-1.7	73.1	1 mmHg greater reduction (vs. -0.7 mmHg in control), p=0.04
10 months		-2.2	71.8	2.7 mmHg greater reduction (vs. +0.5 mmHg in control), p=0.04

*CHW intervention effects summarize statistically significant differences between control and intervention groups. For further details on calculations and data sources, please see Technical Appendix.

The proposed CHW intervention enrolling 96 diabetic individuals with poor control in Washington County is projected to significantly reduce HbA1c levels and blood pressure in the first year.

Other quality measures that may be affected by proposed CHW intervention

Many of the measures listed in Table 1.3 above are key outcome measures used in public reporting and in value-based payment arrangements. Because our proposed CHW intervention can be linked to improved health outcomes, higher payments for meeting quality targets would achieve a positive return on investment. Table 1.4 lists nationally recognized quality measures that we predict will improve in our proposed population of adults with poorly controlled diabetes.

Table 1.4. Quality measures that will likely improve with CHW intervention

Quality Measure Set	NQF #	Measure Title
ACO 33	N/A	Diabetes Composite: ACO #22. Hemoglobin A1c Control (HbA1c) (<140/90 ACO #25. Tobacco Non Use ACO #26. Aspirin Use
ACO 33	0059	Percent of beneficiaries with diabetes whose HbA1c in poor control (>9 %)
Uniform Data System (UDS)	0059	Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) Poor Control (>9.0%)
Uniform Data System (UDS)	0575	Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) Control (<8.0%)
Uniform Data System (UDS)	N/A	Diabetes Hba1c < 7%
Quality Compass	0057	Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) testing
Quality Compass	0059	Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) Poor Control (>9.0%)
Quality Compass	0061	Comprehensive Diabetes Care: Blood Pressure Control (<140/90 mm Hg)
Quality Compass	0575	Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) Control (<8.0%)
Quality Compass	0731	Comprehensive Diabetes Care
AHRQ Quality Indicators	0638	Uncontrolled Diabetes Admission Rate (PQI 14)
AHRQ Quality Indicators	0285	Rate of Lower-Extremity Amputation Among Patients With Diabetes (PQI 16)
AHRQ Quality Indicators	0272	Diabetes Short-Term Complications Admission Rate (PQI 1)
AHRQ Quality Indicators	0274	Diabetes Long-Term Complications Admission Rate (PQI 3)

Abbreviations: ACO, Accountable Care Organization. AHRQ, Agency for Healthcare Research and Quality. CHIP, Children's Health Insurance Program. ED, emergency department. HbA1c, hemoglobin A1c. NCQA, National Committee for Quality Assurance. N/A, not available. NQF, National Quality Forum. PQI, Prevention Quality Indicator.

Projected change in medical costs

In the community-based diabetes education and self-management program in Laredo, Texas, the majority of enrollees reached good glycemic control (HbA1c ≤ 7 percent) within one year, with only one in five patients (20 percent) remaining with poor control (HbA1c ≥ 9 percent). Long-term health benefits included a 3 percent reduction in the 20-year risk of both foot amputations and heart attacks.[29] We used these results to project changes in medical costs.[29]

We projected savings from direct medical costs for our target population in Washington County, based on projected improvements in HbA1c levels, as individuals brought under good glycemic control have lower overall medical costs. We present projected overall costs and savings, rounded to the nearest thousand, and projected savings per person, rounded to the nearest hundred, in Table 1.5 below. In the first year of implementation, our CHW intervention is projected to save $168,000, or $2,100 per person, representing a 15 percent saving relative to costs without an intervention.

Table 1.5: Projected savings in medical costs in Year 1

	Baseline (2016)	Year 1 (2017)	Cost vs. baseline
Target population	82	82	
Number of patients (%) by HbA1c control level			
Good (≤7%)	0	49 (60%)	
Fair (>7% and ≤9%)	0	16 (20%)	
Poor (>9%)	82 (100%)	16 (20%)	
Average annual direct medical costs			
Without CHW intervention *	$1,079,000	$1,108,000	$29,000
Per person	$13,200	$13,500	$300
With CHW intervention	$1,079,000	$939,000	($140,000)
Per person	$13,200	$11,500	($1,700)
Total savings			**($168,000)**
Per person			($2,100)

* This study did not include a control group that did not receive a CHW intervention. Therefore, we assume no improvement in HbA1c control (and therefore no savings in medical costs) in the absence of an intervention (increases from baseline to year 1 reflect medical inflation). Group costs are rounded to the nearest thousand, per-person costs to the nearest hundred. Calculations may not total exactly because of rounding. All costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

In the first year of implementation, the expected savings from direct medical costs from our proposed CHW intervention were $168,000, or $2,100 per patient.

Projected Social Return on Investment

The American Diabetes Association attributes nearly one-third of Maine's total diabetes cost burden ($1.24 billion in 2012), or $360 million, to indirect costs from lost productivity.[20] Here we estimate the social return of our intervention, defined as the value estimated to result from reductions in work absence. For our estimated population of 82 diabetic individuals treated at an FQHC in Washington County, we estimated that 48 (59 percent) were working-age adults. A CHW intervention was estimated to result in approximately 542 fewer days absent from work in the first year alone, representing a nearly $74,000 value of recovered days of work. Working-age adults completing the intervention would be expected to gain an average of 11 working days, valued at $1,500 in wages, over one year. These results are summarized in Table 1.6 below.

Our projections are likely to underestimate the true societal value of the CHW intervention, since we do not calculate the effects of reduced workdays with less productivity due to illness, which economists call "presenteeism." Presenteeism has been estimated to cost four times more than absence from work (30 percent vs. 7 percent reduction in productivity[20]). Further, our projections do not include the value of future lost earnings from premature death, or unemployment from disability.[20]

Table 1.6: Projected Social Return from recovered working days in Year 1

	Baseline (2016)	Year 1 (2017)	Cost vs. baseline
	Annual value of days lost ($)		Days lost per year
Target population, working adults	48	48	
Without CHW intervention	$142,000	$144,000	1,049
Per person	$2,900	$3,000	22
With CHW intervention	$142,000	$69,000	507
Per person	$2,900	$1,400	10
Total recovered value and workdays		**($74,000)**	**(542)**
Per person		($1,500)	(11)

Group costs are rounded to the nearest thousand, per-person costs to the nearest hundred. Calculations may not total exactly because of rounding. All costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

The proposed CHW intervention is projected to result in 542 fewer days absent from work in the first year alone. The social return was estimated at $74,000, representing recovered working days. Each working person remaining in the program at the end of year 1 is projected to gain an average of 11 working days, worth approximately $1,500 per year.

Projected total return on investment (ROI) over 3 years

Table 1.7 summarizes the projected return on investment of our proposed CHW intervention. With an estimated program cost of approximately $378,600 over three years, the estimated return on investment (ROI) of our proposed CHW intervention was $1.37 for every dollar spent on the program over 3 years. In total, the program is projected to save approximately $744,400 over three years, of which nearly $520,000 was from direct medical costs, and approximately $225,000 from the value of recovered working days.

Table 1.7: Expected Total Return on Investment (ROI) of CHW Intervention over 3 years

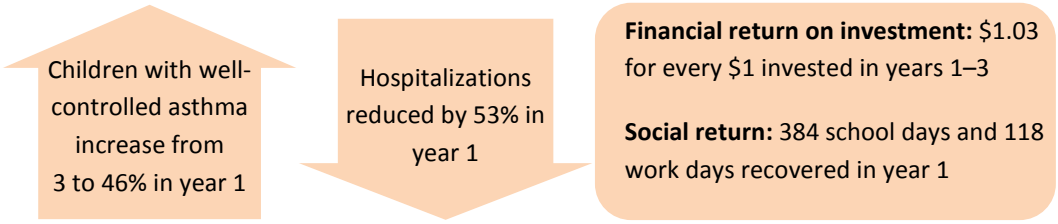
	Year 1 (2017)	Year 2 (2018)	Year 3 (2019)	Total Years 1-3
Target population	82	82	82	
Savings from direct medical costs	$168,000	$173,000	$178,000	$520,000
Expected costs of CHW intervention	($119,000)	($128,000)	($131,000)	($379,000)
Projected financial ROI	**$1.41**	**$1.35**	**$1.36**	**$1.37**
Social return (recovered working days)	$74,000	$75,000	$76,000	$225,000
TOTAL SAVINGS (medical costs + social return)	**$243,000**	**$248,000**	**$254,000**	**$744,000**

Costs are rounded to the nearest thousand. Calculations may not total exactly because of rounding. Costs in years 2 and 3 increase relative to year 1 because they have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

CHW model 2: Improvements in asthma control among children in Kennebec County

Health Issue:	Poorly controlled asthma
Intervention goal:	Improved asthma control
CHW intervention:	Home visits, environmental assessment, asthma mitigation supplies, phone calls
Target population:	Children with poorly controlled asthma
Area:	Kennebec County
Time frame:	Baseline year: 2016 Intervention year: 2016 (1 year) Outcome years: 2017–2019 (3 years)
CHW Employer:	Private group practice in a health system/Accountable Care Organization (ACO) eligible for quality bonus payments

KEY EXPECTATIONS OF CHW INTERVENTION



Need for intervention

Children with uncontrolled asthma are at risk for severe asthma exacerbations following upper respiratory and pulmonary infections.[38] Uncontrolled asthma can lead to emergency department visits, hospitalization, or even death.

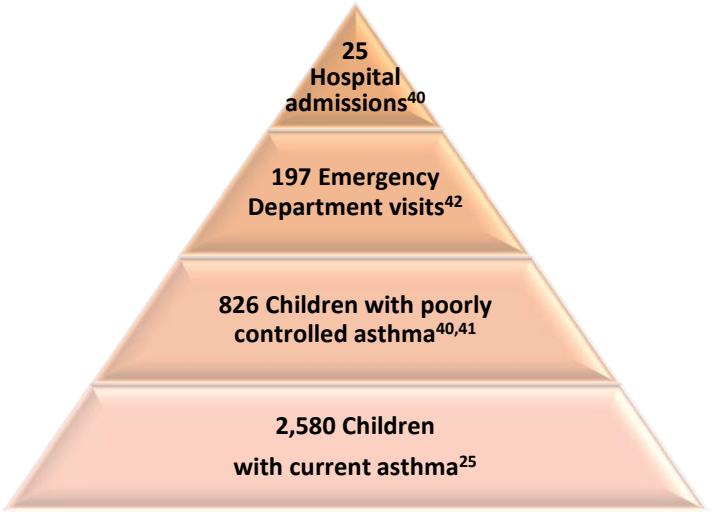
Children with uncontrolled asthma are more likely to have learning disabilities compared with those with good control, and have a higher frequency of obesity. They are more likely than those with good control to miss school (5.5 vs. 2.2 days); to arrive late or leave early (26.7 vs. 7.1 percent); to miss school-related activities (40.6 vs. 6.2 percent); and to visit the health office or school nurse (22.5 vs. 8.8 percent).[38,39] A survey of children with uncontrolled asthma showed they have significantly lower health care-related quality of life and psychosocial measure scores.[39] Furthermore, caregivers of children with uncontrolled asthma reported significantly greater work and activity impairment and lower quality of life for emotional, time-related, and family activities.[39]

BURDEN OF ASTHMA AMONG CHILDREN IN KENNEBEC COUNTY[25,40-42]

One in ten children in Kennebec County, more than 2,500 children, currently has asthma.[25]

Approximately one-third (32%) of children with asthma have poorly managed asthma.[40,41]

In Kennebec County, poorly controlled asthma is estimated to contribute to nearly 200 ED visits and 25 hospitalizations each year.[42]



Description of proposed intervention

In 2002, the King County Asthma Forum in Washington State incorporated CHWs into its care model in order to expand the reach of asthma care beyond the traditional medical setting and into the communities and homes of families who have children with asthma.[43,i] In King County, CHWs make personal connections with families and provide asthma care training, home environmental assessments, and community outreach. CHWs work in communities with ethnically diverse populations, and the most disadvantaged communities—which tend to be those hardest hit by pediatric asthma rates. Most workers are from the communities they serve and are bilingual in English and the language spoken by their clients, and they are sensitive to and aware of the issues these families struggle with daily. CHWs are trained, and meet with families in their homes to educate them about self-management, to connect them to social services that address social determinants of health, and to help coordinate care with providers.[ii]

In this model the primary focus of the CHW intervention is to reduce exposure to indoor asthma triggers, to provide in-home environmental assessments, as well as asthma self-management education, support in understanding and following clinical treatment recommendations from the provider team, and resources to facilitate improved asthma control. CHWs receive up to 40 hours of core training consisting of in-class lessons and exercises, role playing, and field practice.[44]

[i] Information about Seattle/King County asthma rates and King County Asthma Forum gathered from: PediatricAsthma.org: Community Coalitions: King County Asthma.
[ii] CHW model information gathered from: PediatricAsthma.org: Community Coalitions: King County Asthma Forum; and Campbell, et al. 2015.[43]

CHWs make an initial visit to assess the family's knowledge of asthma, the child's asthma control level, family challenges with controlling asthma, self-management practices and exposure to asthma triggers. In Seattle King County, CHWs provided an average of four home visits per participant.[43]

During home visits CHWs use motivational interview tactics to assess family need and tailor the intervention to each family's need. They provide educational content, and they help families develop needed skills to reduce asthma triggers, including the optimal use of cleaning supplies, and coaching on the correct use of asthma devices. Educational content from other successful CHW interventions have used principles from national guidelines, such as the National Asthma Education Prevention Program[45,46,47] developed by the National Heart, Lung and Blood Institute, and You Can Control Asthma, a curriculum that has been validated and distributed by the Asthma and Allergy Foundation.[48,49]

CHWs help families mitigate asthma triggers present in the home by providing materials, such as low-emission vacuum cleaners, cleaning supplies, roach abatement supplies (if roaches were present), and allergy-reducing bedding covers.[41] CHWs also provide support via telephone or email, and through additional home visits, as needed.[43]

We projected the likely effects of implementing this model at a private group practice in Kennebec County. We first estimated the likely number of participants, as shown in Table 2.1 below. We projected that approximately 137 children would enroll in the program, of whom 112 would persist with the entire intervention.

