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Report

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Sustainable Financing Models for Community Health Worker Services in Connecticut: **Translating Science into Practice**

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"A COMMUNITY HEALTH WORKER IS A FRONTLINE PUBLIC HEALTH WORKER WHO IS A TRUSTED MEMBER OF, AND HAS A UNIQUE UNDERSTANDING OF, THE EXPERIENCE, LANGUAGE, CULTURE, AND SOCIOECONOMIC NEEDS OF THE COMMUNITY SERVED."

– From the definition adopted by the Connecticut State Innovation Model CHW Advisory Committee

1. Executive Summary

- **Community health workers promote health and wellness within their own communities, helping to bridge the gap between the doctor's office and patients' lives.**
- **Community health worker services improve health outcomes, help providers and payers meet new quality standards, and can save money. Research on successful models in other states demonstrates that they can be sustainable and tailored to local needs.**
- **The four targeted interventions modeled for Connecticut would improve health and save money. The models focus on Latinos with diabetes in Hartford, children with asthma in Greater New Haven, frequent emergency department users in New London County, and patients with cardiovascular disease risk factors in Windham County.**

Research demonstrates that community health workers (CHW) enhance patient experience, strengthen care coordination, improve clinical outcomes, and can help to control health care costs.

CHWs bring an understanding of patients' culture, language, and communities to the health care team. They can be the team's eyes and ears on the ground, identifying obstacles patients face and tailoring health management strategies to meet each patient's needs.

The health care system's movement toward value-based payment methods – which reward quality health care with incentive payments – encourages providers and payers to meet ambitious quality standards for all patients, including those who face significant barriers to achieving better health.

To date, some policymakers, health systems, insurers, and community organizations have been hesitant to invest in CHW services because of uncertainties about the return on investment and the challenges inherent in translating research into real-world practice. While some CHW programs currently operate in Connecticut, they typically rely on grant funds or other temporary sources of money, and even programs that demonstrate positive results are often at risk of elimination because of a lack of sustainable funding.

In fact, research provides a strong business case for the use of community health workers. This review by the University of Massachusetts (UMass) Medical School's Center for Health Law and Economics demonstrates the value of CHW services, and provides four practical, ready-to-use, sustainable financing models anchored in Connecticut data.

WHAT CONNECTICUT COULD DO

Researchers at UMass developed four CHW models aligned with priorities of Connecticut's State Innovation Model (SIM), a federally funded grant initiative to transform state health care systems. The models target high-need, high-cost patients – the populations for which CHW interventions are most likely to improve health outcomes and generate cost savings. The analysis applies results obtained by successful interventions in other parts of the country and projects outcomes that could be achieved if the same interventions were implemented in Connecticut.

Evidence compiled from research studies, interviews with Connecticut CHW employers, and state public health data were used to construct cost-effective CHW models. Specific state population and cost data were used to create the most cost-effective model for each community.

While the four models are based on actual state data, they are projections based on programs that could be implemented, not evaluations of programs that currently exist.

CHW MODEL 1

CONTROLLING DIABETES AMONG HARTFORD LATINOS

Target population: 158 Latinos (mostly Puerto Rican) with type II diabetes, per 18-month cohort

CHW employer: Community-based organization

Model: University of Texas Community Outreach (UTCO), Laredo, Texas,[1] an 18-month intervention that included home visits, counseling, group education, and exercise classes

Projected intervention cost: $388,000 over 3 years

Projected outcomes:
- 60 percent would achieve good glycemic control
- 74 percent would improve overall glycemic control
- Savings in direct medical costs: $435,000 over 3 years
- Financial return on investment: $1.12 for every $1 invested over 3 years
- Social return: 14 recovered work days per working adult over 18 months

CHW MODEL 2

IMPROVING ASTHMA CONTROL OF CHILDREN IN GREATER NEW HAVEN

Target population: 96 children with uncontrolled asthma per year

CHW employer: Private group practice using a patient-centered medical home model

Model: Seattle-King County Medicaid Healthy Homes, Washington,[2] a 4-month intervention that included home visits, an environmental assessment and asthma mitigation supplies

Projected intervention cost: $229,000 over 3 years

Projected outcomes:
- 27 more children would have well-controlled asthma in year 1
- 32 percent fewer hospitalizations than if no intervention
- Savings in direct medical costs: $427,000 over 3 years
- Financial ROI: $1.86 for every $1 invested over 3 years
- Social return: For each family, 8 recovered school days & 12 fewer days caretakers have to rearrange schedules due to child's asthma symptoms, per year

CHW MODEL 3

CONNECTING INDIVIDUALS WITH COMPLEX HEALTH NEEDS TO APPROPRIATE HEALTH CARE SERVICES IN NEW LONDON COUNTY

Target population: 72 adults with chronic conditions and behavioral health needs with multiple emergency department visits, per year

CHW employer: Hospital system in partnership with affiliated practitioners and clinics

Model: Molina Healthcare/CARE NM, New Mexico,[3] a 1-6 month intervention to connect patients to primary care providers and reduce emergency department visits

Projected intervention cost: $394,000 over 3 years

Projected outcomes:
- 81 percent reduction in hospitalizations
- 69 percent reduction in emergency department visits
- Savings in direct medical costs: $944,000 over 3 years
- Financial ROI: $2.40 for every $1 invested over 3 years
- Social return: Not modeled

CHW MODEL 4

PREVENTING CARDIOVASCULAR DISEASE COMPLICATIONS IN WINDHAM COUNTY

Target population: 148 adults in Windham County with cardiovascular risk factors including diabetes, hypertension or high cholesterol, per year

CHW employer: Federally qualified health center

Model: Community Outreach and Cardiovascular Health in Baltimore, Maryland,[4] a year-long nurse-led intervention that included diet modification, stress management, smoking cessation, exercise and medication management

Projected intervention cost: $194,000 over 3 years

Projected outcomes:
- 230 percent more individuals with controlled blood pressure and 170 percent more individuals with controlled cholesterol levels than if no intervention
- Savings in direct medical costs: $388,000 over 3 years
- Financial ROI: $2 for every $1 invested over 3 years
- Social return: For each working adult with diabetes, 2 recovered workdays per year

This report is intended to show how research on CHW interventions can be applied in Connecticut to produce cost-effective programs that will improve health outcomes and achieve a positive financial return on investment. It provides program specifications needed to achieve these outcomes, and includes the financial and clinical impact analyses and detailed budgets that health care providers and payers need to justify funding CHW services.

The proposed CHW interventions are not the only sustainable models that could be implemented in the state. A wide variety of CHW interventions already operate in almost every state – including Connecticut – and could provide additional implementation strategies, provided there is evidence of cost effectiveness.

USING THIS REPORT

Implementing a new health care intervention typically requires a lot of research and planning. Providers and managed care organizations striving to meet value-based payment requirements need assurances that a new intervention will achieve utilization goals, improve health outcomes, and contain costs.

This report demonstrates ways payer or provider organizations can apply findings from published peer-reviewed studies to develop evidence-based, cost-effective CHW interventions in their own organizations. Each of the four models presented in this report is designed as a standalone intervention.

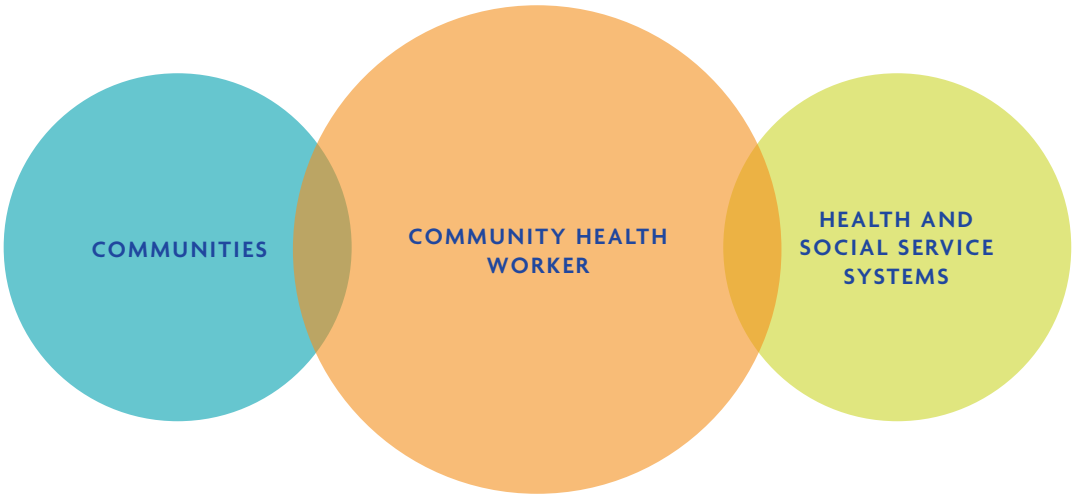
The report cites public health data demonstrating the need for an intervention in a particular location, as well as the approach CHWs could take to address that need. The report then supplies the budget, financial and clinical impact analyses – based on Connecticut data and published study results – that finance officers need to ensure funding CHW services represents a worthwhile investment.

Users can adjust the tables to incorporate baseline data at their own location and can use the methodologies provided to predict the outcomes they will achieve.

Before implementing one of the proposed CHW intervention models, organizations should coordinate with the Connecticut Department of Social Services' contracted administrative services organizations to avoid duplication of health care management services for patients insured under HUSKY, the state's Medicaid program. In addition, organizations should contact administrators of successful CHW interventions to gain firsthand knowledge of effective practices. The Institute for Clinical and Economic Review has also recommended best practices for implementing cost-effective CHW interventions.[5]

If the proposed CHW interventions described in this report are implemented, actual results may differ from projections because 1) while the authors made assumptions based on the best available evidence, they cannot guarantee that their assumptions are accurate, and 2) the authors combined results of multiple studies, which can introduce error. In addition, the rate of clinician acceptance of CHWs as nonclinical health care professionals can affect progress in achieving projected outcomes and cost savings within a model's timeline.

2. Introduction to Community Health Workers



Bridging the gaps between medical care and the many other factors that influence people's health has been a significant challenge for the health care system. At the same time, many patients feel overwhelmed by the complexity of the system and need help managing their health. Community health workers (CHW) offer a way to address these problems. They can broaden the reach of medical practices to address social, environmental, and other factors that can keep people from achieving optimal health, while helping patients to better navigate the system and adding a unique perspective to the health care team, based on a personal understanding of patients' culture and community.