Table 2.1: Projected number of participants per year

Population	Estimate	Rate	Data source for estimate
Number of individuals in Kennebec County	121,164		
Children	24,112	19.9%	19.9% of Kennebec residents[25]
Children with asthma	2,580	10.7%	10.7% of Kennebec children[25]
Children with poorly controlled asthma	826	32%	32% of children with asthma[40,41]
Children with poorly controlled asthma likely to be treated in a private group practice/ACO	137		Assumed a panel size of 4,000 children, of whom 10.7% have asthma, of whom 32% have poor control of their asthma.
Estimated target population size for years 1–3 of CHW intervention	112	82%	We estimate that 18% of intervention participants will be lost to follow-up or discontinue participation in the first year.[43,50] We assume that the greatest rate of dropout will be in year 1 of the program, with constant attendance for years 2 and 3.

For further details on calculations and data sources, please see Technical Appendix.

We estimate that approximately 2,580 children in Kennebec County have asthma. One-third of them, approximately 826 children, are estimated to have poorly controlled asthma.

Estimated costs of proposed intervention

Table 2.2 presents the estimated costs of our proposed CHW intervention. We estimate that one CHW could provide services for a population of 112 children with asthma per year. We assume that the same CHW employee will continue to be employed over three years (no CHW staff turnaround in years 1–3), seeing 112 patients each year. Therefore, we do not include costs for core training in years 2 and 3, however ongoing training costs are included in these years. We assumed that because of the longer travel distances in rural Kennebec, CHWs would provide fewer home visits, an average of three visits per family – rather than the four provided in Seattle – and would supplement with more frequent phone calls.

We estimated annual costs of between $72,000 and $75,000 per year, for a total three-year cost of approximately $220,000. In our budget estimate shown in Table 2, we assumed approximately 200 travel miles per month, reimbursed at prevailing Maine rates. We also assumed that each CHW would distribute asthma mitigation supplies to families during home visits, and that each year approximately 33 percent of families would require all supplies, while other families would require some supplies but not others. As noted above, asthma mitigation supplies include a low-emission vacuum cleaner, allergen-free cleaning supplies, insect abatement supplies if present in the home, and allergen-impermeable bedding covers.[43]

Table 2.2: Estimates of CHW intervention costs[i]

Budget Item	Estimate	Assumptions
Target number of participants	112	
Number of CHWs required	1	Three visits per member + phone calls
Costs per CHW (per worker/year)		
Salary	$38,900	$19/hour (Median full-time CHW wage)
Fringe	$10,900	28%
Travel costs	$1,100	200 miles/month at $0.44/mile (Maine state rate)

[i] Data compiled from interviews conducted by authors (see Section 7) and Maine SIM grant CHW pilot project budget. The estimated costs of training are calculated based on average responses provided in interviews of Maine organizations that employ CHWs. These training costs were noted to be heavily subsidized by grants; for this reason, actual costs of training may be higher than the budgeted amount in our table above.

Budget Item	Estimate	Assumptions
Supplies		
Asthma mitigation supplies	$13,100	$350/family, assuming one-third (33%) of families per year will require all supplies, while two-thirds will require some supplies and not others
Office supplies	$600	$50/month
Computer	$300	One-time purchase of cloud-based low-cost laptop
Cell phone	$400	$35/month
Training	$300	$125 for core training, $200 for ongoing training
TOTAL CHW COSTS	**$66,000**	
Supervision costs	$6,500	Salary $24.50/hour (Maine median CHW supervisor wage) + fringe 28%, valued at 0.1 FTE/CHW.
TOTAL COST – YEAR 1	**$72,000**	
Cost per participant, Year 1	$700	
TOTAL COST - YEARS 1-3	**$220,000**	Year 2 costs = Year 1 costs, less laptop purchase and core training, plus 2% cost-of-living adjustment Year 3 costs = Year 2 costs, plus 2% cost-of-living adjustment

FTE=full-time equivalent. All costs have been adjusted for inflation. Total costs are rounded to the nearest thousand, other costs to the nearest hundred.

The estimated annual costs of the CHW intervention were between $72,000 and $75,000 per year, totaling $220,000 over three years.

Projected improvements in patient outcomes and quality measures

We project that the proposed intervention would result in reductions in asthma-related hospitalizations and emergency department visits, based on results reported in Philadelphia, Pennsylvania.[48] In addition, compared with children who do not receive the intervention, we would expect to see better-controlled asthma, including more symptom-free days, fewer days with limited activity due to asthma, and reduced use of rescue medications.[43] These projections are summarized in Table 2.3 below.

For this proposed intervention, we assume the group practice is eligible to receive an additional $60,000 per year for achieving targets related to these quality measures.

Table 2.3: Projected improvements in patient outcomes and quality in Year 1

Outcome measure	Baseline	Year 1	% change from baseline	CHW intervention effect
Number of patients	112	112		
Health care utilization				
Hospitalizations (number/year)	3	2	(-53%)*	^
Emergency department visits (number/year)	27	19	(-30%)*	^
Quality measures				
Days with activity limitation (per two weeks)	4.1	1.2	(-71%)*	0.6 days more symptom-free days vs. no intervention*
Rescue medication use (days/two weeks)	5.7	2.3	(-59%)**	1.5 fewer days with rescue medication use vs. no intervention**
Symptom-free days (per two weeks)	6.4	10.9	(+72%) ***	1.8 more symptom-free days vs. no intervention ***
Well-controlled asthma, patients (%)	4 (3%)	52 (46%)	+48 (+1300%) ***	19 patients with well-controlled asthma vs. no intervention (increased from 3% to 46% vs. from 6% to 23% with no intervention ***

Baseline rates for emergency department visits and inpatient hospitalizations calculated from MHDO; for all other measures, baseline rates are those reported in published studies for the CHW intervention group. For further details on calculations and data sources, please see Appendix 2.

Asterisks indicate significance level for intervention effect: *p<0.05, **p=0.001, ***p<0.001.

^ No control group in this study; effects estimated from within-group effects (improvement relative to baseline).

In its first year of implementation, similar CHW interventions reduced emergency department visits by 30 percent, reduced hospitalizations by 53 percent, and increased symptom-free days by 72 percent.

Other quality measures that may be affected by proposed CHW intervention

Many of the measures listed in Table 2.3 above are key outcome measures used in public reporting and in value-based payment arrangements. Because our proposed CHW intervention can be linked to improved health outcomes, a provider that receives higher payments for meeting targets related to these measures would achieve a positive return on investment. Table 2.4 lists nationally recognized

quality measures that we predict will improve in our proposed population of children with poorly controlled asthma.

Table 2.4. Quality measures that will likely improve with CHW intervention

Quality Measure Set	NQF #	Measure Title
2016 Core Set of Children's Health Care Quality Measures for Medicaid and CHIP	N/A	Ambulatory Care, ED Visits
2016 Core Set of Children's Health Care Quality Measures for Medicaid and CHIP	1799	Medication Management for People with Asthma (MMA)
Uniform Data System (UDS)	0047	Asthma: Pharmacologic Therapy for Persistent Asthma
AHRQ Quality Indicators/Maine Health Data Organization	0283	Asthma in Younger Adults Admission Rate (PQI 15)
AHRQ Quality Indicators	N/A	Asthma Admission Rate (PDI 14)
NCQA Quality Compass	1560	Relative Resource Use for People with Asthma
NCQA Quality Compass	0036	Use of appropriate medications for people with asthma

Abbreviations: AHRQ, Agency for Healthcare Research and Quality. CHIP, Children's Health Insurance Program. ED, emergency department. NCQA, National Committee for Quality Assurance. NQF, National Quality Forum. PQI, Prevention Quality Indicator.

Projected change in medical costs

We projected the change in direct medical costs from the proposed CHW intervention by calculating the savings associated with fewer emergency department visits and hospital inpatient stays, based on results reported by a study in Philadelphia.[48] As shown in Table 2.5 below, total savings were estimated at $15,000 in the first year of the intervention, or $140 per patient. Savings were mainly driven by a reduction in emergency department visits, with eight fewer emergency department visits, representing a 30 percent reduction. We projected a 53 percent reduction in hospitalizations, however, due to our small model patient population of 112 patients, this reduction resulted in only one less hospitalization.

Table 2.5: Projected savings in medical costs in Year 1

	Baseline (2016)	Year 1 (2017)	Difference vs. baseline
Target population	112	112	
Without CHW intervention *			
Event rates			
Hospitalizations / year	3	3	
ED visits / year	27	27	

	Baseline (2016)	Year 1 (2017)	Difference vs. baseline
Costs			
Hospitalizations	$16,000	$16,000	$400
ED visits	$25,000	$26,000	$700
TOTAL COSTS	$41,000	**$42,000**	$1,100
With CHW intervention			
Event rates			
Hospitalizations / year	3	2	1
ED visits / year	27	19	8
Costs			
Hospitalizations	$16,000	$9,000	($7,300)
ED visits	$25,000	$18,000	($7,100)
TOTAL COSTS	$41,000	**$27,000**	
Cost savings from CHW intervention			**($15,000)**
Per patient			($140)

* This study did not include a control group that did not receive a CHW intervention; therefore, we assume no change to event rates in the absence of a CHW intervention.[48] Group costs are rounded to the nearest thousand, per-person costs to the nearest hundred or 10. All costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

The CHW intervention is estimated to save more than $15,000 in year 1 from reduced hospitalizations and emergency department visits, representing an average saving of $140/patient.

Projected Social Return on Investment

Additional savings can be accrued through a CHW intervention, beyond those from direct medical costs. In table 2.6 below, we present data on the social return of the CHW intervention, as measured by the number of missed school days recovered, and missed work days for adult caregivers (absenteeism), based on results achieved by a study conducted in Boston. We also calculate a dollar value for the social return of our CHW intervention, based on the total recovered working days for adult caregivers who would otherwise be absent from work when their child is experiencing poor control of their asthma. We did not assign a dollar value to school days recovered because the benefit is long-term and difficult to quantify.

Table 2.6: Projected social return on investment in Year 1

	Baseline (2016)	Year 1 (2017)	
	Value of days lost ($)		Days per year
Target population, working adults	112	112	
Missed school days, per year			
Without CHW intervention	-	-	669
Per person	-	-	6.0
With CHW intervention	-	-	284
Per person	-	-	2.5
Total recovered school days			**(384)**
Per person			**(3.4)**
Missed caregiver work days, per year			
Without CHW intervention	$33,100	$33,500	212
Per person	$300	$300	1.9
With CHW intervention	$33,100	$14,900	94
Per person	$300	$130	0.8
Total value of caregiver workdays recovered		**($18,600)**	**(118)**
Per person		($170)	(1.1)

Group costs are rounded to the nearest hundred, per-person costs to the nearest 10. All costs have been adjusted for inflation. Calculations may not total exactly due to rounding. For further details on calculations and data sources, please see Technical Appendix.

Projected total Return on Investment (ROI) over three years

Table 2.7 below shows the projected return on investment (ROI) from our proposed CHW intervention. This model is projected to produce savings that are considerably less than the program costs. A quality bonus payment is required to produce a positive ROI. With an estimated annual program cost of approximately $72,000 to $75,000, and an assumed bonus payment of $60,000 for achieving quality goals, the projected ROI of the CHW model over three years would be $1.03 for every dollar invested. Without the quality bonus payment, the ROI would be only $0.21 for every dollar invested.

Table 2.7: Expected Total Return on Investment (ROI) over three years

	Year 1 (2017)	Year 2 (2018)	Year 3 (2019)	TOTAL (Years 1-3)
Target population	112	112	112	
Savings from direct medical costs	$15,000	$16,000	$16,000	$47,000
Payment for achieving quality goals	$60,000	$60,000	$60,000	$180,000
Expected costs of CHW intervention	($72,000)	($73,000)	($75,000)	($220,000)
Projected financial ROI	**1.04**	**1.04**	**1.01**	**1.03**
Social return (recovered working days)	$19,000	$19,000	$19,000	$56,000
TOTAL SAVINGS (medical costs + social return)	$34,000	$35,000	$35,000	**$104,000**

Costs are rounded to the nearest thousand. Costs in years 2 and 3 increase relative to year 1 because costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

We project that a CHW intervention targeted to children with poorly controlled asthma in Kennebec could produce $47,000 in medical cost savings and a social return of $56,000 in recovered working days over three years. Together with a quality bonus payment of $60,000 per year, this intervention would produce an overall return on investment (ROI) of $1.03 for every dollar invested.

CHW model 3: Improving control of chronic conditions for individuals with high health care use in Aroostook County

Health Issue:	Poor chronic condition management and high health care use
Intervention goal:	Improved control of chronic conditions
CHW intervention:	Connect to community resources, facilitate communication with Primary Care Provider (PCP), assist with appointment scheduling and health screening visits, conduct home visits when needed
Target population:	Adults with chronic conditions with total health spending in the top 5%
Area:	Aroostook County
Time frame:	Baseline year: 2016 Intervention year: 2016 (six months' duration) Outcome years: 2017–2019 (three years)
CHW Employer:	Rural Health Center

KEY EXPECTATIONS OF CHW INTERVENTION

83% reduction in hospitalizations overall in year 1

23% more diabetic patients receiving eye exams in year 1

Financial return on investment: $2.31 for every $1.00 invested in years 1–3
Savings: $1,275,000 over three years

Need for intervention

In Maine, 20 percent of residents account for 87 percent of health care spending, and the top 5 percent account for 54 percent of spending.[51] Of the individuals in this top 5% tier, often called "high utilizers," the vast majority (more than 90 percent) have at least one chronic condition.[52] Reducing potentially avoidable health care use among this population in Maine has been estimated to result in large savings.[i],[53] In Aroostook County, more than one in three adults have three or more chronic conditions (35 percent),[25] and these individuals are more than three times as likely to incur health care costs in the top 5 percent tier.[54]

[i] A previous analysis estimated that by reducing potentially avoidable health care use by 50 percent, overall medical spending would be reduced by 6 percent in a MaineCare population and 12 percent in a commercial population. Source: April 10, 2009, ACHSD Cost Driver Report & Recommendations to the Maine Legislature, April 2009 (cited in: Maine Department of Health and Human Services, State Innovation Plan, 2012).[53]

Heart disease is the leading cause of death in Aroostook County, with rates for cardiovascular disease–related hospitalizations and deaths significantly higher than the state average.[25] Obesity among adults is 38.3 percent in Aroostook; significantly higher than the state rate of 28.9 percent.

Aroostook County has a higher ambulatory care-sensitive condition hospital admission rate than the average for the state of Maine: 1,792 per 100,000 people in Aroostook County versus 1,499 per 100,000 people for the state average.[25] The emergency department (ED) rate for ambulatory care–sensitive conditions is also high at 6,148 per 100,000 people.[25] Additionally, a recent report by the New England Rural Health Roundtable highlighted higher rates of diabetes, heart attacks, strokes and chronic heart disease in rural areas, compared to metro areas.[23] Rurality also affects access to services, which can increase hospital service usage for preventable conditions. Compared to urban peers, rural diabetics are less likely to receive recommended preventive services such as eye exams, foot checks, and cholesterol checks.[55]

THE BURDEN OF CHRONIC CONDITIONS IS HIGHER IN AROOSTOOK COUNTY THAN IN THE REST OF MAINE

- Approximately two in five adults (41%) have high blood pressure (hypertension), compared to 33% in the rest of the state
    - Hospitalizations related to hypertension are 2.5 times more common in Aroostook than in the rest of Maine
- Nearly half (48%) of adults have high cholesterol , a risk factor for cardiovascular disease hospitalizations
    - Heart attack–related hospitalizations occur 1.7 times more frequently in Aroostook than in the rest of Maine
- Approximately 13% of adults have asthma
    - Asthma-related emergency department visits are two times more frequent in Aroostook, compared to the rest of the state
- Approximately 14% of adults have diabetes
    - Diabetes-related emergency department visits are 1.5 times more frequent in Aroostook than in the rest of the state

More than one in three adults (35%) living in Aroostook currently have three or more chronic conditions

Data are 2011–2013 estimates from the Maine 2016 Shared Community Health Needs Assessment.[25] See more details in Technical Appendix.

Improvements in hypertension, high cholesterol and obesity rates can reduce the number of cardiovascular events requiring hospitalization. A 2014 cost-effectiveness study found that treating individuals with existing cardiovascular disease or hypertension could produce cost-savings even if strategies to increase medication adherence doubled treatment cost.[56]

Description of proposed intervention

Molina Healthcare established a CHW model for its managed care plans in New Mexico in 2005. Molina partnered with Community Access to Resources and Education in New Mexico (CARE NM), a nonprofit organization, to reach out and provide CHW intervention to their members with high health care usage who were in need of assistance.[57] The primary goal of this intervention was to decrease emergency department (ED) visits for non-urgent conditions and to improve management of chronic conditions that lead to ED usage. The CHW intervention program relied on a multi-disciplinary team approach that included staff from a federally qualified health center (FQHC) and the University of New Mexico Department of Family and Community Medicine, in addition to the health plan and the nonprofit organization.

The collaborative approach among payers, providers, and community-based organizations created an effective model for the members receiving intervention in New Mexico. Molina Healthcare recently announced expanding this model to more of the 10 states where it operates. We have based this CHW model on the CARE NM approach.

In New Mexico, Molina Healthcare began by using predictive modeling analysis to identify individuals who had high emergency department utilization, high specialist utilization, low primary care utilization, and poorly controlled chronic conditions. Each selected individual's primary care provider then identified monitoring services missed by the targeted individuals (such as missed appointments, LDL cholesterol testing, or HbA1c monitoring). CHWs worked with the target individuals to schedule appointments with their primary care providers for missed services, and CHWs coordinated with the individual and with the provider to ensure that the missed services were completed. CHWs conducted home visits and sometimes joined patients during their first primary care visit.

CHWs also helped individuals overcome barriers to improving their health care by accessing community resources, connecting to public agencies, and applying for Supplemental Security Income (SSI) and other public benefits. These connections to community resources helped participants address social issues that had become barriers to seeking care and adhering to medication regimens. CHWs collaborated with team members from the payer, primary care provider, and community nonprofit organization. This collaborative approach supported CHWs' efforts to ensure individuals received the services and community resources they needed.

We applied the CARE NM model to project improvements in quality measures, patient outcomes and cost savings for a population of patients with chronic conditions treated at three rural health centers (RHCs) located in Caribou, Fort Kent, and Houlton in Aroostook County. Our analyses focused on a high-cost, high-utilizer patient population, following the patient selection methodology used by Molina Healthcare in New Mexico. Table 3.1 summarizes the estimated number of participants in our CHW model.

Table 3.1: Projected number of participants per year

Population	Estimate	Rate	Data source for estimate
Average number of adult patients at a rural health center (RHC) in Aroostook County	1,350		Assumes RHC patient volume is 50% FQHC patient volume in Aroostook County, of which 76% are adults (age ≥18 years).[26]
Estimated high-cost, high-use patients	68	5%	Intervention focuses on the 5% who incur the highest cost.
Estimated target population enrolled into CHW intervention, per site	60	89%	Percent amenable to preventive measures. Excludes patients with terminal conditions (11%).[58]
Estimated population retained after six-month CHW intervention, per site	50	83%	Assumes 1/6 of enrollees will drop out.[57]
Estimated total population at 3 Rural Health Centers			
Estimated population enrolled into CHW intervention, per three RHCs	180	3	Number enrolled at one site x three sites
Estimated population retained after six-month CHW intervention, per three RHCs	150	83%	Assumes 1/6 of enrollees will drop out.[57]

For further details on calculations and data sources, please see Technical Appendix. Abbreviations: FQHC, Federally Qualified Health Center; RHC, Rural Health Center.

More than half of health care spending in Maine is attributable to just 5 percent of the population. The majority of these individuals have at least chronic condition, and many have three or more. Our proposed CHW intervention in Aroostook would aim to enroll 180 such individuals, based at rural health centers in Caribou, Fort Kent and Houlton.

Estimated costs of proposed intervention

As shown in Table 3.2 below, our proposed CHW intervention is estimated to cost between $180,000 and $187,000 per year for three full-time CHWs, each working at sites distributed across the county, in Caribou, Fort Kent, and Houlton. Total costs over three years would be approximately $551,000, with an annual cost of $1,200 to $1,250 per patient.

We estimate that CHWs in rural Aroostook County will each work with a caseload of 50 patients per year, a smaller caseload than CHWs in Laredo, Texas, because of the greater time required for traveling to visit patients and for connecting patients to community services. A CHW initiative in rural Vermont reported larger CHW caseloads, but that program included patients with less intense needs than we model here.[i,14,59] We assume that the same CHW employee will continue to be employed over three years (no CHW staff turnaround in years 1–3), seeing 50 patients each year. Therefore, we do not include costs for core training in years 2 and 3, however ongoing training costs are included in these years.

Table 3.2: Estimates of CHW intervention costs[ii]

Budget Item	Estimate	Assumptions
Target number of participants	150	See Table 3.1
Number of FTEs required	3	Assume one FTE based in Caribou, one in Fort Kent, and one in Houlton
Estimated caseload per CHW per year	50	
Costs per CHW (per worker/year)		
Salary	$38,900	$19/hour (Median full-time CHW wage)
Fringe	$10,900	28%
Travel costs	$2,100	400 miles/month at $0.44/mile (Maine state rate)
Supplies		
Office supplies	$600	$50/month
Computer	$300	One-time purchase of cloud-based low-cost laptop
Cell phone	$420	$35/month
Training	$400	$200 for core CHW and supplemental diabetes training, $200 for ongoing training

[i] At St. Johnsbury Hospital in Vermont, three CHWs are employed full-time as part of a community health team that targets patients with chronic conditions. Their reported patient load over an eight-month period was 387 adult cases (aged 18 years or older), or an average of 129 cases per FTE CHW. Of these, 210 had at least two encounters with a CHW (persisted with the intervention); calculated over a 12-month period, this amounts to a caseload of 105 cases/per CHW.[59]

[ii] Data compiled from interviews conducted by authors (see Section 7) and Maine SIM grant CHW pilot project budget. The estimated costs of training are calculated based on average responses provided in interviews of Maine organizations that employ CHWs. These training costs were noted to be heavily subsidized by grants; for this reason, actual costs of training may be higher than the budgeted amount in our table above.

Budget Item	Estimate	Assumptions
TOTAL CHW COSTS	$160,900	Cost for three CHWs
Supervision costs	$19,600	Salary $24.50/hour (Maine median CHW supervisor wage) + fringe 28%, valued at 0.1 FTE/CHW.
TOTAL COST – YEAR 1	**$180,000**	
Cost per participant, Year 1	$1,200	
TOTAL COSTS – YEARS 1-3	**$551,000**	Year 2 cost = Year 1 costs, less laptop purchase and core training, plus 2% cost-of-living adjustment Year 3 cost = Year 2 costs plus 2% cost-of-living adjustment

FTE=full-time equivalent. All costs have been adjusted for inflation. Total costs are rounded to the nearest thousand, other costs to the nearest hundred.

The estimated cost of the CHW intervention was approximately $180,000 per year for three full-time CHWs, at a total of $551,000 over three years.

Projected improvements in patient outcomes and quality measures

We project that a CHW intervention will produce improvements in a number of quality measures in our target population of 150 patients with chronic conditions in Aroostook County. As summarized in Table 3.3, we project that our intervention will result in 30 fewer inpatient hospitalizations relative to no intervention, and an additional 24 patients will get their blood pressure under control. For diabetes patients, we project that nearly all patients (94 percent) will have received an eye examination in the year following our intervention, representing a 23 percent increase compared to the proportion of patients at baseline. Further, an additional 5 percent of diabetic patients will get their cholesterol levels within recommended levels. Among asthma patients, we predict an additional 3.5 symptom-free days gained per patient, for a total of 92 days gained by the target population per year.

Table 3.3. Projected improvements in patient outcomes and quality in Year 1

	No.	Baseline (2016)		After CHW intervention (2017)			
		No.	%	No.	%	Improvement from baseline	CHW intervention effect
Target population	150						
Hospitalizations							
Without CHW intervention		40	27%	37	25%	8% reduction *	
With CHW intervention		40	27%	7	5%	**83% reduction**	**30 fewer vs. control** (82%), p<0.01 vs. control
Quality measures							
Hypertension	73						
Patients with blood pressure under control (<140/90 mmHg) **		77	51%	101	67%	**24 (16%) more patients**	p<0.001 vs. baseline
Diabetes	42						
Patients with cholesterol levels under control (LDL <100 mg/dL)		13	31%	15	36%	**2 (5%) more diabetic patients**	p=0.029 vs. baseline
Patients receiving eye examination within one year		30	71%	40	94%	**10 (23%) more diabetic patients**	p<0.001 vs. baseline
Asthma	17						
Symptom-free days (per two weeks, per patient)		3.2		6.7	-	**+109%, 3.5 days gained**	p<0.001 vs. baseline; **1.9 more days vs. control** (p<0.001)
Total symptom-free days over one year (per patient)		82		174		**92 days gained**	

Abbreviations: LDL, Low density lipoprotein. *The New Mexico study reported reductions in hospitalizations for patients that were not assigned to a CHW intervention, also. However, these reductions were far smaller than those observed among patients that received CHW services (-7.6% vs. -83%, p<0.01).[57] ** "Hypertension" defined as blood pressure above 140/90 mmHg; "blood pressure under control" defined as blood pressure <140/90 mmHg. For further details on calculations and data sources, please see Technical Appendix.

In the first year of intervention, our CHW program is projected to result in decreased hospital inpatient use, in addition to improvements in blood pressure control, cholesterol levels, proportion of diabetic patients receiving eye examinations, and a doubling in the number of symptom-free days per asthma patient.

Other quality measures that may be affected by proposed CHW intervention

Many of the measures listed in Table 3.3 above are key outcome measures used in public reporting and in value-based payment arrangements. Because our proposed CHW intervention can be linked to improved health outcomes, a provider that receives higher payments for meeting targets related to these measures would achieve a positive return on investment. In addition, we would expect the proposed CHW intervention to produce improvements in the measures listed in Table 3.4 below.

Table 3.4: Quality measures that will likely improve with CHW intervention

Quality Measure Set	NQF #	Measure Title
ACO 33	0066	CAD Composite: ACO #32. Drug Therapy for Lowering LDL Cholesterol ACO #33. ACE Inhibitor or ARB Therapy for Patients with CAD and Diabetes and/or LVSD
ACO 33	N/A	Proportion of Adults Who Had Blood Pressure Screened in Two Years
ACO 33	0421	Adult Weight Screening and Follow-Up
Uniform Data System (UDS)	0018	Controlling High Blood Pressure
Uniform Data System (UDS)	0421	Preventive Care and Screening: Body Mass Index (BMI) Screening and Follow-Up
AHRQ Quality Indicators	N/A	Hypertension Admission Rate (PQI 07)
AHRQ Quality Indicators	N/A	Overall Adult Prevention Quality Indicator Composite (PQI 90)
Quality Compass	N/A	Cholesterol Management for Patients with Cardiovascular Conditions: LDL-C Screening and LDL-C Control <100
Quality Compass	N/A	Adult BMI Assessment
Quality Compass	0061	Comprehensive Diabetes Care: Blood Pressure Control (<140/90 mm Hg)

Abbreviations: ACE, angiotensin-converting enzyme inhibitor, a type of hypertension medication. ACO, Accountable Care Organization. AHRQ, Agency for Healthcare Research and Quality. ARB, Angiotensin receptor blocker, a type of high blood pressure medication. BMI, Body Mass Index. CAD, Coronary artery disease. LDL, Low density lipoprotein, a form of cholesterol. LVSD, Left ventricular systolic dysfunction. NCQA, National Committee for Quality Assurance. N/A, not available. NQF, National Quality Forum. PQI, Prevention Quality Indicator.

Projected change in medical costs

In Table 3.5, we present projected savings from direct inpatient medical costs in our model population of 150 individuals with high medical costs and high health care use, treated at a rural health center in Aroostook County. A CHW intervention was estimated to save approximately $412,000 in the first year from reduced inpatient hospitalizations, or $3,000 per patient.