WHAT IS A COMMUNITY HEALTH WORKER?

According to the definition adopted by the Connecticut State Innovation Model (SIM) CHW Advisory Committee, "A community health worker is a frontline public health worker who is a trusted member of, and has a unique understanding of, the experience, language, culture, and socioeconomic needs of the community served. A CHW serves as a liaison/intermediary between individuals, communities and health and social services to facilitate access to care, improve the quality and cultural responsiveness of service delivery, and address social determinants of health.

"CHWs build individual and community capacity by increasing health knowledge and self-sufficiency through a range of culturally appropriate services such as outreach and engagement, education and informal counseling, advocacy, care coordination, basic screenings and assessments, and research and evaluation."[6]

Community health workers already provide services in Connecticut and across the country, often identified by other titles, including patient navigators, *promotoras*, peer educators, outreach workers, health coaches, home visitors, and case managers.

WHO DO COMMUNITY HEALTH WORKERS SERVE?

CHWs often work with individuals with complex and unmet health needs, such as people with chronic health conditions. CHWs also work with people who are not yet connected to the health care system, including those who do not speak English.

Because CHWs understand where the individuals they work with come from, how they do things, what foods they cook, and their communities' expectations and norms, CHWs can provide culturally competent coaching to help individuals implement care recommendations from their clinical team. The integration of CHWs into primary care teams 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, health insurers, and community-based organizations to help people:

- **Understand and implement chronic disease care management strategies, including medication adherence and action plans**
- **Improve overall health through diet, exercise, and tobacco cessation**
- **Mitigate environmental factors that exacerbate symptoms, by using strategies such as asthma-sensitive cleaning methods**
- **Navigate the health care system and overcome financial, transportation, cultural, and linguistic barriers to obtaining recommended care**
- **Access crucial services that address social determinants of health, including domestic violence, unstable housing, and unemployment**

The role of CHWs and the specific services that they provide vary depending on the needs of the target population. However, there is a set of nationally recognized and agreed-upon roles, skills, and qualities for CHWs. It was drawn from an analysis of existing data and a consensus of CHW leaders, and published in April 2016 by the CHW Common Core (C3) Project. The Connecticut SIM CHW Advisory Committee then adopted an updated version of the C3's roles and skills.[7]

"IN OUR COMMUNITY HEALTH IMPROVEMENT PLAN THAT WE'VE JUST ADOPTED FOLLOWING OUR COMMUNITY HEALTH NEEDS ASSESSMENT, THERE'S A VERY HEAVY IMPACT ON SOCIAL DETERMINANTS. AND CHWS ARE SUPERBLY POSITIONED TO DO THAT."

– Official at a hospital program that uses community health worker services

WHAT BENEFITS DO CHWS PROVIDE TO STAKEHOLDERS?

Individuals

- CHWs disseminate culturally sensitive and language-appropriate information to improve health care literacy
- Improve health outcomes and quality of life
- Enhance the patient and caregiver experience within the health care system
- Empower individuals and communities to advocate for necessary health and social services
- Reduce days missed from work and school

Providers

- CHWs extend the reach of a medical practice from the office to the home
- Improve communication between providers and patients to increase treatment/medication regimen adherence
- Connect individuals to health care providers and services
- Meet quality standards tied to incentive reimbursement payments (such as reduced emergency department visits and hospitalizations)

Society

- CHWs reduce government spending on preventable health care services (such as reduced emergency department visits and hospitalizations)
- Create jobs in an allied health field
- Improve employee and student attendance
- Increase worker productivity

Payers

- CHWs contribute to cost containment by reducing preventable health care spending
- Produce financial returns on investment
- Help achieve quality standards of care benchmarks
- Enhance the member experience

WHAT DOES THE RESEARCH SHOW?

Studies show that community health workers help underserved and high-need patients access the right care at the right time by removing barriers to care. These services enhance patient experience, improve population health outcomes, and reduce costs.[8]

SUCCESSFUL CHW PROGRAMS IN THE U.S.

MOLINA HEALTHCARE OF NEW MEXICO, a Medicaid managed care organization, partnered with Community Access to Resources & Education in New Mexico to employ CHWs to help patients with complex and unmet health needs navigate the health care system.[9,10]

- Molina pays providers a monthly per-patient fee for CHW services
- Molina reported a $4 return on every $1 invested in CHW services
- Molina is expanding this model to all 10 states within its network[8]

NEW YORK-PRESBYTERIAN HOSPITAL IN NEW YORK CITY integrated CHWs as team members in five medical homes through the Washington Heights/Inwood Network For Asthma (WIN) program.[13,14]

- An initial grant-funded program generated cost savings from reduced health care utilization over five years
- Hospital leadership then agreed to support WIN through the hospital's operating budget and later expanded the program

UNIVERSITY OF PENNSYLVANIA HEALTH SYSTEM uses CHWs to improve primary care utilization and patient engagement, while reducing hospital readmission rates.[11,12]

- CHWs are now fully integrated into routine care throughout the health system
- The health system employs 40 CHWs to provide health care system navigation, social support, and advocacy for more than 1,500 high-risk patients each year

HENNEPIN HEALTH IN MINNESOTA, a safety net system, uses CHWs at patient-centered medical homes to help patients with high needs navigate the health care system.[12,14]

- CHW services are covered through per-member, per-month and fee-for-service payment arrangements
- Hennepin Health expanded the role of CHWs by reinvesting savings generated by accountable care organizations

"QUITE OFTEN, YOU CAN'T GET THE ENGAGEMENT OF THE HOUSEHOLD UNTIL YOU CAN ADDRESS THE SOCIAL DETERMINANTS...WE CAN HELP THEM ADDRESS THOSE, AND THEN IT HELPS US ENGAGE THEM."

– Official at a behavioral health clinic that employs community health workers

3. Methods

1. SELECTION OF PRIORITY AREAS

The authors selected the four proposed models to align with four of the priorities established by Connecticut's State Innovation Model project:[15]

- Individuals with complex care needs
- Diabetes
- Hypertension
- Asthma

2. SELECTION OF PUBLISHED EVALUATIONS OF COMMUNITY HEALTH WORKER INTERVENTIONS

The UMass team based its models on published studies of community health worker (CHW) interventions in other states that met all or most of the following criteria:

- Delivered to populations that were similar to Connecticut's target population, by:
    - Health condition
    - Insurance status
    - Disease control
    - Age group
    - Ethnicity
- Completed in similar settings, such as federally qualified health centers (FQHC) or community-based organizations (CBO)
- Published recently, ideally within the past five years
- Strong research design using randomized controlled trials where control groups did not receive CHW services. If controlled trials were not available, studies that reported a pre-post effect on a general population were used
- Found a statistically significant effect on health outcomes
- Reported the effects on health care costs or health care utilization, including emergency department (ED) use and hospitalizations

3. TARGET POPULATION

To estimate the number of people in the proposed target population, the UMass team 1) researched the disease burden in the target county or metropolitan area; 2) estimated the size of the entire population in the county or area that met eligibility criteria (such as age group or insurance status) for the proposed CHW intervention model; 3) estimated the number of patients who could be realistically served in the target setting (such as a CBO or an FQHC), based on the organization's capacity.

4. CASELOAD

Based on detailed data from published studies, other existing programs, and CHW employer interviews, the authors developed an annual caseload per CHW to include time he or she would spend on direct client work, phone calls, travel, making referrals, training, and other administrative duties. Participant enrollment and drop-out rate estimates were based on data reported in published studies. When several different measures were available, an average of those measures was used.

5. BUDGET DEVELOPMENT

Model budgets were based on data collected from Connecticut organizations that currently employ CHWs and program cost data reported in published studies. For each CHW model, a three-year program cost was developed using a 3.3 percent increase in each future year's cost, based on the Congressional Budget Office's projected annual average Employment Cost Index for 2018-2020.[16]

6. OUTCOMES

The effects of the proposed CHW interventions on health outcomes were calculated based on the effect size among people who received CHW services, as documented in published studies. When randomized controlled study evidence was available, the UMass researchers compared study participants' outcomes in the time periods before and after the intervention to outcomes for the control group (individuals who did not participate in the CHW intervention) in the same time periods. If the best evidence did not include a control group, researchers assumed no change in the underlying health status of patients with no CHW interventions.

Data from each target county's population was used to create baseline rates of specific metrics (such as asthma hospitalizations). If county-specific data was not available, the authors used state of Connecticut data. If no Connecticut data was available, the authors used estimates for comparable populations drawn from published studies.

7. QUALITY MEASURES AFFECTED BY PROPOSED CHW INTERVENTION

The UMass team searched nationally recognized measurement sets to identify standard measures likely to be affected by each CHW intervention. The report identifies these, and indicates which of the summarized measures were recommended by the Connecticut State Innovation Model Quality Council for use by commercial and Medicaid payers in value-based payment arrangements.[17]

- **The Accountable Care Organization (ACO) Shared Savings program** puts an emphasis on quality data reporting and measurement. ACOs must 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** (UDS) 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 that receive grants from HRSA, and to create a list ranking health centers for each clinical performance measure.

- **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 of indicators representing various aspects of quality: Prevention, Inpatient Quality, Patient Safety, and Pediatric Quality. These measures are commonly used to highlight potential quality concerns, identify areas that need further investigation, and track changes over time.
- **AHRQ's Prevention Quality Indicators** (PQI) 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 preventive care in reducing complications, more severe disease, and hospitalizations. The PQIs are used to flag potential health care quality problems needing 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 compare health plans' performance results from the Healthcare Effectiveness Data and Information Set (HEDIS) and Consumer Assessment of Healthcare Providers and Systems (CAHPS). The ratings enable individuals to examine a health plan's quality improvement and benchmark plan performance before buying health insurance.

8. COST MODELING

To project cost savings, the authors relied on data reported in published studies. Where sufficient data was reported, cost savings were modeled based on reductions in health care use, including ED visits, inpatient hospitalizations, and prescription drugs. Where utilization data was available, the authors applied average Connecticut-based costs (rates) to each visit type, adjusted for insurance type and trended to current and future rates using National Health Expenditure Projections published by the Centers for Medicare & Medicaid Services.

For one model (CHW Model 1), health care utilization data was not available. As a result, the authors modeled savings from overall reductions in per-capita health care costs based on clinical improvements in health status. They 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 Connecticut, using Kaiser Family Foundation's State Indicators data for expenses per inpatient day. This model assumed no change in health care status or utilization in the absence of intervention.