The CHW model is likely to produce additional savings through reductions in prescription drug costs and emergency department utilization. A number of studies cited savings in these areas, however insufficient data was available to apply the savings figures to the CHW model.

- The New Mexico CHW intervention reported cost savings from reductions in prescription drug usage of $1,300 to $1,500 per patient.
- CHWs integrated into community health teams in rural Vermont targeting chronic disease patients have been reported to produce a 36 percent reduction in emergency department (ED) costs per patient per month.[14]
- In Texas, a CHW pilot program targeting individuals with high, inappropriate ED usage produced savings estimated at $56,000 per patient assigned to a CHW over the course of one year.[60]

Table 3.5: Projected savings in medical costs in Year 1

	Baseline (2016)	Year 1 (2017)	Cost vs. baseline
Target population	150	150	
Annual inpatient costs			
Without intervention *	$1,871,000	$730,000	($1,141,000)
Per person	$12,000	$5,000	($8,000)
With CHW intervention	$1,871,000	$318,000	($1,553,000)
Per person	$12,000	$2,000	($10,000)
Total savings			**($412,000)**
Per person			($3,000)

* In the New Mexico study, patients in the control group that did not receive a CHW intervention also experienced a reduction in their average hospital inpatient costs, but the reduction observed in the CHW intervention group was significantly larger (-83% vs. -61%; $p<0.01$).[49] Costs are rounded to the nearest thousand. All costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

In its first year of implementation, a CHW intervention for 150 individuals with chronic conditions and high medical spending in Aroostook County is expected to reduce inpatient costs by $412,000, representing a saving of $3,000 per patient.

Projected social return on investment

We estimated the social return on investment arising from our proposed CHW intervention by calculating the value of recovered wages from additional working days, estimated from the reduction in lost work days (absenteeism) associated with improvements in chronic disease control. As shown in Table 3.6 below, the projected social return for three chronic conditions (asthma, diabetes and hypertension) was $41,000 per year for our cohort of 150 patients with high use of medical resources. Greatest savings were projected from improved diabetes control, with modest savings from improved asthma control and hypertension control. Total recovered workdays per year were 261 days for all working diabetes patients, 20 days for asthma patients, and 16 days for hypertensive patients.

Table 3.6: Projected social return on investment in Year 1

	Baseline (2016)	**Year 1 (2017)**	
Chronic condition	Annual value of days lost ($)		Days per year
Diabetes[i]			
Target population, working adults	23	23	
Without CHW intervention	$69,000	$70,000	505
With CHW intervention	$69,000	$34,000	244
Savings (recovered)		($36,000)	(261)
Per employed person		($2,000)	(*11*)
Asthma[ii]			
Target population, working adults	16	16	
Without CHW intervention	$26,000	$16,000	115
With CHW intervention	$26,000	$13,000	96
Savings (recovered)		($2,000)	(20)
Per employed person		($200)	(*1.3*)
Hypertension[iii]			
Target population, working adults	47	47	
Without CHW intervention	$22,000	$22,000	157
With CHW intervention	$22,000	$30,000	141
Savings (recovered)		$2,000)	(16)
Per employed person		($50)	(*0.33*)
Total Savings (recovered working days)		**($41,000)**	**(296)**

[i] Modeled for 23 working adults, assuming 55 percent of our cohort of 42 diabetic patients are working, per Tunceli et al., 2008.[61] Reductions in workdays modeled based on average workdays lost by Hb1Ac level from Tunceli et al., 2008,[61] CHW effect on Hb1Ac from Brown et al., 2012.[29]

[ii] Modeled for 16 working adults, assuming 91 percent of our cohort of 17 asthma patients are working, per New England Asthma Regional Council, 2006.[62] Reductions in workdays by asthma control level modeled from Sullivan et al., 2007,[63] CHW effect on asthma control from Krieger et al., 2015.[64]

[iii] Modeled for 47 working adults, assuming 31 percent of our entire cohort of 150 patients are working, per Ayala et al., 2015.[65] Reductions in workdays modeled from Unmuessig et al.,2015,[66] CHW effect on hypertension control from Adair et al., 2012.[67]

Work days lost per year expressed for the entire group of patients with the condition, unless specified. All costs have been adjusted for inflation. Group costs are rounded to the nearest thousand, per person costs to the nearest hundred, or 10 (if <$100).

We project the annual value of days lost due to asthma to decrease even in the absence of a CHW intervention, based on a published result of 13 percent decrease from baseline in the number of days lost from work among the control group. We projected average days lost due to diabetes and hypertension stratified by health outcomes (HbA1c measures <7 percent, 7-9 percent or >9 percent, or blood pressure under control vs. not under control). These projections assume no change in days lost per work in the absence of a CHW intervention.

For further details on calculations and data sources, please see Technical Appendix.

A CHW intervention for 150 individuals with chronic conditions and high medical spending in Aroostook County was projected to return nearly 300 workdays in total, the majority of which were for working individuals with diabetes, at 261 workdays saved per year. These recovered workdays are valued at $41,000 per year.

Projected total return on investment (ROI) over three years

As shown in Table 3.7 below, we project a return on investment (ROI) over three years of $2.31 for every $1 spent. We project reduced hospitalizations would save nearly $1.3 million over three years, with a social return from recovered working days in excess of $123,000. Total savings from direct medical costs and social return over three years were estimated at nearly $1.4 million.

Table 3.7: Projected total return on investment (ROI) over three years

	Year 1 (2017)	Year 2 (2018)	Year 3 (2019)	TOTAL (Yrs. 1–3)
Target population	150	150	150	
Savings from direct medical costs	$412,000	$423,000	$440,000	$1,275,000
Expected costs of CHW intervention	($180,000)	($184,000)	($187,000)	($551,000)
Projected financial ROI	**2.29**	**2.30**	**2.35**	**2.31**
Social return (recovered working days)	$41,000	$41,000	$41,000	$123,000
TOTAL SAVINGS (medical costs + social return)	**$452,000**	**$464,000**	**$481,000**	**$1,397,000**

Costs are rounded to the nearest thousand. Costs in years 2 and 3 increase relative to year 1 because costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

A CHW intervention for 150 individuals with chronic conditions and high medical spending in Aroostook County was projected to have a total return of investment of $2.31 for every $1 spent over three years. Total savings from reduced inpatient hospitalizations were valued at nearly $1.3 million, or $3,000 per patient/year, in addition to a social return of $123,000 in recovered working days.

CHW model 4: Connecting underserved individuals to services in the Lewiston area

Health Issue:	Underserved populations not connected to health care services and/or health insurance
Intervention goal:	Connecting underserved individuals to culturally competent health care systems and public insurance systems
CHW intervention:	Increase guideline-recommended cancer screening rates and connect high utilizers of inappropriate emergency room services to primary care and medical homes
Target population:	"New Mainers" in the Somali community with language and cultural barriers to accessing health care
Area:	Lewiston area
Time frame:	Baseline year: 2016 Intervention year: 2016 (one year) Outcome years: 2017–2019 (three years)
CHW Employer:	Community-based organization (CBO) working with several health care providers

KEY EXPECTATIONS OF CHW INTERVENTION

Mammograms increase 3x and colonoscopy rates increase 2x

- 86% increase in primary care visits in year 1
- 46% reduction in ED visits in year 1

Financial return on investment: $1.54 for every $1 invested in years 1-3
Savings: $274,000 over years 1-3

Need for intervention

Immigrants that have recently arrived in Maine from other countries are often colloquially referred to as "New Mainers." Because of cultural and language barriers, this population of individuals is often poorly connected to the health care system.[68] In addition, these recent immigrants rate their personal health status worse than American-born individuals, and often have higher uninsured rates.[68] Chronic, lifestyle-related conditions such as diabetes and high blood pressure are ranked among the most important health problems among New Mainers.[68] However, because they often lack a primary care provider, New Mainers may seek treatment at the emergency department (ED) for conditions that could be easily managed in primary care settings at far lower costs. Inappropriate use not only strains hospital resources, but also results in higher hospital uncompensated care costs, a burden that is ultimately met by taxpayers.

The Lewiston area has one of the highest concentrations of New Mainers. Somalis are the largest immigrant population, comprising approximately 3,500 to 5,000 individuals, or 10 to 13 percent of the city's population.[69,70] A recent survey of the most pressing health needs among Somalis in neighboring Cumberland County[66] showed that a high proportion of Somalis are enrolled in public insurance coverage, and that uninsured rates were lower among Somalis than among other immigrants. As shown in the chart below, Somalis in Maine rated diabetes, high blood pressure, and cancer among their top unmet health needs, similar to other New Mainers.

UNMET HEALTH NEEDS AMONG SOMALI RESIDENTS IN MAINE

A recent survey of New Mainers in a neighboring county[68] reported the following:

INSURANCE STATUS of Somalis[i]

- 46% Medicare
- 30% Medicaid/MaineCare
- 17% uninsured

HEALTH NEEDS AND CONCERNS

- Self-rated health among Somalis was lower than among American-born individuals
- Access to health care was rated as third among the most important factors for a healthy community
- The most important health problems were perceived to be diabetes (44%), high blood pressure (39%), dental problems (34%) and cancer (26%)
- Lack of exercise and being overweight ranked among the top five behaviors perceived to pose the greatest health risk in their community

Immediate opportunities among a Somali population in the Lewiston area therefore include improving chronic care management for high blood pressure and diabetes, and improving cancer screenings. There is also an opportunity for Medicare and Medicaid programs to reap savings from CHW interventions targeted to preventing exacerbations of these health issues.

Somali individuals in other states have been reported to over-use ED services for medical problems that could be easily managed in an urgent care or primary care setting.[71] Qualitative research shows that Somali individuals often seek care in the ED rather than a primary care setting.[71] Even among Somalis who are well-connected to the health system, both in terms of insurance and health care providers, cancer screening rates lag between 20 and 35 percentage points behind that of the overall U.S. population.[72] Somalis may face greater cultural barriers to receiving cancer screenings than other

[i] Note that we present data from the 2014 Minority Health Assessment Report for Cumberland County, however the 2011 Report reported a lower proportion of Somali respondents that were uninsured (3%) or on Medicare (38%), and a higher proportion on Medicaid/MaineCare (51%).

immigrant groups, as evidenced by the fact that their screening rates lag behind even that of other immigrant groups.[73] Somalis report significant cultural barriers to cancer screening.[74,75] In addition, the majority of Somalis in Maine are unable to read or write in English.[68]

CHWs recruited from a Somali community would be ideally suited to help other Lewiston Somalis overcome these barriers to receiving recommended preventive care. Programs in other states have been successful in helping immigrants, including Somalis, overcome cultural barriers to receiving preventive cancer screenings. In addition, culturally tailored CHW interventions have shifted care from the ED to a lower-cost primary care setting.

Description of proposed intervention

A number of studies have shown CHW interventions to be effective in connecting underserved immigrant populations to services, increasing cancer screening rates, and decreasing emergency department use.

- **Cervical cancer screening among Somali females in Minnesota:**[76] Somali women at a community-based organization (CBO) in Minnesota received a culturally tailored informal informational session, followed by a home-based HPV test. Somali women strongly preferred the home-based test: Women who received the intervention were several times more likely to complete screening than women who had been asked to obtain a regular clinic-based Pap test. Social support from family and friends was an important factor for improving the likelihood of completing screening.
- **Breast cancer screening among Somali females in Massachusetts:**[77] A Patient Navigator (a form of CHW) breast cancer screening program was delivered at a community health center outside of Boston to refugee women, including Somalis. Over two years, mammography rates increased to levels observed among English-speaking, U.S.-born women. Somali women had the largest increases in breast cancer screening rates, relative to other refugee groups (Arabic and Serbo-Croatian).
- **Colorectal cancer screening among Hispanic males in Texas:**[78] The Colorectal Cancer Male Navigation (CCMN) program in San Antonio, Texas, was a bilingual home- and community-based intervention delivered to low-income, uninsured Hispanic men age 50 years and older. The intervention improved screening rates from 16 percent to 84 percent, and increased life-expectancy by six months.
- **Patient navigators for reducing inappropriate emergency department use:** Two studies assessed the benefit of CHWs in reducing emergency department (ED) use:
  - The Men's Health Initiative (MHI) at Denver Health Community Voices[79] delivered community outreach to underserved, low-income men. Within a year of initiating contact with a CHW, use of ED, inpatient and behavioral health services declined while primary and specialty care visits increased. This also resulted in health care cost savings of more than $14,000 a month.
  - Another program in Houston, Texas,[80] employed CHWs as patient navigators to provide language-appropriate peer counseling to uninsured and Medicaid-insured individuals, to

help connect them with medical homes and provide education on preventive health. Compared to similar patients not receiving patient navigation from CHWs, patients who frequented the ED for primary care-related reasons were significantly (17 percent) less likely to visit the ED one year after engaging with the CHW. Average ED costs per participant declined by amounts ranging from $300 for those with one or more baseline visits per year, up to $1,400 per patient for those with five or more baseline visits per year.

Based on the success of the CHW interventions outlined in the section above, our proposed CHW intervention aims to increase the level of preventive care received by Somali residents in the Lewiston area. Specifically, our proposed program has two goals:

(1) Providing culturally appropriate health education to Somalis on the health benefits of cancer screenings, with an aim to increase completion rates for cervical, breast, and colorectal screenings, and
(2) Connecting individuals who frequently use the ED for health needs that could be better managed in primary care settings, such as diabetes or hypertension, to primary care providers or medical homes.

Our proposed intervention is based on recruiting trusted members of the Somali community who speak both Somali and English, to train as CHWs. Following the program designs in the above models, CHWs would be trained in national cancer screening guidelines, preventive care measures for chronic lifestyle diseases, motivational interviewing, and peer-to-peer counseling. As is common for CHW interventions, our proposed program would deliver services that are patient-centered, and tailored to individuals' needs.

Most cancer screening programs involve delivery of health education at local mosques, churches and community events, in addition to visiting individuals in their homes and accompanying patients to screening appointments. Home visits enable CHWs to engage family members in discussions, thereby building social support. CHWs would distribute culturally and linguistically appropriate educational materials such as leaflets and brochures. CHWs would also help patients connect to public insurance programs, assist with transportation, and schedule appointments.

Patients would be recruited through social networks, word of mouth, and informational flyers distributed by the CBO. In addition, partnering providers could identify those individuals who have not received their recommended cancer screenings and individuals who commonly use the ED for low-acuity conditions.

In Table 4.1 below, we present a target patient population at a single CBO, at which our CHW intervention would be delivered. We estimate the number of people in our target population who are recommended to receive each type of screening using nationally recommended age ranges. We model the increase in colorectal cancer screening only on men of an appropriate age only, because our cited study in San Antonio, Texas, (above)[76] provided data on men only.

Table 4.1: Projected number of participants per year

Population	Estimate	Rate	Data source for estimate
Somalis residing in Lewiston	4,250		Median of two reported sources
Total patients at Lewiston CBO	300		Estimated from CHW interviews with organizations that target immigrant populations, including Somali populations
Number retained in CHW program	**260**	87%	Median from three cancer screening studies
Cervical cancer screening population			
Females, total	150	50%	50% of patient population
Number eligible for Pap smear per recommended guidelines (age 21–64 years)	83	55%	Estimate for Lewiston females based on U.S. census data
Number who persist with intervention	**80**	95%	Estimate from Sewali et al., 2015[76]
Breast cancer screening population			
Females, total	150	50%	50% of patient population
Number eligible for mammogram per recommended guidelines (age 50+ years)	55	37%	Estimate for Lewiston females based on U.S. census data; note that women age 50–64 are recommended to receive both Pap smear and mammogram
Number who persist with intervention	**40**	75%	Estimate from Percac-Lima et al., 2013[77]
Colorectal screening population			
Males, total	150	50%	50% of patient population
Number eligible for colonoscopy per recommended guidelines (age 50–75 years)	41	27%	Estimate for Lewiston males based on U.S. census data
Number who persist with intervention	**40**	87%	Estimate from Wilson et al., 2015[78]
Population with high use of ED services			
Number with ED visit in previous year	86	30%	Total estimated number of patients with ED visit in previous year (since many of these patients will use ED for non-emergent causes
Number who persist with intervention	**78**	90%	Estimate from Enard et al., 2013[80]

Numbers of patients that persist with intervention are rounded to the nearest 10 for the purpose of this analysis. For further details on calculations and data sources, please see Technical Appendix. Abbreviations: CBO, Community Based Organization; ED, emergency department.

Estimated costs of proposed intervention

As shown in Table 4.2, a CHW intervention delivered by a CBO to Lewiston-based Somalis is estimated to cost $178,000 over three years, with an annual cost of approximately $60,000. We assumed a caseload of 260 per CHW, based on the assumption that a large number of clients will require relatively low-intensity services, such as class participation or a one-time consultation; only a minority of patients is estimated to require more intensive and repeated services, such as multiple home visits or being accompanied to clinic visits. In addition, the Lewiston area is more densely populated than the rural areas covered by the CHW models described above, and thus would require less CHW travel time. We assume that the same CHW employee will continue to be employed over three years (no staff turnaround), seeing 260 patients each year. Therefore, we do not include costs for core training in years 2 and 3, however ongoing training costs are included in these years.

Table 4.2: Estimates of CHW intervention costs[i]

Budget Item	Estimate	Assumptions
Target number of participants	260	Retained at year 1 end of CHW program
Number of FTEs required	1	
Costs per CHW (per worker/year)		
Salary	$38,900	$19/hour (Median full-time CHW wage)
Fringe	$10,900	28%
Travel costs	$500	100 miles/month at $0.44/mile (Maine state rate)
Supplies		
Office supplies	$600	$50/month
Computer	$300	One-time purchase of cloud-based low-cost laptop
Cell phone	$400	$35/month
Training	$400	Includes core and supplemental targeted training
TOTAL CHW COSTS	$52,000	
Supervision costs	$6,500	Salary $24.50/hour (Maine median CHW supervisor wage) + fringe 28%, valued at 0.1 FTE/CHW.
TOTAL COST - YEAR 1	$59,000	
Costs per participant, Year 1	$230	
TOTAL COSTS - YEARS 1–3	**$178,000**	Year 2 costs = Year 1 costs, less laptop purchase and core training, plus 2% cost-of-living adjustment Year 3 costs = Year 2 costs plus 2% cost-of-living adjustment

FTE=full-time equivalent. All costs have been adjusted for inflation. Total costs are rounded to the nearest thousand, other costs to the nearest hundred.

[i] Data compiled from interviews conducted by authors (see Section 7) and Maine SIM grant CHW pilot project budget. The estimated costs of training are calculated based on average responses provided in interviews of Maine organizations that employ CHWs. These training costs were noted to be heavily subsidized by grants; for this reason, actual costs of training may be higher than the budgeted amount in our table above.

The projected cost of the CHW intervention is approximately $60,000 per year, totaling $178,000 over three years, for one full-time CHW providing services to 260 Somali individuals.

Projected improvements in patient outcomes and quality measures

Table 4.3 summarizes the projected improvements in quality measures and health care utilization at the end of our CHW intervention. We project that a CHW intervention will produce improvements in the number of recommended cancer screenings received by our target population of 260 Somali patients in Lewiston. For women ages 21–64 years for whom HPV screening or Pap smears are recommended every three to five years, our proposed CHW intervention is projected to increase screening rates by 35 percent. Among women age 50 years and older, rates of receiving mammograms is projected to more than double, from less than one-third of patients to nearly 90 percent of patients. For men ages 50–74 years, our CHW intervention is projected to double the rate of completed colonoscopies to 80 percent, thereby increasing projected life expectancy by an average of six months per screened patient.

In addition, we project that the rate of primary care visits per person will nearly double, from an average of two visits per year, to four visits per year. Moreover, we project a nearly twofold reduction in the rate of using the ED for primary care-related health problems.

Table 4.3. Projected improvements in patient outcomes and quality in Year 1

	Without CHW intervention		With CHW intervention		Difference	
	No	Rate	No	Rate	No	%
Target population at CBO	260					
Cervical cancer screening among females						
Population 21–64 years, females	80		80			
Completed HPV or Pap test (within 3 months)	39	49%	52	66%	**13**	**+34% ***
Breast cancer screening among females						
Population 50+ years, females	40		40			
Completed mammogram (within two years)	12	31%	35	88%	**23**	**+183% ****
Colorectal cancer screening among males						
Population 50–74 years, males	40		40			
Received colonoscopy (within two years)	15	39%	32	80%	**17**	**+109%**
Gains in life expectancy (years)			20	0.5		
Health care utilization						
Primary care utilization						
Population, all individuals	260		260			
Number of visits per year	556	2.1	1,019	3.9	**463**	**+86%**
Urgent care/ED utilization						
Population with ED visits in past year	78		78			
Number of visits per year	34	0.4	18	0.2	**-16**	**-46% *****

*Participants in CHW intervention were 14 times more likely to complete screening, compared to those receiving usual care only (recommended to receive Pap smear at regular clinic).[76] ** No statistically significant difference

compared to English-speaking, U.S.-born women (p=0.66).[77] ***Greater reduction in mean visits relative among those receiving CHW intervention, relative to controls (no CHW intervention), CHW group had 17 percent lower likelihood of having ED visits for primary care-related health problems, relative to no CHW intervention (odds ratio 0.83, p<0.05).[80] For further details on calculations and data sources, please see Technical Appendix.

Our proposed CHW program delivered to Lewiston-based Somalis is projected to:

- **Increase cervical cancer screening rates by 34 percent**
- **Nearly triple the rate of breast cancer screening**
- **More than double the rate of colorectal cancer screening**

In addition, we project a near-doubling in the number primary care visits, with a corresponding 46 percent reduction in ED visits.

Other quality measures that may be affected by proposed CHW intervention

The proposed intervention is expected to result in improvements in several preventive measures that are often subject to public reporting requirements and tied to value-based payments. The standard measures are listed in Table 4.4 below.

Table 4.4: Quality measures that will likely improve with CHW intervention

Quality Measure Set	NQF #	Measure Title
NCQA Quality Compass	2372	Breast cancer screening
NCQA Quality Compass; HRSA Uniform Data System	0034	Colorectal cancer screening
NCQA Quality Compass; HRSA Uniform Data System	0032	Cervical cancer screening
ACO 33	0041	Influenza Immunization
AHRQ Quality Indicators	N/A	Overall adult prevention quality indicator composite (PQI 90)
Uniform Data System (UDS)	0421	Preventive Care and Screening: Body Mass Index (BMI) Screening and Follow-Up
ACO 33	0421	Adult Weight Screening and Follow-Up
Quality Compass	N/A	Adult BMI Assessment
ACO 33	N/A	Proportion of Adults who had blood pressure screened in two years

Abbreviations: ACO, Accountable Care Organization. AHRQ, Agency for Healthcare Research and Quality. BMI, Body Mass Index. HRSA, Health Resources and Services Administration. NCQA, National Committee for Quality Assurance. N/A, not available. NQF, National Quality Forum. PQI, Prevention Quality Indicator.

Projected change in medical costs

We project savings from direct medical costs arising from a shift in health care services from costly hospital settings to lower-cost primary care and ambulatory settings. As shown in Table 4.5, total health care costs are projected to decrease by nearly $90,000 the first year, representing an average savings of $300 per participant, or a 6 percent decrease.

In addition, we project lifetime savings of $1,230 per each male age 50–74 years who receives a colonoscopy. For our 40 enrolled men, this lifetime savings totals to nearly $50,000. These savings are realized from avoiding lifetime cancer treatment costs and terminal illness costs. We do not include these lifetime savings in our short-term savings projections below.

Table 4.5: Projected savings in medical costs in Year 1

	Baseline(2016)	Year 1 (2017)	Cost vs. baseline
Target population	260	260	
Annual health care costs *			
Without CHW intervention **	$1,545,000	$1,586,000	$41,000
Per person	$5,900	$6,100	$200
With CHW intervention	$1,545,000	$1,497,000	($48,000)
Per person	$5,900	$5,800	($200)
Total savings			**($89,000)**
Per person			($300)

*Published study reports a reduction in charges; we have converted charges to costs using cost-to-chart ratio reported.[78] ** Whitley study did not include a control group that did not receive a CHW intervention; therefore, we included only an inflation adjustment to annual health care costs in the absence of a CHW intervention.[79] Group costs are rounded to the nearest thousand, per-person costs to the nearest hundred. All costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

Our proposed CHW program delivered to Lewiston-based Somalis is projected to save approximately $90,000 per year in total health care costs, representing a 6 percent savings.

Projected total Return on Investment (ROI) over three years

Our proposed CHW program delivered to a Somali population in the Lewiston area returned a positive return on investment (ROI). For every dollar invested in the program, we projected a $1.54 return per year. Over three years, we project total medical cost savings of $274,000. These results are shown in Table 4.6 below.

Table 4.6: Projected total return on investment (ROI) over three years

	Year 1	Year 2	Year 3	TOTAL (years 1–3)
Target population	260	260	260	
Savings from direct medical costs	$89,000	$91,000	$94,000	**$274,000**
Expected costs of CHW intervention	($59,000)	($59,000)	($60,000)	($178,000)
Projected financial ROI	**$1.52**	**$1.54**	**$1.56**	**$1.54**

Group costs are rounded to the nearest thousand, per-person costs to the nearest hundred. Costs in years 2 and 3 increase relative to year 1 because costs have been adjusted for inflation. For further details on calculations and data sources, please see Technical Appendix.

Our proposed CHW intervention connecting Somalis in Lewiston to primary care services and preventive care is projected to save $274,000 over three years, representing a positive return on investment of $1.54 for every $1 spent on the program.

7. INTERVIEWS WITH CHW EMPLOYERS

In order to collect Maine-specific data about the costs of employing CHWs, we interviewed seven organizations that currently employ CHWs, including: federally qualified health centers, community-based organizations, a department of public health, an area agency on aging, and a hospital-based-community health care system. One of the seven interviewees used only volunteer CHWs; CHW costs and hours for this program are not included in the table below.

Table 7.1 below outlines the cost data collected from the seven organizations we interviewed. We have used this cost data to estimate the costs of employing a CHW in our models. CHW employers also reported miles traveled per month by CHWs, which varied by location.

Table 7.1: Maine CHW Employment Costs

Parameter	Mean	Median	Minimum*	Maximum	No. responses & Notes
Hours worked by full-time CHWs (per week)	36.38	36.75	32	40	Four out of seven CHW employers reported employing full-time CHWs.
Hours worked by part-time CHWs (per week)	19.30	18	13	28	Five responses. Six of seven CHW employers reported employing part-time CHWs. Five reported average number of hours worked, while a sixth reported "sporadic" part-time CHW hours.
Cost of CHW benefits (as a percent of income, for full-time CHWs)	28%	28%	25%	30%	Four of five employers of full-time CHWs reported that CHWs are eligible for benefits. One of these four employers also provided benefits to part-time CHWs paid at 20% of their part-time salary.
Full-time CHW salary (per hour)	$20.27	$19.00**	$17.00	$25.00	Five responses. One employer employs only part-time CHWs, another uses only volunteers.
CHW supervisor salary (per hour)	$25.51	$24.50	$18.89	$33.65	Six responses. A seventh reported the CEO supervises CHWs (no salary reported).
Percent FTE CHW supervisor time spent supervising per FTE CHW * **	9%	10%	1%	19%	Six responses. A seventh organization did not report proportion of supervisor time spent supervising CHWs.

Abbreviations: CEO, Chief Executive Officer; FTE, Full-time equivalent. Some hourly salary responses were calculated from annual salaries, and some annual salaries were calculated from hourly salaries. * Minimum responses reflect minimum values for those employers that reported a value; some questions were not applicable to all employers, for example some employers did not provide benefits to their CHW employees and some had CHWs that were unpaid volunteers. **Median hourly salary for full-time workers ($19.00) was used in our estimations of CHW intervention costs in Section 6. *** Calculated by 1) summing the reported number of FTE CHWs and the number of part-time CHWs (converted to FTEs using ratio of reported no. of hours PT CHWs work relative to no. of hours FTE CHWs work; if either value was not reported by the organization, we used median values from interview responses), 2) divided by the proportion of total time that FTE supervisors reported spending supervising CHWs.