Two of the models proposed by the UMass team (CHW Models 2 and 3) were based on studies that included control groups and reported health care utilization and costs for both the intervention and control groups, which facilitated estimating costs in the absence of a CHW intervention.

The fourth model was based on a study that included a control group but did not report health care utilization. In this case the authors estimated reductions in health care use in the absence of an intervention based on the clinical improvements obtained for individuals enrolled in the control group.

The authors estimated health care cost savings based on reductions in ED visits, hospitalizations, and/or per-person overall health care costs (using published study data), and adjusted to Connecticut's current-day rates.

9. FINANCIAL RETURN ON INVESTMENT

The financial return on investment (ROI) is the amount returned in savings for every dollar spent on the intervention, calculated by dividing the total medical cost savings by total program costs. A positive ROI indicates the intervention yielded savings greater than the program costs, while a negative ROI (less than 0) demonstrates the intervention did not recover program cost investments. All four CHW models include projected savings and ROIs over a three-year period (2017–2020).

10. SOCIAL RETURN

The social return of the proposed CHW interventions was measured in terms of working days recovered by individuals participating in each program (CHW Models 1 and 4). Because CHW Model 2 targets children, the social return for this model includes changes in the number of days that their caretakers would need to change their plans, in addition to school days recovered, based on data reported in published studies. When days lost from school or work were not reported, the authors modeled the associated reductions based on health outcome improvements described in separate published studies that report missed work days by health outcome (such as hypertension control; CHW Model 1 and CHW Model 4). The authors did not assign a dollar value to the estimated days recovered from school, or days during which a caretaker would need to change plans. Social return was not estimated for CHW Model 3 because a of lack of reliable data.

A note on estimates and rounding:

All figures calculated through this modeling analysis are estimates. Figures are rounded to reflect the level of uncertainty inherent in producing these estimates. All figures are rounded using standard statistical procedures, which require completing the full calculation and then rounding each component. Because of this final rounding step, some reported results will not compute exactly.

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

Community Health Worker **Model 1**:

Controlling Diabetes Among Hartford Latinos

Intervention goal: Improve diabetes control

Target population: Latinos (mostly Puerto Rican) with type II diabetes

Area: Greater Hartford

CHW employer: Community-based organization

Caseload: 79 participants per CHW per 18-month period; 158 participants per cohort

Timeframe: 18-month intervention for cohort 1 (2017-2019) and cohort 2 (2019-2020)

Model: University of Texas Community Outreach, Laredo, an 18-month intervention that included home visits, counseling, group education, and exercise classes

Projected intervention cost: $388,000 for 2 CHWs over 3 years

Projected outcomes (intervention compared to no intervention):

- 74 percent of participants would improve overall glycemic control
- 60 percent would achieve good glycemic control
- Savings in direct medical costs: $435,000 over 3 years, or $1,300 per participant per year
- Financial return on investment: $1.12 for every $1 invested over 3 years
- Social return: 14 recovered workdays per working adult, worth approximately $3,200 per person per 18-month cohort

IMPACT OF UNCONTROLLED DIABETES ON HARTFORD LATINOS

- Connecticut Latinos with diabetes experience leg amputations at three times the rate of whites with diabetes[18]*
- Among Latinos statewide, 33 percent are obese (vs. 24 percent of whites), and 37 percent get no physical activity (vs. 18 percent of whites)[18] – both are diabetes-related risk factors
- In Connecticut, diabetes was responsible for $2.92 billion in direct and indirect costs in 2012 – an average of $13,500 per person for the 216,600 patients diagnosed with the disease[19]
- Indirect costs of diabetes, including the costs of disability, work absences, lost productivity, and premature death accounted for almost 30 percent of the total cost, an average of $3,800 per patient per year[19]

* Compared to white non-Hispanic residents, Connecticut Latinos have: 1) a higher prevalence of diabetes (10.7 percent vs. 8.2 percent);[20] 2) higher mortality rates caused by diabetes (20.8/100,000 residents vs. 13.4 for whites) and related to diabetes (64.7/100,000 vs. 45.5);[18] 3) higher rates of premature mortality caused by diabetes (age-adjusted life years lost under 75 years; 335/100,000 vs. 212);[18] 4) more than twice the rate of hospitalizations caused by diabetes (234.2/ 100,000 vs. 101.1) and related to diabetes (2,637.2/100,000 vs. 1,236.4/100,000);[18] 5) twice the rate of diabetes-related emergency department visits (476/100,000 vs. 207);[21] and 6) nearly three times the rate of diabetes-related leg amputations (age adjusted): 47.1/100,000 compared to 16.5 for whites.[18]

Uncontrolled diabetes increases the risk of early death and can lead to life-threatening complications including heart disease, chronic kidney disease, blindness, and limb amputation.[22]

It is also costly to individuals, the health care system, and the state. Nearly one-fifth of hospital spending in Connecticut is related to diabetes, according to the Connecticut Department of Public Health (DPH).[18]

The high cost burden of diabetes in Connecticut in part reflects the fact that many state residents with the condition do not receive adequate preventive care or take all recommended steps to reduce the risk of serious complications. According to DPH data:

- 30 percent of Connecticut residents with diabetes did not receive the recommended two HbA1c (blood glucose) tests per year[18]
- 37 percent did not check their glucose levels at least once a day[23]
- 35 percent did not receive an annual eye exam[18]
- 50 percent never participated in a diabetes self-management class[20]
- 25 percent did not receive an annual foot exam[18]

The authors propose a model using community health workers (CHW) to improve diabetes control.

SUMMARY OF PROPOSED INTERVENTION MODEL

Diabetes is particularly burdensome for Latinos in Hartford, many of whom face cultural and linguistic barriers to receiving appropriate health care. Hispanics in Connecticut are less likely than other ethnic groups to have health insurance,[18] and those in Hartford are more likely to live in poverty.[24] Diabetic Hispanics are less likely than their white and black counterparts to receive diabetes monitoring,[18] and are more likely to visit the emergency room,[21] have a leg amputated,[18] be hospitalized,[18] and die from the disease.[18]

According to the authors' projections, approximately 5,900 of Hartford's 55,000 Latinos currently have a diabetes diagnosis. Poorly controlled diabetes among this population is estimated to cause 11 deaths, contribute to 26 foot amputations, and generate 129 hospitalizations and 263 emergency department (ED) visits per year.

The proposed intervention is designed to target Latinos with poor glycemic control. Two community health workers employed by a community-based organization (CBO) would provide both individual and group interventions. The model augments the benefits of culturally tailored, patient-centered care planning that occurs during home visits with social supports provided through group sessions.

The group classes would cover topics including nutrition, health education, counseling, and exercise. The CHWs would visit participants at home an average of eight times to provide information about upcoming group classes and to support effective diabetes self-management. In addition, CHWs would accompany participants to clinic visits and provide additional counseling over the telephone. CHWs would co-teach the group sessions with a registered nurse, registered dietician, or an exercise instructor. The nurse and dietician would join counseling sessions as needed.

While this CHW diabetes intervention focuses on Hartford Latinos, the program could be implemented anywhere in the state with other discrete populations.

EVIDENCE BASE FOR PROPOSED INTERVENTION MODEL

The proposed community health worker diabetes intervention is based primarily on the results of the University of Texas Community Outreach (UTCO) program in Laredo, Texas. This community-based diabetes education and self-management program was run in partnership with Mercy Clinic** to target low-income adult Latinos for program enrollment.[1] Results indicate the UTCO intervention was cost-effective for patients with high glycemic levels (HbA1c levels above 9 percent).

The 18-month UTCO intervention included: home-based CHW visits, health education, nutrition and exercise classes, as well as counseling sessions. Each participant attended an average of 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). Community health workers made an average of seven or eight home visits for each participant to discuss upcoming class schedules, prioritize the most appropriate classes for their needs, and help overcome hurdles to effective diabetes self-management.***[25]

Classes and counseling sessions were co-taught by CHWs, together with a nurse practitioner assigned to the program, a dietician, and several volunteers, including a Zumba instructor. Most of the state-certified CHWs (referred to as *promotoras*) in the UTCO program were Mercy Clinic employees before the intervention and received additional training on nutrition, exercise, and data-gathering protocols from the University of Texas Health Science Center School of Public Health.

A similar CHW program in San Diego concluded that trained peers – community members with the same life experiences and language as intervention participants – enhanced diabetes care interventions.[26]

IMPLEMENTATION DETAILS

Caseload Estimates

Two CHWs working full time at a community-based organization would enroll 192 Latino individuals with poor diabetes control. Of them, 158 would likely complete the program.

The authors developed an estimated caseload and budget for the UTCO model if it were implemented by a community-based organization in Hartford.

Table 1.1 displays projected caseload per CHW and number of participants in the proposed diabetes intervention. Where data was not reported in the UTCO study,[1] the authors used data from a similar CHW diabetes intervention that combined group classes and home visits in Detroit,[27] as well as a home visit-based CHW diabetes intervention in Hartford.[23]

Under the proposed intervention, two CHWs working at a single CBO site would have the work capacity to enroll 192 patients and provide home visits (including travel), clinic visits, phone calls, and classes over the course of 18 months. The authors project that 34 individuals would drop out of the intervention and assume that these dropouts would use fewer resources than the 158 participants who complete the program.

** Mercy Clinic is run by Mercy Ministries of Laredo, an outreach ministry of the national Mercy health care system, and primarily serves low-income residents.[1]

*** Diabetes self-management education programs used several different curricula, including the Diabetes Empowerment Education Program, Merck's Journey for Control, and the locally developed *Si Yo Puedo Controlar Mi Diabetes* (some classes included materials from more than one curricula).[25]

Table 1.1: Projected Caseload and Number of Participants per Cohort (over 18 months)

Caseload Components (per CHW)	Estimated Hours Required	Assumptions and Data Sources
Work hours available		
Total work hours	2,772	• 13 paid holidays/year • 10 paid vacation days/year • 6 paid sick days/year
Administrative hours	261	• 3.25 hours/week of meeting time including supervision, case review, staff meetings, etc.[28] • 24 hours/year of trainings, annual meetings, etc.
Group sessions	234	• 3 hours/session, including 2 hours class time and 1 hour of preparation[27] • 52 sessions delivered/year/CHW • 1 session/week, 8 lessons/participant • Course attendance, 10 participants/class[27]
Total hours available to work with participants	2,277	Total work hours/18-month cohort, less administrative and group session time
Caseload assumptions - time required per participant (in hours)		
Home visits	16	• Average of 8 home visits/participant/18-month cohort[1] • 2 hours/initial visit, 1 hour/subsequent visits; average 1.1 hours/visit[27,1] • 0.6 hours round trip travel time/visit • 0.3 hours data entry time/visit
Phone calls	13	• 0.4 hours total time/participant (including case note entry) • Calls every 2 weeks for months 1-12; monthly calls for months 13-18[27,28]
Total time required	29	16 home visit hours/participant plus 13 phone call hours/participant
Caseload	**79**	**Total hours available to work with participants, divided by home visit and phone call hours/participant**
Number of CHWs and participants		
Number of full-time equivalent CHWs required to implement intervention	2	
Number of participants enrolled in cohort 1 (18 months)	192	2 CHWs, based on caseload/CHW
Number of participants engaged at cohort 1 end (18 months)	158	18% dropout rate (82% complete the intervention) based on Detroit intervention[27]

Abbreviations and definitions: CHW = community health worker; dropout rate = percent of participants that enroll, but do not complete intervention. For details on calculations and data sources, see the Technical Appendix.