Key takeaways from the interviews include:

- Because CHWs typically visit individuals in their home, they are able to see an aspect of the individual's life that is not always apparent to other providers. CHW observations in the home are able to pick up on non-medical issues that can be causing poor health.
- The individuals that the CHWs serve tend to have real, and in some cases complex, medical issues that the CHWs need to help address, but the individuals have other issues related to social determinants of health (such as food, fuel, and transportation) that need resolution before the CHW can address the medical issues.
- Especially in the rural counties in Maine, the ability of CHWs to travel to the individuals that they serve is a crucial aspect of the assistance that they provide. Many individuals served by the CHWs report transportation as a significant barrier to getting health care.
- The individuals that are most commonly served by CHWs have multiple chronic conditions, and multiple barriers to accessing care. Other than social determinants of health, a major barrier to care is a limited knowledge of the health care system and lack of health activation, empowerment, and involvement in their own health care.
- CHWs' language capacity and their community knowledge are key in developing trusting relationships with the vulnerable people that they serve—especially for individuals who have low literacy in English.
- Challenges to financing CHW work include: the difficulty in counting and billing for CHW encounters under current financing systems, as well as educating clinicians and provider organizations on the benefits of CHWs, how CHWs can play a role on their care teams, and establishing the level of trust needed for collaboration.
- Minimum credentials for CHWs varied, whereby the majority of interview sites did not require a minimum level of education for the CHW position, or did not state one. At one site, where CHWs worked predominantly with elderly patients, CHWs were required to have a bachelor's in Social Work degree.

8. ABBREVIATIONS USED IN THIS REPORT

Abbreviation	Explanation
AADE	American Association of Diabetes Educators
ACO	Accountable Care Organization
ADA	American Diabetes Association
AHRQ	Agency for Healthcare Research and Quality
BMI	Body Mass Index
BP	Blood pressure
CAHPS	Consumer Assessment of Healthcare Providers & Systems
CBO	Community Based Organization
CCO	Coordinated Care Organization
CDC	Centers for Disease Control and Prevention
CHIP	Children's Health Insurance Program
CHW	Community Health Worker
CHWI	Community Health Worker Initiative
DHHS	Department of Health and Human Services
ED	Emergency Department
FQHC	Federally Qualified Health Center
FTE	Full-time equivalent
HbA1c	Glycated hemoglobin
HEDIS	Healthcare Effectiveness Data and Information Set
HHS	Health and Human Services
HPV	Human Papillomavirus
HRSA	Health Resources and Services Administration
LDL	Low-density lipoprotein (cholesterol)
MHDO	Maine Health Data Organization
NAEPP	National Asthma Education Prevention Program
NCQA	National Committee for Quality Assurance
NHLBI	National Heart, Lung and Blood Institute
NQF	National Quality Forum
Pap	Papanicolaou test/smear (cervical cancer screening)
PCMH	Patient-Centered Medical Home
PCP	Primary Care Provider
PDI	Pediatric Quality Indicator
PMPM	Per member per month
PQI	Prevention Quality Indicator
RHC	Rural Health Center
ROI	Return on Investment
SIM	State Innovation Model

Abbreviation	Explanation
SHNAPP	Maine Shared Health Needs Assessment and Planning Process
SSI	Supplemental Security Income
UDS	Uniform Data System

9. REFERENCES

Maine Department of Health and Human Services. Maine State Innovation Model. Retrieved July 08, 2016, from http://www.maine.gov/dhhs/sim/overview.shtml.

2 National Academy for State Health Policy (NASHP). (2015). State Community Health Worker Models. Retrieved July 08, 2016, from http://www.nashp.org/state-community-health-worker-models/.

3 DeMars, C. (2016). Transformation Center Flexible Services in Oregon's Medicaid Program, State Approaches to Providing Health-Related Supportive Services through Medicaid [webinar]. Retrieved July 08, 2016, from http://www.chcs.org/resource/state-approaches-providing-health-related-supportive-services-medicaid/.

4 Maine Community Health Worker Initiative. Who are Community Health Workers? Retrieved July 08, 2016, from http://www.mechw.org/who.html.

5 American Public Health Association. Community Health Workers. Retrieved July 08, 2016, from https://www.apha.org/apha-communities/member-sections/community-health-workers.

6 CHWA (California Health Workforce Alliance). (2013). Community health workers, promotores, and the triple aim: Taking innovation to scale. Retrieved July 08, 2016, from http://www.phi.org/resources/?resource=taking-innovation-to-scale-community-health-workers-promotores-and-the-triple-aim.

7 American Public Health Association. (2014). Support for Community Health Workers to Increase Health Access and to Reduce Health Inequities. Retrieved July 08, 2016, from https://www.apha.org/policies-and-advocacy/public-health-policy-statements/policy-database/2014/07/09/14/19/support-for-community-health-workers-to-increase-health-access-and-to-reduce-health-inequities.

8 U.S. Bureau of Labor Statistics. Health Educators and Community Health Workers. Retrieved July 08, 2016, from http://www.bls.gov/ooh/Community-and-Social-Service/Health-educators.htm.

9 CHW Common Core (C3) Project. (2014). Understanding Scope and Competencies: A Contemporary Look at the United States Community Health Worker Field. Retrieved July 08, 2016, from http://www.cachw.org/community-health-worker-common-core-c3-project/.

10 Michigan Community Health Worker Alliance (MiCHWA). CHWs and the Triple Aim. Retrieved July 08, 2016, from http://www.michwa.org/wp-content/uploads/MiCHWA_CHW-ROI.pdf

11 State of Maine. Health Home SPA #12-004, Attachment 3.1-H. Approved January 17, 2013. Retrieved July 08, 2016, from https://www.medicaid.gov/State-Resource-Center/Medicaid-State-Technical-Assistance/Health-Homes-Technical-Assistance/Downloads/Maine-SPA-4.pdf.

12 Institute for Economic and Clinical Review (ICER). (2013). The New England Comparative Effectiveness Public Advisory Council, An Action Guide on Community Health Workers: Guidance for Health Insurers. Retrieved July 08, 2016, from http://icer-review.org/wp-content/uploads/2011/04/Action-Guide-for-Health-Insurers_09-05-131.pdf

13 Vermont Agency of Human Services, Department of Vermont Health Access. (2015). Budget Document, State Fiscal Year 2016. Retrieved July 08, 2016, from http://dvha.vermont.gov/budget-legislative/sfy201602042015.pdf .

14 Bielaszka-Duvernay, C. (2011). Vermont's Blueprint for Medical Homes, Community Health Teams, and Better Health at Lower Cost. Health Affairs, 30(3), 383-386. doi:10.1377/hlthaff.2011.0169.

15 HRSA Health Center Program. Uniform Data System (UDS) Health Center Adjusted Quartile Ranking. Retrieved July 08, 2016, from http://bphc.hrsa.gov/datareporting/reporting/ranking.html

16 National Council on Quality Assurance (NCQA). Quality Compass. Retrieved July 08, 2016, from http://www.ncqa.org/hedis-quality-measurement/quality-measurement-products/quality-compass.

17 Centers for Medicare and Medicaid Services (CMS). (2014). Medicare Program Rates and Statistics, Market Basket Data. Retrieved July 08, 2016, from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/MedicareProgramRatesStats/MarketBasketData.html

18 Kaiser Family Foundation (2016). Hospital Adjusted Expenses per Inpatient Day, 2014. Retrieved July 08, 2016, from http://kff.org/other/state-indicator/expenses-per-inpatient-day/.

19 U.S. Bureau of Labor Statistics (BLS). (2016). New England Information Office - County Employment and Wages in Maine — Third Quarter 2015. Retrieved July 08, 2016, from http://www.bls.gov/regions/new-england/news-release/countyemploymentandwages_maine.htm

20 American Diabetes Association. (2013). Economic Costs of Diabetes in the U.S. in 2012. Diabetes Care, 36(6), 1797-1797. doi:10.2337/dc13-er06

21 Felton, A., LaSalle, J., & McGill, M. (2016). Treatment Urgency: The Importance of Getting People with Type 2 Diabetes to Target Promptly. Diabetes Research and Clinical Practice, 117, 100-103. doi:10.1016/j.diabres.2016.04.026.

22 American Diabetes Association. Cardiovascular disease and risk management. Sec. 8. In Standards of Medical Care in Diabetes - 2016. Diabetes Care 2016;39(Suppl. 1): S60–S71.

23 New England Rural Health Round Table. Rural Data for Action: A Comparative Analysis of Health Data for the New England Region. 2nd Edition, 2014. Retrieved July 08, 2016, from https://newenglandruralhealthroundtable.wildapricot.org/page-18139.

24 Drewette-Card R. Preventing and Controlling Cardiovascular Disease and Diabetes in Maine: Maine Cardiovascular Health and Diabetes Strategic Plan 2011-2020. June 2011. Retrieved July 08, 2016, from https://www1.maine.gov/dhhs/mecdc/population-health/hmp/mcvhp/documents/226-003-11-AnnReport.pdf.

25 Maine Center for Disease Control and Prevention (CDC). (2016). Maine Shared Health Needs Assessment and Planning Process, State & County reports. Retrieved July 08, 2016, from http://www.maine.gov/dhhs/mecdc/phdata/SHNAPP/county-reports.shtml.

26 HRSA Health Center Program. Health Center Program Grantee Profiles 2014. Retrieved July 08, 2016, from http://bphc.hrsa.gov/uds/datacenter.aspx?q=d.

27 Maine Diabetes Prevention & Control Program. Health Fact Sheet: Diabetes in Maine. August, 2011. Retrieved July 08, 2016, from http://www.maine.gov/dhhs/mecdc/population-health/dcp/documents/factsheet.pdf.

28 Maine Center for Disease Control and Prevention Diabetes Prevention and Control Program (DPCP). Diabetes Surveillance Report 2012 Tables. Augusta, ME; November 2012. Retrieved July 08, 2016, from http://www.maine.gov/dhhs/mecdc/population-health/dcp/statistics.htm

29 Brown, H. S., Wilson, K. J., Pagán, J. A., Arcari, C. M., Martinez, M., Smith, K., & Reininger, B. (2012). Cost-Effectiveness Analysis of a Community Health Worker Intervention for Low-Income Hispanic Adults with Diabetes. Preventing Chronic Disease Prev. Chronic Dis., 9,120074. doi:10.5888/pcd9.120074.

30 Philis-Tsimikas, A., Fortmann, A., Lleva-Ocana, L., Walker, C., & Gallo, L. C. (2011). Peer-Led Diabetes Education Programs in High-Risk Mexican Americans Improve Glycemic Control Compared with Standard Approaches: A Project Dulce Promotora Randomized Trial. Diabetes Care, 34(9), 1926-1931. doi:10.2337/dc10-2081.

31 Arcari, Christine M., Arredondo, Issa, and Reininger, Belinda M., personal communication, September 14, 2016.

32 Haas L., Maryniuk M., Beck J., Cox C.E., Duker P., Edwards L.,… Youssef G.; 2012 Standards Revision Task Force. National standards for diabetes self-management education and support. Diabetes Care. 2014;37 Suppl 1:S144-53.

33 Brown, S.A., Hanis, C.L. (2014). Lessons Learned from 20 Years of Diabetes Self-Management Research with Mexican Americans in Starr County, Texas. The Diabetes Educator, 40(4), 476-487. doi: 10.1177/0145721714531336.

34 Spencer, M. S., Rosland, A., Kieffer, E. C., Sinco, B. R., Valerio, M., Palmisano, G., . . . Heisler, M. (2011). Effectiveness of a Community Health Worker Intervention Among African American and Latino Adults With Type 2 Diabetes: A Randomized Controlled Trial. Am J Public Health, 101(12), 2253-2260. doi:10.2105/ajph.2010.300106.

35 Prezio, E. A., Cheng, D., Balasubramanian, B. A., Shuval, K., Kendzor, D. E., & Culica, D. (2013). Community Diabetes Education (CoDE) for Uninsured Mexican Americans: A Randomized Controlled Trial of a Culturally Tailored Diabetes Education and Management Program Led by a Community Health Worker. Diabetes Research and Clinical Practice, 100(1), 19-28. doi:10.1016/j.diabres.2013.01.027

36 Bureau of Labor Statistics (2016). May 2015 State Occupational Employment and Wage Estimates – Maine. Retrieved Sept 21, 2016, from http://www.bls.gov/oes/current/oes_me.htm#29-0000

37 Rothschild SK, Martin MA, Swider SM, Tumialán Lynas CM, Janssen I, Avery EF, Powell LH. Mexican American trial of community health workers: a randomized controlled trial of a community health worker intervention for Mexican Americans with type 2 diabetes mellitus. Am J Public Health. 2014 Aug;104(8):1540-8.

38 O'Byrne, P. M., Pedersen, S., Schatz, M., Thoren, A., Ekholm, E., Carlsson, L., & Busse, W. W. (2013). The Poorly Explored Impact of Uncontrolled Asthma. Chest, 143(2), 511-523. doi:10.1378/chest.12-0412.

39 Dean, B. B., Calimlim, B. C., Sacco, P., Aguilar, D., Maykut, R., & Tinkelman, D. (2010). Uncontrolled asthma: Assessing quality of life and productivity of children and their caregivers using a cross-sectional Internet-based survey. Health Qual Life Outcomes, 8(1), 96. doi:10.1186/1477-7525-8-96.

40 Maine Center for Disease Control and Prevention. (2014) Asthma in Maine - A Data Brief for Health Professionals. Retrieved July 08, 2016, from: http://www.maine.gov/dhhs/mecdc/population-health/mat/information-and-publications/2014%20Factsheets/Statewide_factsheet%202-8-16.pdf

41 Centers for Disease Control and Prevention (2016). Data, Statistics, and Surveillance - Asthma Surveillance Data. Retrieved July 08, 2016, from http://www.cdc.gov/asthma/asthmadata.htm

42 Maine Center for Disease Control and Prevention. (2016). Maine Environmental Public Health Tracking Program (MHDO) Data Portal. Retrieved July 08, 2016, from https://data.mainepublichealth.gov/tracking/home

43 Campbell, J. D., Brooks, M., Hosokawa, P., Robinson, J., Song, L., & Krieger, J. (2015). Community Health Worker Home Visits for Medicaid-Enrolled Children with Asthma: Effects on Asthma Outcomes and Costs. Am J Public Health, 105(11), 2366-2372.