Cost Estimates

The intervention is estimated to cost between $192,000 and $197,000 in years 1–3, with a total cost of $388,000 over 3 years.

The cost estimates in Table 1.2 include time for a registered nurse and registered dietitian to provide diabetes self-management and nutrition classes. The authors assume each CHW would be continuously employed over three years (no CHW staff turnover in years 1–3) and have a 79-patient caseload over an 18-month period. Estimates for the second cohort (months 18-36) do not include initial training costs, but do include the cost of ongoing training. Estimated total costs are projected to equal between $192,000 and $197,000 over each 18-month cohort, with a three-year cost of $388,000 (for two cohorts).

Table 1.2: Projected Cost Estimates for Cohort 1 (over 18 months) and Cohorts 1-2 (over 3 years)

Budget Item	Estimate	Assumptions
Number of participants	158	Per cohort
Number of full-time equivalent CHWs required	2	
Costs per CHW (per 18 months)		
Salary	$59,300	$19/hour (median FTE wage according to Connecticut CHW employers)
Fringe	$19,000	32%
Travel costs	$400	Annual travel costs (according to a Hartford community-based organization)
Supplies		
Office supplies	$200	Average annual spending (according to three Connecticut CHW employers)
Computer	$300	One-time cost of cloud-based laptop
Cell phone	$900	$50/month
Training	$1,300*	$1,000 for core and supplemental diabetes training; $400 for ongoing training per 18-month cohort (average spending according to three Connecticut CHW employers)
Cost per CHW	*$81,400*	

Table continued on page 17

Table continued from page 16

Budget Item	Estimate	Assumptions
TOTAL CHW COST	**$162,800**	
Supervision costs	$21,500	0.1 FTE/CHW average annual supervisor salary (according to five Connecticut CHW employers) + 32% fringe
Registered nurse and registered dietitian costs	$7,400	1.3 RN and RD combined hours/participant/18 months based on median RN wage ($36.51/hour) and RD wage ($29.50/hour) in 2015, adjusted to 2017 dollars
TOTAL INTERVENTION COST, COHORT 1 (over 18 months)	**$192,000**	**158 participants**
Cost per participant	*$1,200*	
TOTAL INTERVENTION COST, COHORTS 1-2 (over 3 years or 36 months)	**$388,000**	**Cohort 2 = Cohort 1 costs, less laptop and core training costs, plus 3.3% inflation adjustment based on the Congressional Budget Office annual average Employment Cost Index forecast for 2018-2020**[16]

Abbreviations: CHW = community health worker; FTE = full-time equivalent; RD = registered dietician; RN = registered nurse. Total costs were rounded to the nearest thousand, other costs to the nearest hundred. All costs were adjusted for inflation. *Figures do not total due to rounding. For details on cost estimates see Section 5, Interviews with Connecticut Community Health Worker Employers.

PROJECTED OUTCOMES

Health Outcome Improvements

The proposed CHW intervention is projected to improve HbA1c control for 74 percent of participants. Sixty percent, or 95 individuals, are anticipated to reach good glycemic control.

In the UTCO intervention, 80 percent of enrollees with poor glycemic control at baseline improved their control to levels considered moderate or good, and 60 percent of all program participants reached good control levels during the 18-month program.[1] Poor glycemic control is defined as HbA1c above 9 percent. Moderate control is defined as HbA1c between 7 and 9 percent, while good control is defined as at or below 7 percent.

If the Hartford intervention with 158 Latinos achieves the same success as UTCO, the authors project that 74 percent of participants (117 of 158) would achieve moderate or good glycemic control. Of those, 95 individuals – 60 percent of all participants – would obtain good control. Only 41 individuals, or 26 percent, would remain at poor glycemic control at the end of the 18 months.

Table 1.3 summarizes the results when modeled for the 158 Latinos expected to complete the CHW diabetes intervention. The estimated numbers of participants at each glycemic control level at baseline and at the end of the intervention are based on statistics of participants in the UTCO diabetes study.[1]

Table 1.3: Projected Number of Participants at Each Glycemic Control Level in Cohort 1 (over 18 months)

Hemoglobin A1c (HbA1c) Control Level (percents)	Baseline (2017)		Cohort 1 End (at 18 months in 2019)		Difference vs. Baseline	
	Number	Percent	Number	Percent	Number	Percent
Number of participants	158		158			
Good control (≤ 7%)	0	0%	95	60%	95	+60%
Moderate control (> 7% to < 9%)	33	21%	22	14%	-11	-7%
Poor control (≥ 9%)	125	79%	41	26%	-84	-53%

Abbreviation: HbA1c = Hemoglobin A1c, which measures blood glucose. For details on calculations and data sources, see the Technical Appendix.

The UTCO study reported the effects of a CHW intervention on reducing HbA1c at 18 months, but did not report longer-term outcomes. However, two other studies focused on diabetes improvement among Latino populations in Chicago and Hidalgo County, Texas, demonstrated sustained effects lasting up to two years.[29,30] In addition, as a result of improvements in glycemic control, two groups of researchers have projected long-term reductions (over 20 years or lifetime) in the risk of heart attacks, heart disease, foot ulcers, leg or foot amputations, kidney disease, and blindness.[30,31,32] Other CHW diabetes interventions targeting Mexican American populations found short-term effects (up to two years) on cholesterol levels[30] and diastolic blood pressure.[26]

The improvements in HbA1c modeled for a Hartford population are based on results from the UTCO study that were obtained from a sample of 30 individuals. The UTCO study did not include a control group that would allow researchers to draw conclusions on intervention effectiveness compared to no intervention. Consequently, these results may not be possible to achieve in all settings.

Effects on Other Quality Measures

Many diabetes-related health outcomes, including HbA1c listed in Table 1.3, are key outcome measures used in public reporting and in value-based payment arrangements. For example, the National Quality Forum and the Medicare Shared Savings Program Accountable Care Organization benchmarks include measuring patients with poor glycemic control, in addition to patients with glycemic control.

Because the concept behind the proposed CHW intervention has been demonstrated to improve health outcomes, a provider that receives higher payments for meeting targets related to these measures would achieve a higher return on investment.

Table 1.4 lists these and additional nationally recognized quality measures that the authors predict could be affected by improved diabetes control among participants in the proposed CHW intervention. Several of these quality measures also are recommended by the Connecticut State Innovation Model Quality Council for use by commercial payers and Medicaid in value-based payment arrangements, as indicated in Table 1.4.[17]

Table 1.4: Other Quality Measures Potentially Affected by Proposed Intervention

NQF #	Quality Measure Title	Quality Measure Set
0421	ACO #16. Preventative Care and Screening: BMI Screening and Follow Up*	**ACO 33**
0057	HbA1c Screening*	
0055	ACO #41. Diabetes Eye Exam*	**ACO 33**
0062	Medical Attention for Kidney Disease*	
	ACO #36. All Unplanned Admissions for Patients With Diabetes*	**ACO 33**
0731	Comprehensive Diabetes Care	
N/A	Diabetes Composite: ACO #22. Hemoglobin A1c Control (HbA1c) (< 8%) ACO #25. Tobacco Non Use ACO #26. Aspirin Use	**ACO 33**
59	ACO #27. Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) Poor Control (> 9%)*	**ACO 33, UDS, QC**
575	Comprehensive Diabetes Care: Hemoglobin A1c (HbA1c) Control (< 8%)	**UDS, QC**
N/A	Diabetes HbA1c < 7%	**UDS**
61	Comprehensive Diabetes Care: Blood Pressure Control (< 140/90 mmHg)	**QC**
638	Uncontrolled Diabetes Admission Rate (PQI #14)	**AHRQ Quality Indicators, PQI**
285	Lower-Extremity Amputation Rate of Patients with Diabetes (PQI #16)	**AHRQ Quality Indicators, PQI**
272	Diabetes Short-Term Complications Admission Rate (PQI #01)	**AHRQ Quality Indicators, PQI**
274	Diabetes Long-Term Complications Admission Rate (PQI #03)	**AHRQ Quality Indicators, PQI**

Measures are listed in order of relevance by their National Quality Forum identifier, their title, and the measure set they are derived from.

*Connecticut SIM Quality Council recommended measures for value-based payment arrangements.

Abbreviations: ACO = Accountable Care Organization (Medicare Shared Savings Program); AHRQ = Agency for Healthcare Research and Quality; BMI = body mass index; HbA1c = hemoglobin A1c; mmHg = millimeters of mercury; NQF = National Quality Forum; PQI = Prevention Quality Indicator; QC = Quality Compass; and UDS = Uniform Data System.

Change in Medical Costs

In the first 18 months of implementation, the intervention is expected to save $206,000 in direct medical costs, or $1,300 per patient.

To estimate changes in direct medical costs among the participants who complete the intervention, the authors calculate cost savings based on the number of participants expected to achieve good or moderate glycemic control (see the Technical Appendix for details), and the three-year per-capita costs

for participants at each control level reported in an analysis of medical claims conducted in Minnesota.[33] Table 1.5 presents projected overall costs and savings, for all 158 participants and per person. For the first 18-month cohort, the intervention is estimated to save $206,000, or $1,300 per person relative to costs with no intervention.

Total health care costs per person at each HbA1c control level are estimated based on a Minnesota study of health care costs related to diabetes.[33] For these estimates, the Minnesota data is adjusted to Connecticut cost levels and trended for inflation. The authors compare the results of the intervention to "no change" (from baseline) because the UTCO study[1] did not include a control group.