44 Krieger, J. K., Takaro, T. K., Allen, C., Song, L., Weaver, M., Chai, S., & Dickey, P. (2002). The Seattle-King County healthy homes project: implementation of a comprehensive approach to improving indoor environmental quality for low-income children with asthma. Environmental Health Perspectives, 110(Suppl 2), 311–322.

45 Woods ER, Bhaumik U, Sommer SJ, Ziniel SI, Kessler AJ, Chan E, ... Nethersole S. (2012) Community asthma initiative: evaluation of a quality improvement program for comprehensive asthma care. Pediatrics, 129(3), 465-72.

46 Bhaumik, U., Norris, K., Charron, G., Walker, S. P., Sommer, S. J., Chan, E., . . . Woods, E. R. (2013). A Cost Analysis for a Community-Based Case Management Intervention Program for Pediatric Asthma. Journal of Asthma, 50(3), 310-317. doi:10.3109/02770903.2013.765447.

47 "National Heart, Lung, and Blood Institute (NHLBI). (2007) National Asthma Education and Prevention Program, Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. Washington, DC: US Department of Health and Human Services; 2007. Retrieved July 08, from http://www.nhlbi.nih.gov/health-pro/guidelines/current/asthma-guidelines"

48 Bryant-Stephens, T., Kurian, C., Guo, R., & Zhao, H. (2009). Impact of a Household Environmental Intervention Delivered by Lay Health Workers on Asthma Symptom Control in Urban, Disadvantaged Children With Asthma. Am J Public Health, 99(S3). doi:10.2105/ajph.2009.165423

49 Asthma and Allergy Foundation of American (AAFA) (2016) Educational Programs for Teaching Patients. Retrieved July 08, 2016, from http://www.aafa.org/page/asthma-allergy-education-programs-teach-patients.aspx#youcontrolasthma

50 Krieger, J. W., Takaro, T. K., Song, L., & Weaver, M. (2005). The Seattle-King County Healthy Homes Project: A Randomized, Controlled Trial of a Community Health Worker Intervention to Decrease Exposure to Indoor Asthma Triggers. Am J Public Health, 95(4), 652-659. doi:10.2105/ajph.2004.042994.

51 Maine Department of Health and Human Services (DHHS). MaineCare Expenditure History and Projected Spending: DHHS Budget Fact Sheet 2013-2015. Retrieved July 08, 2016, from https://www1.maine.gov/dhhs/budget/DHHS-Budget-Fact-Sheet-13-14-15.pdf

52 The Health Care Transformation Task Force. (2015). Proactively Identifying the High Cost Population. Retrieved July 08, 2016, from http://cqrcengage.com/trinityhealth/file/Ujnle93jS4K/Task%20Foce%20White%20Paper%20on%20High%20Cost%20Patients.pdf.

53 Maine Department of Health and Human Services (2012). Maine State Health Care Innovation Plan. Draft version. Retrieved July 08, 2016, from http://www.maine.gov/dhhs/sim/documents/C%20%20Maine%20Health%20INNOVATION%20PLAN%20_Sept%2024_.pdf

54 The Lewin Group. (2010). Individuals Living in the Community with Chronic Conditions and Functional Limitations: A Closer Look. Office of the Assistant Secretary for Planning & Evaluation United States Department of Health and Human Services. Retrieved July 08, 2016, from: https://aspe.hhs.gov/sites/default/files/pdf/75961/closerlook.pdf.

55 Talbot, J.; Ziller, E.; Lenardson, J.; Hartley, D. (2014). Maine Rural Health Research Center Research & Policy Brief PB-56: Implications of Rurality and Psychiatric Status for Diabetic Preventive Care Use among Adults with Diabetes. Retrieved July 08, 2016, from https://muskie.usm.maine.edu/Publications/rural/PB56-Rurality-Diabetes-Psychiatric-Status.pdf.

56 Moran, Andrew E.; Odden, M.; Thanataveerat, A.; Tzong, K.; Rasmussen, P….Goldman, L. (2015). Cost-effectiveness of Hypertension Therapy according to 2014 Guidelines. N Engl J Med, 372(17), 1677-1677.

57 Johnson, D., Saavedra, P., Sun, E., Stageman, A., Grovet, D., Alfero, C. . . . Kaufman, A. (2011). Community Health Workers and Medicaid Managed Care in New Mexico. J Community Health, 37(3), 563-571. doi:10.1007/s10900-011-9484-1

58 Institute of Medicine (IOM), Committee on Approaching Death. Dying in America. (2014). Improving Quality and Honoring Individual Preferences near the End of Life. Retrieved July 08, 2016, from http://www.iom.edu/Reports/2014/Dying-In-America-Improving-Quality-and-Honoring-Individual-Preferences-Near-the-End-of-Life.aspx.

59 ICF International. (2014). The St. Johnsbury Community Health Team Evaluation: Final Report submitted to the Centers For Disease Control and Prevention. Retrieved July 08, 2016, from http://blueprintforhealth.vermont.gov/sites/blueprint/files/BlueprintPDF/CHT%20Eval%20Report_formatted.pdf.

60 Dower, C.; Knox, M.; Lindler, V.; O'Neil, E. (2006). Advancing Community Health Worker Practice and Utilization: The Focus on Financing. National Fund for Medical Education. Retrieved July 08, 2016, from http://hsc.unm.edu/community/toolkit/docs1/CHW%202006%20Advancing%20Community%20Health_Focus%20on%20Financing.pdf.

61 Tunceli, K., Bradley, C. J., Lafata, J. E., Pladevall, M., Divine, G. W., Goodman, A. C., & Vijan, S. (2007). Glycemic Control and Absenteeism among Individuals with Diabetes. Diabetes Care, 30(5), 1283-1285. doi:10.2337/dc06-1657.

62 New England Asthma Regional Council. (2006). The Burden of Asthma in New England. Retrieved July 08, 2016, from http://asthmaregionalcouncil.org/wp-content/uploads/2014/02/2006_BurdenofAsthmainNE-Summary.pdf.

63 Sullivan, S. D., Rasouliyan, L., Russo, P. A., Kamath, T., & Chipps, B. E. (2007). Extent, Patterns, and Burden of Uncontrolled Disease in Severe or Difficult-to-treat Asthma. Allergy, 62(2) 126-33. doi:10.1111/j.1398-9995.2006.01254.

64 Krieger, J., Song, L., & Philby, M. (2015). Community Health Worker Home Visits for Adults with Uncontrolled Asthma. JAMA Internal Medicine, 175(1), 109. doi:10.1001/jamainternmed.2014.6353.

65 Ayala, C., Fang, J., & Yuan, K. (2015). Prevalence of Taking Actions to Control Blood Pressure Among Adults With Self-Reported Hypertension in 18 States and the District of Columbia, 2009. The Journal of Clinical Hypertension, 17(3), 172-182. doi:10.1111/jch.12476.

66 Unmuessig, V., Fishman, P. A., Vrijhoef, H. J., Elissen, A. M., & Grossman, D. C. (2015). Association of Controlled and Uncontrolled Hypertension With Workplace Productivity. The Journal of Clinical Hypertension, 18(3), 217-222. doi:10.1111/jch.12648.

67 Adair, R., Christianson, J., Wholey, D. R., White, K., Town, R., Lee, S., . . . Elumba, D. (2012). Care guides: Employing Nonclinical Laypersons to Help Primary Care Teams Manage Chronic Disease. Journal of Ambulatory Care Management, 35(1), 27-37. doi:10.1097/jac.0b013e31823b0fbe

68 City of Portland Public Health Division's Minority Health Program (2014) 2014 Minority Health Assessment Report – Cumberland County. Retrieved July 08, 2016, from http://www.portlandmaine.gov/DocumentCenter/Home/View/6805

69 Maine Humanities Council (2011). The Newsletter of the Maine Humanities Council, Winter 10-11. Retrieved July 08, 2016, from https://mainehumanities.org/wp-content/uploads/2014/10/MHC-NewsW10-11.pdf

70 American Immigration Council (2015) New Americans in Maine: The Political and Economic Power of Immigrants, Latinos, and Asians in the Pine Tree State. Retrieved July 08, 2016, from http://www.immigrationpolicy.org/just-facts/new-americans-maine

71 Deshaw M. Use of the emergency department by Somali immigrants and refugees. Minn Med. 2006;89(8):42–5

72 Morrison TB, Wieland ML, Cha SS, Rahman AS, Chaudhry R. Disparities in preventive health services among Somali immigrants and refugees. J Immigr Minor Health. 2012 Dec;14(6):968-74.

73 Samuel PS, Pringle JP, James NW 4th, Fielding SJ, Fairfield KM. Breast, cervical, and colorectal cancer screening rates amongst female Cambodian, Somali, and Vietnamese immigrants in the USA. Int J Equity Health. 2009;8:30.

74 Carroll J, Epstein R, Fiscella K, Volpe E, Diaz K, Omar S. Knowledge and beliefs about health promotion and preventive health care among Somali women in the United States. Health Care Women Int. 2007;28(4):360-80.

75 Sewali B, Pratt R, Abdiwahab E, Fahia S, Call KT, Okuyemi KS. Understanding cancer screening service utilization by Somali men in Minnesota. J Immigr Minor Health. 2015s;17(3):773-80.

76 Sewali B, Okuyemi KS, Askhir A, Belinson J, Vogel RI, et al. Cervical cancer screening with clinic-based Pap test versus home HPV test among Somali immigrant women in Minnesota: a pilot randomized controlled trial. Cancer Med. 2015;4(4):620-31.

77 Percac-Lima S, Ashburner JM, Bond B, Oo SA, Atlas SJ. Decreasing disparities in breast cancer screening in refugee women using culturally tailored patient navigation. J Gen Intern Med. 2013;28(11):1463-8.

78 Wilson FA, Villarreal R, Stimpson JP, Pagán JA. Cost-effectiveness analysis of a colonoscopy screening navigator program designed for Hispanic men. J Cancer Educ. 2015 Jun;30(2):260-7.

79 Whitley EM, Everhart RM, Wright RA. Measuring return on investment of outreach by community health workers. J Health Care Poor Underserved. 2006 Feb;17(1 Suppl):6-15.

80 Enard KR, Ganelin DM. Reducing preventable emergency department utilization and costs by using community health workers as patient navigators. J Healthc Manag. 2013 Nov-Dec;58(6):412-27

81 Oglesby, A. K., Secnik, K., Barron, J., Al-Zakwani, I., & Lage, M. J. (2006). The Association between Diabetes Related Medical Costs and Glycemic Control: A Retrospective Analysis. Cost Effectiveness and Resource Allocation, 4(1). http://doi.org/10.1186/1478-7547-4-1.

82 Juarez, D., Goo, R., Tokumaru, S., Sentell, T., Davis, J., & Mau, M. (2013). Association between Sustained Glycated Hemoglobin Control and Healthcare Costs. The American Journal of Pharmacy Benefits, 5(2), 59–64.

83 Fingar K and Washington R. (2015). Potentially Preventable Pediatric Hospital Inpatient Stays for Asthma and Diabetes, 2003-2012. HCUP Statistical Brief #192.

84 Pearson WS, Goates SA, Harrykissoon SD, Miller SA. State-Based Medicaid Costs for Pediatric Asthma Emergency Department Visits. Prev Chronic Dis 2014;11:140139. DOI: http://dx.doi.org/10.5888/pcd11.140139

85 Maine DHHS. MaineCare SFY 2010 High-Cost Member Fact Sheet. Retrieved July 08, 2016, from https://www1.maine.gov/dhhs/oms/pdfs_doc/vbp/Highcost_Member_Summary.pdf

86 Jiang HJ, Weiss AJ, Barrett ML, Sheng M. (2015). Characteristics of Hospital Stays for SuperUtilizers by Payer, 2012. HCUP Statistical Brief #190. Retrieved July 08, 2016, from http://www.hcup-us.ahrq.gov/reports/statbriefs/sb190-Hospital-Stays-Super-Utilizers-Payer-2012.pdf

87 Babamoto KS, Sey KA, Camilleri AJ, Karlan VJ, Catalasan J, Morisky DE. Improving diabetes care and health measures among Hispanics using community health workers: results from a randomized controlled trial. Health Educ Behav. 2009;36(1):113-26.

88 Morrison TB, Flynn PM, Weaver AL, Wieland ML. Cervical cancer screening adherence among Somali immigrants and refugees to the United States. Health Care Women Int. 2013;34(11):980-8.

89 Wieland ML, Morrison TB, Cha SS, Rahman AS, Chaudhry R. Diabetes care among Somali immigrants and refugees. J Community Health. 2012;37(3):680-4.

10. TECHNICAL APPENDIX: DATA SOURCES & NOTES ON METHODS

The chart below summarizes data sources, notes on calculations, and assumptions made in our CHW models listed in Section 6.