Table 1.5: Projected Medical Costs and Savings in Cohort 1 (over 18 months)

Direct Medical Costs	Baseline (2017)	At 18 months (2019)	Difference vs. Baseline	Savings (with vs. without intervention)
Number of participants	158	158		
TOTAL MEDICAL COSTS				
With intervention	**$3,863,000**	**$4,012,000**	**$149,000**	**$206,000**
Per participant	$24,500	$25,400	$900	$1,300
Without intervention	**$3,863,000**	**$4,219,000**	**$355,000**	
Per participant	$24,500	$26,700	$2,200	

Cohort costs were rounded to the nearest thousand and per-participant costs to the nearest hundred. All costs were adjusted for inflation. For details on calculations and data sources, see the Technical Appendix. Figures may not total due to rounding.

Social Return

The CHW intervention is projected to result in 1,190 fewer days absent from work in the first 18 months. Each working person who completes the 18-month intervention is projected to gain an average of 14 working days, worth approximately $3,200 in wages, over 18 months.

The social return of the proposed intervention is defined as the estimated value of fewer work absences, as shown in Table 1.6. Based on a Michigan study of working-age adults with diabetes, the authors estimate that 55 percent of the 158 proposed CHW intervention participants would be working full-time.[34] The intervention would reduce work absences by approximately 1,190 days in cohort 1 (18 months), based on the Michigan data.[34] The estimated value of these recovered workdays – $280,000 – is based on the average hourly wages for all occupations in the Hartford area published by the Bureau of Labor Statistics.[35] Working-age adults completing the intervention would be expected to gain an average of 14 workdays each, valued at $3,200 in wages, over 18 months.

These projections are likely to underestimate the true societal value of the CHW intervention, since the authors did not calculate the effects of reducing the number of workdays with lower productivity due to illness, which economists call "presenteeism." Presenteeism has been estimated to cost four times more

than a work absence (work productivity reductions of 30 percent vs. 7 percent).[19] In addition, the projections do not include the value of future lost earnings from premature death, or unemployment from disability.[19]

Table 1.6: Projected Social Return of Recovered Workdays in Cohort 1 (over 18 months)

	Baseline (2017)		At 18 months (2019)		Difference vs. Baseline	
Number of working adults among participant population	87		87			
	Missed Days/ 18 months	**Wage Value/ 18 months**	**Missed Days/ 18 months**	**Wage Value/ 18 months**	**Recovered Days/ 18 months**	**Wage Value/ 18 months**
With intervention	**2,690**	**$615,000**	**1,500**	**$355,000**	**1,190**	**$259,000**
Per participant	*31*	*$7,100*	*17*	*$4,100*	*14*	*$3,000*
Without intervention	2,690	$615,000	2,690	$636,000		-$21,000
Per participant	*31*	*$7,100*	*31*	*$7,300*		*-$200*
TOTAL RECOVERED WORKDAYS AND WAGE VALUE					**1,190**	**$280,000**
Per participant with diabetes					*14*	*$3,200*

Figures do not total due to rounding. Cohort costs were rounded to the nearest thousand and per-participant costs to the nearest hundred. Cohort days were rounded to the nearest ten while per-participant days were not rounded. All costs and recovered wage values were adjusted for inflation.[36] For details on calculations and data sources, see the Technical Appendix.

Financial Return on Investment

The proposed Hartford CHW intervention for Latinos with poor diabetes control is projected to produce a return on investment of $1.12 for every $1 spent across years 1–3. Over three years, the program is projected to cost $388,000 and save $435,000 in direct medical costs.

Table 1.7 summarizes the projected return on investment (ROI) of the proposed CHW diabetes intervention over three years (for two 18-month cohorts). With an estimated three-year intervention cost of $388,000, and estimated savings of $435,000 in direct medical costs, the projected ROI is $1.12 for every $1 spent over the same time period.

While it is assumed CHWs would continue to work with participants past the initial 18-month intervention and could potentially help more patients control their diabetes, no changes in HbA1c levels are assumed for each cohort after the 18-month intervention period. The authors project medical cost savings using a conservative approach that does not include the potential savings incurred by patients in cohort 1 who sustain glycemic control and lower medical costs during the second 18-month period. A few

studies using home-based diabetes CHW interventions (but no group classes) reported effects on glycemic levels that persisted for up to two years.[29,30] Therefore, the potential cost savings are likely to be greater than the estimates in Table 1.7.

Table 1.7: Projected Financial Return on Investment (ROI) for Cohorts 1-2 (over 3 years)

	Cohort 1 (2017-2019)	Cohort 2 (2019-2020)	Cohorts 1-2 (2017-2020)
Number of participants	158	158	316
Estimated direct medical cost savings	$206,000	$228,000	$435,000
Estimated intervention cost	$192,000	$197,000	$388,000
FINANCIAL ROI	**$1.07**	**$1.16**	**$1.12**
Estimated social return from recovered workdays	$280,000	$290,000	$570,000
TOTAL NET SAVINGS (direct medical cost savings – intervention cost)	**$15,000**	**$32,000**	**$46,000**

Costs were rounded to the nearest thousand. Costs in cohort 2 (2019-2020) were adjusted for inflation. Figures do not total due to rounding. For details on calculations and data sources, see the Technical Appendix.

Community Health Worker **Model 2**:

Improving Asthma Control of Children in Greater New Haven

Intervention goal: Improve asthma control

Target Population: Children with uncontrolled asthma

Area: Greater New Haven

CHW Employer: Private group practice using a patient-centered medical home model

Caseload: 96 participants per CHW per year

Timeframe: Four-month intervention for cohort 1 (2018), cohort 2 (2019), and cohort 3 (2020)

Model: Seattle-King County Medicaid Healthy Homes, a 4-month intervention that included home visits, an environmental assessment, and asthma mitigation supplies

Projected intervention cost: $229,000 for 1 CHW over 3 years

Projected outcomes (intervention compared to no intervention):

- 27 more children would have well-controlled asthma in year 1
- Participants would gain 3 more symptom-free days each in every two-week period
- Participants would use rescue medications 2.2 fewer days in every two-week period
- 32 percent fewer hospitalizations
- 9 percent fewer emergency department visits
- More than threefold greater drop in urgent care clinic visits
- Savings in direct medical costs: $427,000 over 3 years
- Financial return on investment: $1.86 for every $1 invested over 3 years
- Social return: For each family, 8 school absences avoided and 12 fewer adult caretaker days disrupted by their child's asthma symptoms, per year

IMPACT OF UNCONTROLLED ASTHMA ON CONNECTICUT CHILDREN

- 12 percent of children (about 1 in 8) in Connecticut currently have an asthma diagnosis[37,20]
- Uncontrolled asthma contributes to approximately 60,000 missed days of school or day care,[38] 900 hospitalizations,[39] and 9,500 emergency department visits among children each year[37]
- Children with asthma incur more than $13 million in hospitalization charges each year[39]
- Two-thirds of children hospitalized for asthma are covered by HUSKY A, the state's Medicaid program[39]

Uncontrolled asthma can lead to emergency department (ED) visits, hospitalization, or even death. In Connecticut, nearly two-thirds of children diagnosed with asthma do not have the condition under control.[40,41] "Poorly controlled"* asthma disproportionately affects children of color and those living in poverty: Latino and black children in Connecticut visit the ED four times more frequently and are hospitalized two to three times more often than white children.[40,42,39] Of children with asthma who live in households earning below $25,000 annually, 38 percent experience very poor asthma control, the most severe level of symptoms.[40]

Even when children in Connecticut are appropriately diagnosed with asthma, many do not receive recommended health care:

- 31 percent did not receive a routine asthma checkup in the past year, according to a 2007-2009 survey[40]
- 44 percent did not receive an Asthma Action Plan, as is recommended by national guidelines[40]
- 50 percent of children insured by Medicaid did not receive follow-up care within two weeks of hospital discharge, and 76 percent did not receive follow-up care within two weeks of an ED visit[40]
- 12 percent of families did not receive information about how to recognize asthma symptoms and what to do during an asthma attack[40]

These unmet needs, as well as state health policy goals, suggest there is a strong opportunity for community health workers (CHW) to help improve asthma outcomes. The authors propose a model intervention using CHWs to work with children with poorly controlled asthma to improve asthma control and reduce their need for emergency health care services, thereby reducing medical costs.

SUMMARY OF PROPOSED INTERVENTION MODEL

Connecticut's largest cities bear the greatest asthma burdens in the state.[40,21] The authors selected New Haven as the location of the proposed intervention because the city ranks first in asthma-related hospitalizations and has a higher rate of ED visits than the rest of the state.[44,45] The authors estimate that 3,600 New Haven-area children – one in eight – currently have an asthma diagnosis;[21] of them, an estimated 12 percent have "very poorly controlled" asthma, while an additional 51 percent have "not well controlled" asthma.[40] In Greater New Haven, the authors estimate that poorly controlled asthma leads to 290 hospital admissions and 690 ED visits annually.

The proposed asthma intervention would target children with poorly controlled asthma who had at least one hospitalization or ED or urgent care clinic visit in the past year, or were identified as high risk by a clinician.[13,46,47,48,49,50] A CHW in a private group practice or patient-centered medical home would invite families of children meeting this criteria to enroll.

Over the four-month intervention period, CHWs would attempt to make four hour-long visits to the enrolled children's homes. During the initial visit, the CHW would assess the level of asthma control, self-management practices, and exposure to asthma triggers, as well as the family's challenges in learning about and controlling the condition. At subsequent home visits, the CHW would present self-

*"Uncontrolled" asthma is a control level classification of the Centers for Disease Control and Prevention (CDC)'s National Asthma Control Program.[43] The CDC's "uncontrolled" designation encompasses two asthma control level classifications of the National Asthma Education and Prevention Program Expert Panel (NAEPP) – "not well controlled" or "very poorly controlled."[41] Indicators NAEPP uses to define "not well controlled" or "very poorly controlled" include: 1) experiencing symptoms more than two days/week; 2) experiencing nighttime awakenings more than once/month for ages 0-4; two or more times/month for ages 5-11; and one to three times/week for ages 12 and older; 3) limiting normal activities; 4) using short-acting beta agonist inhalers for symptom control at least two days/week; 5) having poor lung function; and 6) having exacerbations requiring oral systemic corticosteroids at least two times/year.[41]

management techniques, help the child and caregivers understand clinical treatment recommendations, and provide resources, including asthma education materials. The CHW would also provide supplies to help families mitigate asthma triggers at home, including, depending on the family's needs, a low-emission vacuum cleaner, cleaning and pest abatement supplies, and allergy-reducing bedding covers.

While the authors modeled this intervention for a private group practice in Greater New Haven, the intervention could be implemented in any large city in Connecticut in a variety of clinical and community-based settings.

EVIDENCE BASE FOR PROPOSED INTERVENTION MODEL

The proposed asthma intervention is based on the experiences of the King County Asthma Program in Washington, a national leader in CHW asthma program implementation. After testing multiple interventions since the early 2000s, King County determined CHW asthma control programs were cost effective only for children at high risk of hospitalizations and ED or urgent care clinic visits. Over time, King County – which includes Seattle – streamlined its model to include only essential elements.

The proposed intervention is based specifically on one of King County's most recent CHW programs, called "Medicaid Healthy Homes," first implemented in 2009.[2] It focused exclusively on low-income children ages 3 to 17 who were enrolled in Medicaid and who had "not well controlled" or "very poorly controlled" asthma.[2,51] Children within this population who met clinical criteria were recruited into the intervention using Medicaid health plan lists and direct provider referrals.[2]

The goals of this King County intervention included:

- Helping families to understand clinical treatment recommendations
- Providing asthma self-management education
- Reducing exposure to indoor asthma triggers by providing in-home environmental assessments and supplying resources to improve asthma control

The CHWs made four home visits per participant, with visits scheduled two, six, and 14 weeks after the initial in-home assessment. In addition, they distributed asthma education materials; provided support by telephone, email and additional home visits as required;[2] and equipped families with asthma trigger mitigation supplies.[2]

CHWs in the King County intervention shared ethnic backgrounds with participants, experienced asthma personally or through a family member, and lived in the target communities. They were recruited predominantly through word of mouth or networking with community-based organizations. The CHWs received 40 hours of initial training (including classroom instruction and exercises, role playing, and a field practicum) from a program developed by the American Lung Association of Washington.[52] (The King County Department of Public Health has made CHW training materials, environmental protocols, patient educational materials, provider referral forms and other tools used in the Medicaid Asthma Home Visit program [Medicaid Healthy Homes] available on its website.[53])

To ensure that this model produced a positive return on investment (ROI), King County excluded families whose social needs would likely require more intensive case management. As a result, the program excluded families: 1) with a caretaker who did not speak Spanish or English, or suffered from serious mental illness; 2) without permanent housing; 3) living in homes that appeared unsafe for CHW visitation; and 4) with a child with a serious medical condition (in addition to poorly controlled asthma).[2] Programs seeking to implement the UMass team's proposed asthma intervention model should consider partnering

with a social service organization that could connect families facing more complex needs with non-asthma related social services, which could enable the families to participate in the asthma intervention.

The UMass team's projections are based on having the Greater New Haven asthma intervention implemented by a private group practice that integrates CHWs into its care teams. Integrating CHWs in this way is an approach recommended by health experts that is increasingly being adopted nationally. The Centers for Disease Control and Prevention[54] and the Institute of Medicine[55] recommend integrating CHWs into team-based care, as an evidence-based approach to addressing chronic diseases, including asthma. Across the country, CHWs are increasingly being integrated into primary care settings, including patient-centered medical homes.[14,56,57,58.59]

When details were not available from the King County model, the authors drew on data and assumptions from other CHW asthma programs. In addition, they developed model assumptions based on past or current programs in New England and Connecticut, including:

- A Connecticut Department of Public Health home visiting asthma program, Putting on AIRS (Asthma Indoor Reduction Strategies),[60] that targets people living in seven regions (including New Haven) to reduce acute asthma episodes and improve asthma control through patient education and home environmental assessment.[61,62] The intervention reported savings in excess of $260 per participant based on decreased ED and urgent care clinic visits.[63] This program does not employ CHWs.
- A CHW program for children insured under Medicaid or the Children's Health Insurance Program (CHIP) called Community Asthma Integrated Resources (CAiR), which was delivered through a private practice patient-centered medical home outside New Haven, and a similar intervention at Middlesex Hospital in Middletown. Both were grant-funded from 2012 through 2015, but were discontinued when leaders were unable to secure ongoing funding.[49]

IMPLEMENTATION DETAILS

Caseload Estimates

The authors estimate a caseload of 96 children per year for one CHW employed at a New Haven-based private group practice.

Table 2.1 features the estimated caseload per worker and number of intervention participants. The authors estimate that one full-time CHW in a private group practice would annually contact 307 New Haven-area children who had at least one hospital stay in the past year, visited an ED or urgent care clinic more than once in the past year, or were referred by a clinician. A projected 177 children with uncontrolled asthma would enroll in the program, with 96 completing the four-month intervention. The experience of interventions in New York City and Boston indicates that the other 81 families would likely drop out sometime before the fourth visit.

These projections are calculated using results from:

- King County's model study[2,52,64]
- The Putting on AIRS and CAiR programs in Connecticut[63,49]
- Other CHW interventions implemented elsewhere in New England[46,47,65,66]
- Studies conducted in Chicago,[67] Philadelphia,[50] and New York City[13]
- Interview responses of current Connecticut CHW employers (see Section 5)

The projected annual caseload of 96 children per full-time CHW is comparable to home visit asthma interventions in other U.S. cities, which had annual caseloads that varied between 80 and 102 clients per full-time CHW.[67,46,47] The high attrition rate is calculated using the average dropout rate (46 percent) of CHW asthma programs in New York City[13] and Boston.[46,47]

Table 2.1: Projected Caseload and Number of Participants per Cohort (over 1 year)

Caseload Components (per CHW)	Estimated Hours Required	Assumptions and Data Sources
Work hours available		
Total work hours	1,848	• 13 paid holidays/year • 10 paid vacation days/year • 6 paid sick days/year
Administrative hours	205	• 3 hours/week of meeting time including supervision, case review, staff meetings, etc. • 40 hours/year of trainings, annual meetings, etc.[51,66,65,67] • 0.2 hours/call for 130 individuals refusing enrollment[2]
Total hours available to work with participants	1,643	• Total work hours/year, less administrative time
Caseload assumptions – time required per participant (in hours)		
Home visits	6.9	• Average 3 home visits/participant /year[2,46,47,48,49,51,63,65,50] • 1 hour/average visit (assumed subsequent visits would be shorter than initial visit)[2,64] • 0.8 hours round trip travel time/visit • 0.5 hours data entry and follow-up call time (including referrals)/visit
Phone calls	2.4	• Total time/call totals 0.3 hours (including case note entry time) • Average number of calls/participant /year: 4[68,63,48]
Total time required	9.3	• 6.9 home visit hours/participant plus 2.4 phone call hours/participant
Caseload	96	• Total hours available to work with participants, divided by home visit and phone call hours/participant (rounded)

Table continued on page 28

Table continued from page 27

Caseload Components (per CHW)	Estimated Hours Required	Assumptions and Data Sources
Number of CHWs and participants		
Number of full-time equivalent CHWs required to implement intervention	1	
Number of individuals (children and their caregiver) contacted in cohort 1	297	Based on caseload/CHW/year
Number of participants enrolled in cohort 1	178	60% enrollment rate based on King County[2] and Boston[46] interventions
Number of participants engaged at cohort 1 end	96	46% dropout rate (54% complete the intervention) based on Boston[46] and New York[57] interventions

Abbreviations and definitions: CHW = community health worker; dropout rate = percent of participants that enroll, but do not complete intervention; enrollment rate = percent of individuals contacted for potential participation that enroll in intervention. For details on calculations and data sources, see the Technical Appendix.

Cost Estimates

The estimated annual cost of the CHW intervention is between $75,000 and $79,000 per year, totaling $229,000 over three years.

Table 2.2 presents cost estimates based on interview data from Connecticut CHW employers (see Section 5) and an assumption that the same CHW will be continuously employed throughout years 1 to 3. The first-year budget includes higher initial training costs, while years 2 and 3 include lower ongoing training costs. The authors estimate the proposed asthma intervention costs at $75,000 to $79,000 per year, for a total of $229,000 over three years (assuming one-third of participants require all asthma mitigation supplies – vacuum cleaners, bedding covers, cleaning and insect abatement supplies – while other enrollees need fewer items).

SEVERAL EMPLOYERS OF COMMUNITY HEALTH WORKERS INDICATED A PER-PERSON, PER-MONTH PAYMENT WOULD BE THE BEST WAY TO SUSTAIN COMMUNITY HEALTH WORKER SERVICES IN A VALUE-BASED INSURANCE PAYMENT LANDSCAPE

Table 2.2: Projected Cost Estimates for Cohort 1 (over 1 year) and Cohorts 1-3 (over 3 years)

Budget Item	Estimate	Assumptions
Number of participants	96	Per cohort
Number of full-time equivalent CHWs required	1	
Costs per CHW		
Salary	$39,500	$19/hour (median FTE wage according to Connecticut CHW employers)
Fringe	$12,600	32%
Travel costs	$2,100	Annual travel cost calculations (according to a New Haven-based private clinic CHW employer)
Supplies		
Asthma mitigation supplies	$11,200	$350/full kit (assumed approximately 33% of participants would require all supplies and 66% would need fewer items/year)
Office supplies	$100	Average annual spending (according to three Connecticut CHW employers)
Computer	$300	One-time cost of cloud-based laptop
Cell phone	$600	$50/month
Training	$1,200	$1,000 for core training; $200 for ongoing training (average spending according to three Connecticut CHW employers)
TOTAL CHW COST	**$67,700**	
Supervision costs	$7,200	0.1 FTE/CHW average annual supervisor salary (according to five Connecticut CHW employers) + 32% fringe
TOTAL INTERVENTION COST, COHORT 1 (over 1 year)	**$75,000**	
Cost per participant	*$800*	
TOTAL INTERVENTION COST, COHORTS 1-3 (over 3 years)	**$229,000**	**Cohorts 2 and 3 costs = Cohort 1 costs, less laptop and core training costs, plus 3.3% inflation adjustment based on the Congressional Budget Office annual average Employment Cost Index forecast for 2018-2020**[16]

Abbreviations: CHW = community health worker; FTE = full-time equivalent. Total costs were rounded to the nearest thousand and other costs to the nearest hundred. All costs were adjusted for inflation. For details on cost estimates see Section 5, Interviews with Connecticut Community Health Worker Employers.