Population	Outcomes	Cost projections	Social Return
CHW model 1: Improvements in diabetes control in Washington County			
Number of diabetics at an FQHC, proportion with poor control: Population (total number of patients) and clinical data (number of diabetics, proportion with poor control, defined as HbA1c at 9% or above) reported for four Washington County-based HRSA grantee FQHCs (2014);[26] average of four sites. **No. of patients enrolled in year 1:** Calculated based on estimated caseload per CHW. **Patients engaged at year 1 end:** Average dropout/loss-to-follow-up rate from three CHW intervention studies: Spencer et al., 2011;[34] Prezio et al., 2013;[35] Philis-Tsimikas et al., 2011.[30] **Proportion of diabetics treated at FQHCs:** Calculated number of patients treated at four FQHC sites in Washington County (percent diabetics at each site multiplied by number of patients at each site),[26] divided by calculated number of patients in county with diabetes,	**Average baseline and study end readings** per enrolled individual, from Philis-Tsimikas et al., 2011.[30] **Number of patients (%) brought to HbA1c control level:** Proportions reported by Brown et al, 2012,[29] applied to our population. *Assumption:* In the absence of CHW intervention, patients remain in poor control (>9%) at the end of the modeled time period (one year). This was a conservative estimate, since our model paper did not include results for a control group.	**Per-person annual direct medical costs:** Calculated using ratios of per-person costs by HbA1c levels (<7%, 7-9%, >9%) reported by Oglesby et al., 2006,[81] applied to average baseline per-person costs for poorly controlled diabetic patients reported by Juarez et al., 2013.[82] Rates trended to 2016–2021 and adjusted for Maine. *Assumption*: no improvement in glycosylated hemoglobin levels in the absence of CHW intervention, all patients remain at >9% level at the end of year 1.	**Number of adults working:** Average proportion of working-age adults among our cohort at four FQHCs in Washington County: 59% of 110 participants.[26] *Assumption:* All working-age adults in our sample (59%) are working full time. **Number of days lost from work:** Calculated based on number of hours lost per work in the past four weeks, converted to number of days per year, by level of HbA1c control, from Tunceli et al., 2007.[61] Our calculations summed data reported for males and females by Tunceli et al., 2007.[59] We calculated days lost from work for our three HbA1c levels (<7%, 7–9%, >9%). Since the paper reports five levels of HbA1c control, we combined data for 8-8.99% and 7–7.99% categories reported in the paper by taking the midpoint reported for these categories and using this for our 7–9% category. Similarly, we calculated the midpoint reported for 9–9.99% and >10% by the study, and used this for our >9%

Population	Outcomes	Cost projections	Social Return
from ME SHNAPP 2016.[25] **Population at years 1–3:** *Assumption:* The number of patients per year remains constant (new patients enrolled to replace ones that drop out), outcomes modeled for a cohort of patients followed for one year.			category. For the <7% category, we used 7–7.99% category data reported in the study, since this study did not report levels for <7%, and 7–7.99% was the lowest level of glycosylated hemoglobin reported in the study. We calculated the total number of days lost by all patients, by multiplying the number of patients at each level of HbA1c control (three levels), with the average number of days lost per year for patients at this level of control (per the calculations outlined above). *Assumption 1:* no improvement in glycemic levels in the absence of CHW intervention, all patients remain at >9% level at the end of year 1. *Assumption 2:* Patients receiving CHW intervention experience improvement in HbA1c levels per Brown et al. 2012.[29]
CHW model 2: Improvements in asthma control among children in Kennebec County			
Number of children with poorly controlled asthma in Kennebec County: Number of total individuals in Kennebec, percent (%) children, and percent (%) children with asthma, from ME SHNAPP 2016 – Kennebec data.[25] Proportion of children with poorly controlled asthma calculated as midpoint (median %) of data reported for all	**Number of ED visits and hospitalizations, baseline:** Data for Kennebec County baseline data from the Maine Environmental Public Health Tracking Program (MHDO);[42] number of ED visits and hospitalizations for children in years 2007–2011, calculated per year. For our cohort of patients, we calculated the number of events by applying the	**Costs of hospital stay:** Calculated from national average hospital cost per stay for potentially preventable pediatric inpatient stay for asthma, adjusted for Maine (Fingar and Washington, 2015)[83], and for a private insurance. **Cost of ED visit:** Calculated from national average cost of ED visit for	**Number of missed school and workdays:** From Bhaumik et al., 2013.[46] We applied the mean number of days lost per person at baseline and after the CHW intervention, to our sample population. *Assumption:* We assumed that all parents (adults) in our sample are working full time.

Population	Outcomes	Cost projections	Social Return
children with asthma in Maine by the Maine CDC (Asthma in Maine Fact Sheet 2014; low estimate)[40] and CDC reporting 2006-10 BRFSS data (Asthmastats by state;[41] high estimate). **Number of patients at a private group practice/ACO:** *Assumption:* We estimated a panel size of 4,000 children. We calculated the number of children likely to have poor control of their asthma, using the method above. **Population at years 1–3:** 18% loss to follow-up or discontinuation of participation in year 1, calculated as midpoint (median) reported by two pivotal studies: Krieger et al., 2005;[50] Campbell et al., 2015.[43] *Assumption:* Attendance will be constant across years 2 and 3, with a constant number of patients seen each year, and followed for 1 year.	rate among poorly controlled children in the county (calculated by dividing the countywide number of events by the calculated number of children in the county with poorly controlled asthma). **Number of ED visits and hospitalizations, after CHW intervention:** Effects calculated from Bryant-Stephens et al., 2013.[48] *Assumption:* Rates in the absence of CHW intervention assumed to be constant (no reduction at year 1). **Average reductions in days with activity limitation** (per person/two weeks)**, rescue medication use** (days per person/two weeks)**, symptom-free days** (per person/two weeks)**, well-controlled asthma** (% of patients): From Campbell et al., 2015.[43]	children with asthma covered by Medicaid/CHIP,[84] converted to commercial rates and for Maine.	
CHW model 3: Improving control of chronic conditions for individuals with high health care use in Aroostook County			
Average number of adult patients at a rural health center in Aroostook County: First, we calculated the average (median) number of patients per site for three FQHCs in Aroostook County, as reported by HRSA for 2014.[26] *Assumption:* The number of patients	**Conditions**: We modeled improvements in three conditions that have a high disease burden in Aroostook County relative to the rest of the state (asthma, diabetes, hypertension), since individuals with these three conditions are frequently also found among the top 5% of	**Costs per inpatient visit:** Based on average cost of an inpatient stay for high utilizers (top 5% of spend) enrolled in Maine Care, converted to Maine rates, trended to 2016–2019 and adjusted for all insurance types, from MaineCare, 2010.[85] Adjustment of rates for all insurance types was	**Working adults**: We first calculated the estimated proportion of working adults in our sample, for each of our three chronic care conditions (asthma, diabetes, hypertension), using rates reported by Ayala et al., 2015[65] for hypertension (31%), Tunceli et al., 2007 for diabetes

Population	Outcomes	Cost projections	Social Return
at a RHC is approximately half of that at a FQHC. Estimated proportion of adults was calculated by applying the average (median) proportion of adults (76%) at the three Aroostook FQHCs, reported by HRSA.[26] **Estimated number of high-cost, high-use patients enrolled per RHC site:** 5% of patients, minus patients likely to have conditions that are not amenable to chronic condition management, estimated as 11% of top 5% patients. Estimate from IOM, 2016 (patients who are likely to die within one year).[58] **Estimated number of patients retained at the end of CHW intervention:** Estimated from Johnson et al., 2012.[57] Study reports that 65% of patients had complete data. For our estimate of proportion of patients persisting with the intervention, we used an estimate slightly higher than this (83%), as the 65% estimate excludes patients that persist with the intervention but have some missing data, and we aimed to include these patients in our target population.	individuals by health care spend.[54] **Hospitalizations:** Baseline calculated from the proportion of high cost (top 5%) members enrolled in MaineCare that had an inpatient hospitalization, from Maine DHHS, 2010.[85] Effect of CHW intervention estimated from reported reduction among patients that are high-ED utilizers, from Johnson et al., 2012 (83%).[57] *Assumption:* In the absence of an intervention, the reduction in the number of inpatient hospitalizations is -7.6%, the rate observed among controls in the study by Johnson et al., 2012.[57] **Hypertension:** The number of patients was calculated using the proportion of top 5% patients by health care spend that are reported to have high blood pressure nationally (49%), from Lewin Group, 2010.[54] The projection from our proposed CHW intervention was calculated using an improvement in the proportion of patients achieving blood pressure control in a study of chronic care patients by Adair et al, 2012.[67] **Diabetes:** The number of patients with diabetes was calculated using the proportion of top 5% patients by health care spend that are reported	calculated by first calculating the average distribution of insurance types (uninsured, Medicaid/CHIP, Medicare, other third party) at three FQHCs in Aroostook (HRSA, 2014)[26] We then calculated the average cost of an inpatient stay for each insurance category by using the average MaineCare (Medicaid) rate calculated above, and applying the difference (ratio) to each insurance category in average inpatient stay costs reported for super utilizers nationally (Jiang et al., 2015).[86] We then applied these rates to the distribution of insurance types reported for high utilizers (top 5%), reported by Lewin Group, 2010.[54] Lastly, these average insurance-specific hospitalization rates and insurance distributions were applied to our sample, and trended to 2016–2019. Using this average rate for inpatient hospitalizations for our Maine high utilizers (top 5% of spend), we calculated the projected reduction in the cost per inpatient spend, according to the reduction reported by Johnson et al., 2012.[57] *Assumption*: In the absence of CHW intervention, the average cost per inpatient event remains the same.	(55%),[61] and the New England Regional Council for Asthma (91%).[62] We applied these proportions to the number of adults with each condition. We modeled the social returns realized from recovered workdays for each of the three conditions: **Hypertension:** Estimated number of days lost for individuals with hypertension under control vs. not under control, from Unmuessig et al., 2015.[66] *Assumption:* In the absence of CHW intervention, no change to baseline rates. **Diabetes:** From Tunceli et al., 2007[61] reporting days missed work, applied to proportions of patients achieving each level of HbA1c control (<7%, 7–9%, >9%), based on Brown et al., 2012.[29] See Model 1 social return calculations for more details. *Assumption*: No change to days lost from work in the absence of a CHW intervention, based on three CHW intervention studies that reported no significant change to HbA1c levels among control groups (Spencer et al., 2011,[35] Babamoto et al., 2009,[87] Rothschild et al., 2014).[37] **Asthma:** From Krieger et al., 2015[64] (-31%), based on the reduction in the proportion of adults with very poor control of their asthma. The

Population	Outcomes	Cost projections	Social Return
	to have diabetes nationally (28%), from Lewin Group, 2010.[54] Baseline rates for the proportion of patients that have cholesterol levels under control (69%) were based on Drewette-Card, 2011.[24] Improvements from our CHW intervention were modeled based on the increase in proportion of diabetic patients that achieved a cholesterol level of <100 mg/dL reported in a study of chronic care patients (17.2%) by Adair et al., 2012.[67] *Assumption:* In the absence of intervention, no increase in proportion. Baseline rates for the proportion of patients that had an annual dilated eye examination (71%) based on Maine SHNAPP 2016.[25] Improvements in proportion of patients with annual eye examination (31.7%) based on Adair et al., 2012.[67] *Assumption*: In the absence of intervention, no increase in proportion. **Asthma:** The number of patients was calculated using the proportion of top 5% patients by health care spend that are reported to have asthma nationally (11%), from Lewin Group, 2010.[54] Reductions in number of symptom-free days from Krieger et al., 2015.[64]		estimated number of workdays lost based on good vs. poor control, was calculated from Sullivan et al., 2007.[63] *Assumption*: Days lost in the absence of a CHW intervention per those observed in the control group reported by Krieger, 2015 (-13%).[64]

Population	Outcomes	Cost projections	Social Return
CHW model 4: Connecting underserved individuals to services in the Lewiston area			
Somalis residing in Lewiston: Based on average (median) reported by Maine Humanities Council,[69] and American Immigration Council, 2015.[70] **Proportion of patients persisting with CHW intervention at year 1 end**: Median rate of retention reported in three cancer screening studies: Sewali et al., 2015;[76] Percac-Lima et al., 2013[77] and Wilson et al., 2015.[78] **Cancer screening populations:** Estimated based on the proportion of females or males in the relevant age category (21–64 years for cervical cancer, 50+ for breast cancer and 50–75 years for colorectal cancer) in Lewiston per U.S. Census data, applied to our estimated number of individuals of that gender at a hypothetical Lewiston-based CBO. **Population with high use of ED:** Calculated using the proportion of Somali patients reported to have an ED visit in the previous year, based on a report of administrative data in Minnesota (Morrison et al., 2012).[72] *Assumption:* All of these visits will be for non-emergent health issues, based on the reported preferences of	**Cervical cancer screening:** Baseline rates from Morrison, 2013 reporting for a Somali population.[88] Improvements in screening rates based on Sewali, et al., 2015 reporting for a Somali population.[76] **Breast cancer screening:** Baseline rates from Morrison, 2012 reporting for a Somali population.[72]Improvements in screening rates based on Percac-Lima, et al, 2013 reporting for a Somali population.[77] **Colorectal cancer screening:** Baseline rates from Morrison, et al 2012 reporting for a Somali population.[72] CHW effects based on Wilson et al., 2015.[78] **Primary care visits:** Baseline rates based on median reported by Morrison, et al 2012[72] and Morrison, et al 2013[88] for Somali populations. Effects of CHW intervention based on Whitley, et al 2006.[79] **Emergency care/Urgent care visits:** Baseline based on median reported by Morrison, et al. 2012[72] and Wieland, et al., 2012[89] for Somali populations. CHW effects based on Enard, et al., 2013.[80]	**Total health care costs:** Estimated from Whitley et al., 2006.[79] Total charges reported for all patients receiving a CHW intervention was divided by the number of patients reported in the study. These values were converted to costs using a cost-to-charge ratio reported in the same study (62%), and converted to Maine rates and trended to 2016–2019. *Assumption:* No change in per-capita health care costs in the absence of an intervention.	Not modeled for this population/model, because of lack of reliable data.

Population	Outcomes	Cost projections	Social Return
Somalis to use the ED over primary care or outpatient services (Deshaw, 2006;[71] Carroll et al., 2007).[74]			

The Department of Health and Human Services (DHHS) does not discriminate on the basis of disability, race, color, creed, gender, sexual orientation, age, or national origin, in admission to, access to, or operations of its programs, services, or activities, or its hiring or employment practices. This notice is provided as required by Title II of the Americans with Disabilities Act of 1990 and in accordance with the Civil Rights Act of 1964 as amended, Section 504 of the Rehabilitation Act of 1973, as amended, the Age Discrimination Act of 1975, Title IX of the Education Amendments of 1972 and the Maine Human Rights Act and Executive Order Regarding State of Maine Contracts for Services. Questions, concerns, complaints or requests for additional information regarding the ADA may be forwarded to DHHS' ADA Compliance/EEO Coordinators, 11 State House Station – 221 State Street, Augusta, Maine 04333, 207-287-4289 (V), 207-287-3488 (V), TTY users call Maine relay 711. Individuals who need auxiliary aids for effective communication in program and services of DHHS are invited to make their needs and preferences known to the ADA Compliance/EEO Coordinators. This notice is available in alternate formats, upon request.