Health Outcome Improvements

Children in the CHW intervention would gain three more symptom-free days each every two weeks, compared to no intervention. Of the 96 participating children, 27 more would achieve well-controlled asthma than if there were no intervention.

The authors project changes in asthma symptom control, quality measures, and health care utilization for the participants who complete the proposed CHW asthma intervention, relative to children who do not participate. This approach is distinct from comparing participant outcomes to baseline data alone, because some children will experience improvements in asthma control without intervention. Therefore, Table 2.3 shows asthma improvement for children who complete the intervention beyond those improvements experienced by children with no intervention. Because those that begin but don't complete the intervention will likely also experience some health benefit, they were not included in projections.

The authors use baseline data from the Medicaid Healthy Homes intervention[2] to develop these estimates because comparable Connecticut data is not available. These estimates are largely consistent with published data for Greater New Haven children with poorly controlled asthma covered by Medicaid,[40] and for a Connecticut population enrolled in the Putting on AIRS home visit program.[63] (See the Technical Appendix for more information.)

The anticipated benefits on health outcomes shown in Table 2.3 are based on King County's study, which only measured improvements over one year. Other studies have found that the positive effects of home-based CHW interventions on symptom control and urgent health care use were sustained for two to three years.[46,47,69]

The authors project that, compared to children who do not receive the full intervention, the 96 children receiving the intervention would have 13 fewer asthma-related hospitalizations and seven fewer emergency department visits. In addition, the children who receive the CHW intervention would have better-controlled asthma, including three more symptom-free days per person (per two weeks), reduced use of rescue medications, and 27 more children would have "well controlled" asthma.

"I DON'T HAVE TO WORRY AT NIGHT THAT THE PATIENT COULDN'T PAY FOR THEIR MEDICATION, BECAUSE OUR CHW WOULD HAVE SAID 'HEY, YOU KNOW, WE HAVE TO FIND ANOTHER MEDICINE, BECAUSE THEY CAN'T PAY FOR THIS.' I DON'T HAVE TO WAIT THREE WEEKS UNTIL I'LL SEE THEM AGAIN, I'LL KNOW THE NEXT DAY, BECAUSE THE CHW WILL CALL THEM A FEW DAYS LATER AND ASK THE PATIENT WHETHER THEY TOOK THEIR MEDICATION."

—Official at a behavioral health clinic that employs community health workers

Table 2.3: Projected Health Care Utilization and Quality Measure Improvements in Cohort 1 (over 1 year)

	Baseline (2017)	Year 1 (2018)	Difference vs. Baseline	
	Number	Number	Number	Percent
Number of participants	96	96		
Health care utilization (number of asthma events per child/year)				
Hospitalizations				
With intervention	**59**	**5**	**-54**	**-92%**
Without intervention	59	18	-41	-69%
Difference with intervention vs. without intervention			*13 fewer admissions*	
Relative change with intervention vs. without intervention				*32% fewer admissions*
ED visits				
With intervention	**170**	**81**	**-89**	**-52%**
Without intervention	170	88	-82	-48%
Difference with intervention vs. without intervention			*7 fewer visits*	
Relative change with intervention vs. without intervention				*9% fewer visits*
Urgent care clinic visits				
With intervention	**262**	**78**	**-184**	**-70%**
Without intervention	262	205	-57	-22%
Difference with intervention vs. without intervention			*127 fewer visits*	
Relative change with intervention vs. without intervention				*222% fewer visits*
Quality measures				
Rescue medication use days (days/2 weeks), per child				
With intervention	**5.3**	**2.0**	**-3.3**	**-62%**
Without intervention	5.3	4.1	-1.2	-23%
Difference with intervention vs. without intervention			*2.2 fewer days**	
Relative change with intervention vs. without intervention				*185% fewer days*

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	Baseline (2017)	Year 1 (2018)	Difference vs. Baseline	
	Number	Number	Number	Percent
Symptom-free days (days/2 weeks), per child				
With intervention	**6.6**	**11.7**	**5.1**	**77%**
Without intervention	6.6	8.7	2.1	32%
Difference with intervention vs. without intervention			*3.0 more days*	
Relative change with intervention vs. without intervention				*145% more days*
Children with well-controlled asthma				
With intervention	**0**	**43**	**43**	
Without intervention	0	16	16	
Difference with intervention vs. without intervention			*27 more children*	
Relative change with intervention vs. without intervention				*176% more children*

Abbreviation: ED = emergency department. For details on calculations and data sources, see the Technical Appendix. *Figures do not total due to rounding.

Effects on Other Quality Measures

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 the concept behind the proposed CHW intervention has been demonstrated to improve health outcomes, a provider organization that receives higher payments for meeting targets related to these measures would achieve a higher return on investment. The Connecticut State Innovation Model (SIM) Quality Council has recommended adding asthma-related emergency department visits and hospitalizations as quality measures for use in value-based payment arrangements by commercial and public payers, in addition to process-oriented measures already adopted by most payers, such as medication management among people with asthma.[15,17] Table 2.4 lists additional nationally recognized quality measures that the authors predict would improve in children with poorly controlled asthma under this model that are also recommended by the SIM Quality Council.

IN INTERVIEWS, LEADERS OF SEVEN ORGANIZATIONS THAT EMPLOY COMMUNITY HEALTH WORKERS ALL SAID THEY WORRIED ABOUT SECURING CONSISTENT FINANCING FOR COMMUNITY HEALTH WORKERS BECAUSE MOST INTERVENTIONS RECEIVED TIME-LIMITED GRANT FUNDING THROUGH PRIVATE FOUNDATIONS OR STATE AND FEDERAL GOVERNMENT PROGRAMS

Table 2.4: Other Quality Measures Potentially Affected by Proposed Intervention

NQF #	Quality Measure Title	Quality Measure Set
1799	Medication Management for People With Asthma*	
283	Asthma in Younger Adults Admission Rate*	
	Annual Percent Asthma Patients (Ages 2-20) With One or More Asthma-Related ED Visits*	
728	Asthma Admission Rate (for Children)*	
N/A	Ambulatory Care, ED Visits	**CHIP, NCQA**
47	Drug Therapy for Persistent Asthma	**UDS**
1560	Relative Resource Use	**NCQA**
36	Appropriate Medication Use	**NCQA**

*Connecticut SIM Quality Council recommended measures for value-based payment arrangements.

Abbreviations: CHIP = Children's Health Insurance Program; this represents the core set of children's health care quality measures for Medicaid and CHIP (child core set); ED = emergency department; NCQA = National Committee for Quality Assurance; NQF = National Quality Forum; and UDS = Uniform Data System.

Change in Medical Costs

The CHW intervention is projected to save $138,000 in year 1 from reduced hospitalizations, emergency department visits, and urgent care clinic visits, representing an average savings of $1,400 per patient.

The authors project the change in direct medical costs from the proposed CHW intervention by calculating the savings associated with fewer emergency department visits, hospital inpatient stays, and urgent care clinic visits, based on results from King County.[2] As baseline data, the authors use event rates calculated based on results from King County, as these rates were comparable with those calculated for the target population of children with poorly controlled asthma in Greater New Haven.

Costs per person are estimated by multiplying event rates – calculated from King County results – by cost. For hospitalization and ED visit costs, the authors use statewide average charges published by the Connecticut Department of Public Health,[40] trended for inflation to 2017 and adjusted to costs using the statewide cost-to-charge ratio in 2012 (0.36).[39] For urgent care visit costs, the authors use the average Medicare payment for outpatient clinic visits published by the Centers for Medicare & Medicaid Services, trended to 2017. These calculations produced cost estimates of $8,450/hospitalization, $572/emergency department visit, and $197/clinic visit. For further information on calculations, see the Technical Appendix.

As shown in Table 2.5 below, the authors project a total savings of $138,000 in the first year of the intervention, or $1,400 per patient. Savings are driven primarily by a 32 percent greater reduction in costly hospitalizations compared to no intervention. The authors also predict a three-fold greater reduction in urgent care clinic visits and a 9 percent greater reduction in emergency department visits, compared to no intervention. These results are comparable to those from a study in Boston; it reported a $1,475 cost savings per person in the first 12 months (2006 dollars), relative to a comparison group.[47]

Table 2.5: Projected Medical Costs and Savings in Cohort 1 (over 1 year)

Direct Medical Costs	Baseline (2017)	Year 1 (2018)	Difference vs. Baseline	Savings (with vs. without intervention)
Number of participants	96	96		
Hospitalizations per child				
With intervention	**$5,200**	**$400**	**-$4,700**	**$1,100**
Without intervention	$5,200	$1,600	-$3,600	
ED visits per child				
With intervention	**$1,010**	**$480**	**-$530**	**$40**
Without intervention	$1,010	$520	-$490	
Urgent care clinic visits per child				
With intervention	**$540**	**$160**	**-$380**	**$260**
Without intervention	$540	$420	-$120	
TOTAL MEDICAL COSTS = hospitalizations + ED visits + urgent care clinic visits				
With intervention	**$644,000**	**$103,000**	**-$540,000**	**$138,000**
Per participant	*$6,700*	*$1,100*	*-$5,600*	*$1,400*
Without intervention	**$644,000**	**$241,000**	**-$403,000**	
Per participant	*$6,700*	*$2,500*	*-$4,200*	

Cohort costs were rounded to the nearest thousand and per-participant costs to the nearest hundred or ten. All costs were adjusted for inflation. For details on calculations and data sources, see the Technical Appendix. Figures may not total due to rounding.

Social Return

The CHW intervention is projected to result in eight fewer school absences per child per year, and 12 fewer days per family per year during which caretakers' plans are disrupted due to their child's asthma symptoms.

The social return of the proposed CHW intervention includes the reduction in the number of missed school days for children, and the reduction in the number of days during which adult caregivers had to change their plans because of their child's asthma symptoms. The authors estimate these reductions based on findings from the Inner-City Asthma Study, which was carried out in seven large U.S. cities.[69] In that study, children who did not receive home visits also experienced reductions in missed school days and disruptions in caretaker plans, but these reductions were significantly greater among the families that received CHW home visits. UMass researchers did not assign a dollar value to recovered days, because the value of recovered school days is difficult to quantify and because of a lack of data on whether changed plans for caretakers resulted in days absent from work. As baseline data, the authors used the number of days reported in King County,[2] as comparable Connecticut data was not available.

As shown in Table 2.6 below, the authors estimate that children in Greater New Haven receiving the proposed intervention would each miss eight fewer school days in the first year, compared to those receiving no intervention. In addition, the authors estimate that in each family, adult caretakers would have 12 fewer days during which they would have to change their plans because of a child's asthma symptoms. (For further details on calculations and data sources, see the Technical Appendix.)

Several other home-based CHW interventions delivered to inner-city children with asthma have reported fewer missed school days compared to before the intervention, consistent with this estimate.[13,46,47,71] Some studies also reported reductions in caretaker work absences compared to baseline.[46,47,71] However, most of these studies did not compare these reductions to a control group (or report whether these comparisons were statistically significant), as the Inner City Asthma Study did,[69] and therefore, could not assess the true effects of the CHW intervention.

Table 2.6: Projected Social Return of Recovered School and Caregiver Days in Cohort 1 (over 1 year)

	Baseline (2017)	Year 1 (2018)	Difference vs. Baseline
			Days per year
Number of participants	96	96	
Missed school days			
With intervention	**2,300**	**1,360**	**-940**
Per child	*24*	*14*	*-10*
Without intervention	**2,300**	**2,100**	**-210**
Per child	*24*	*22*	*-2*
TOTAL RECOVERED SCHOOL DAYS			**740**
Per child			*8*
Adult caregiver days disrupted by child's asthma symptoms			
With intervention	**3,740**	**2,130**	**-1,620**
Per caregiver	*39*	*22*	*-17*
Without intervention	**3,740**	**3,260**	**-480**
Per caregiver	*39*	*34*	*-5*
TOTAL RECOVERED CAREGIVER DAYS			**1,130**
Per caregiver			*12*

Figures do not total due to rounding. Cohort days were rounded to the nearest ten while per-participant days were not rounded. For details on calculations and data sources, see the Technical Appendix.

Financial Return on Investment

The proposed CHW intervention is projected to produce a return of $1.86 for every $1 invested over three years. It is projected to cost $229,000 and produce $427,000 in medical cost savings over three years.

With an estimated annual cost of $75,000 to $79,000 per year, the proposed intervention is projected to produce a financial return on investment of $1.86 for every $1 invested over three years, as illustrated in Table 2.7. This result is comparable to the ROI of $1.90 for every $1 invested reported by King County.[2] The intervention would produce a projected $197,000 in net savings over three years.

Table 2.7: Projected Financial Return on Investment (ROI) for Cohorts 1-3 (over 3 years)

	Cohort 1 (2017)	Cohort 2 (2018)	Cohort 3 (2019)	Cohorts 1-3 (2017-2019)
Number of participants	96	96	96	288
Estimated direct medical cost savings	$138,000	$144,000	$145,000	$427,000
Estimated intervention cost	$75,000	$76,000	$79,000	$229,000
FINANCIAL ROI	**$1.84**	**$1.89**	**$1.84**	**$1.86**
TOTAL NET SAVINGS (direct medical cost savings - intervention cost)	**$63,000**	**$68,000**	**$66,000**	**$197,000**

Costs were rounded to the nearest thousand. Costs in Cohorts 2 and 3 were adjusted for inflation. Figures do not total due to rounding. For details on calculations and data sources, see the Technical Appendix.

Community Health Worker **Model 3**:

Connecting Individuals with Complex Health Needs to Appropriate Health Care Services in New London County

Intervention goal: Connect patients with complex health needs to primary health care and reduce emergency department use for non-urgent conditions

Target population: Adults with chronic conditions and behavioral health needs with high health care spending and multiple emergency department visits

Area: New London County

CHW employer: Hospital system in partnership with affiliated practitioners and clinics

Caseload: 36 participants per CHW per year; 72 participants per cohort

Timeframe: Cohort 1 in 2017, cohort 2 in 2018, cohort 3 in 2019; duration of up to 6 months per participant

Model: Molina Healthcare/Community Access to Resources & Education in New Mexico, a 1- to 6-month intervention to connect patients to primary care providers and reduce emergency department visits

Projected intervention cost: $394,000 for 2 CHWs over 3 years

Projected outcomes:

- 81 percent reduction in hospitalizations
- 69 percent decrease in emergency department visits
- 63 percent drop in prescribed medications
- Savings in direct medical costs: $944,000 over 3 years
- Financial return on investment: $2.40 for every $1 invested over 3 years
- Social return: Not modeled

IMPACT OF COMPLEX CARE NEEDS IN CONNECTICUT

- 13 percent of Connecticut's Medicaid enrollees account for 46 percent of the program's health care spending[72]
- Connecticut's rate of emergency department use – 476 visits per 1,000 in 2012 – is above the national average[73,74]
- State officials estimate nearly half of emergency department visits could be avoided with timely treatment in a primary care setting[75]
- Nearly one in five emergency department visits include a behavioral health diagnosis[76]
- Unmet behavioral health needs contributed to approximately 6,000 emergency department visits for children and 41,000 for adults in 2011[77]
- 32 percent of adults ages 18 to 34 have no primary care provider[20]

A small population of patients accounts for a significant portion of health care spending, and despite the high costs, the services they receive often do not meet their needs. Nationwide, 10 percent of the population incurs 66 percent of total health care expenditures.[78] A similar dynamic exists in Connecticut's Medicaid program, in which 13 percent of enrollees account for 46 percent of health care spending.[72] Many of these high-cost patients have complex health issues, including disabilities, chronic physical conditions, and behavioral health needs.[79] Barriers to accessing specialty care and socioeconomic challenges can lead to difficulty managing their health conditions, and these patients tend to disproportionately use the emergency department (ED) for care.[80,81,3]

The Connecticut Office of Health Care Access has estimated that nearly half of ED visits could be avoided through timely treatment in a less costly primary care setting, such as a doctor's office, community health center, or urgent care clinic.[75] But many patients do not have a primary care provider, including 24.6 percent of people earning less than $35,000 per year and 32 percent of adults aged 18-34.[20]

Even when patients have access to primary care, some frequently use the emergency department. In 2013, among Connecticut Medicaid enrollees who used the emergency department at least four times per year, between 67 percent and 86 percent reported having a primary care provider.[80,82] These individuals reported several reasons for frequent ED visits:

- Negative experiences with the health system, including lack of trust in providers and difficulty obtaining outpatient specialty appointments
- Challenges related to socioeconomic status
- A high burden of physical and mental illnesses[80,81]

Twenty-two percent of Connecticut residents who use the ED for non-urgent conditions present with both severe mental illness and a substance use disorder.[77]

New London County has the highest rate of avoidable emergency department visits in Connecticut, and nearly half of all ED visits are for non-urgent conditions.[75,76] Several towns in New London County report prescription pain medication death rates that are among the highest in the state.[21] Based on these statistics, the authors selected New London County as the location of the proposed community health worker intervention, although the model could be implemented in any community.

SUMMARY OF PROPOSED INTERVENTION MODEL

The proposed intervention targets a high-cost patient population, with a special focus on those who misuse prescription drugs and have unmet behavioral health needs, as these are key drivers of emergency department visits not only in New London County, but throughout Connecticut.

Under the model intervention scenario, community health workers (CHW) – trusted public health workers from a target population's community – employed by a hospital-affiliated provider would supply a variety of services, such as:

- Connecting patients to a primary care provider and facilitating better communication with the clinical care team
- Helping patients navigate the health care system by scheduling appointments and health screenings
- Helping patients access community resources

These services would not duplicate the ongoing case management or care coordination efforts of clinical staff. They are intended to complement existing non-CHW programs in Connecticut that aim to reduce ED use by high utilizers, including the Beacon ED Frequent Visitor Program,[83] the Middlesex Hospital Community Care Team program, and intensive case management programs run by the administrative services organizations that serve Medicaid clients.[77,84]

EVIDENCE BASE FOR PROPOSED INTERVENTION MODEL

The authors based this intervention on Molina Healthcare's community health worker model,[3] and used it to estimate potential improvements in patient outcomes and cost savings in New London County.

Molina Healthcare, a commercial insurer operating Medicaid managed care plans in 10 states, partnered with the nonprofit Community Access to Resources & Education in New Mexico (CARE NM) in 2005 to use community health workers to reach Medicaid clients who were high health care users.[3] The intervention relied on a multi-disciplinary team approach that included representatives from a federally qualified health center, the University of New Mexico Department of Family and Community Medicine, Molina Healthcare, and CARE NM. The primary goals were to decrease ED visits for non-urgent conditions and improve health literacy, health care access, and management of chronic conditions.

The model has been so successful that Molina Healthcare has expanded it to 13 of the New Mexico's 33 counties and to the nine other states where the company operates.[3,8] In addition, two other Medicaid managed care organizations in New Mexico have implemented the intervention.[8]

Predictive modeling analysis identified the target population: patients who had high utilization of EDs and specialists, low primary care utilization, and poorly controlled chronic conditions. Claims analysis identified key services missed by the target population, such as appointments and cholesterol testing or blood glucose monitoring. It also found that many patients in the target group had obtained narcotics for pain management from several providers simultaneously.

Community health workers were deployed to:

- Connect intervention participants with primary care and behavioral health providers
- Ensure missed appointments and tests were rescheduled and completed
- Conduct home visits to educate participants about alternatives to the ED
- Coordinate pain management oversight
- Help patients identify and overcome barriers to improving their health, including accessing public and community resources such as housing, employment services, and public benefits

Additional evidence for this approach comes from another study that evaluated a CHW program established in Denver in a public safety net setting. The Denver Community Voices Men's Health Initiative employed 12 CHWs to conduct culturally tailored outreach to underserved city residents. CHWs provided community-based screenings, health education, assistance with enrollment in publicly funded health care, specialty referrals, system navigation, and care management. As a result, utilization of primary and specialty care increased, and utilization of urgent care, inpatient hospital services, and outpatient behavioral health care decreased. The study attributes the increase in primary and specialty visits and decrease in overall costs to CHWs providing case management and helping clients select a primary care provider within a patient-centered medical home and navigate the health system.[85]

Caseload Estimates

Two full-time CHWs would aim to enroll 124 individuals with high health care costs and frequent ED use, each year. Out of the 124, 72 would be expected to participate in the intervention for up to six months.

The authors estimate that two CHWs working full-time would have time to contact 270 individuals, and that 124 would enroll in the intervention. Of the 124 enrolled, an estimated 58 percent, or 72 individuals per year, would be expected to persist for the full intervention. The low estimated caseload of 36 individuals per CHW per year is based on the Molina Healthcare model,[3] and reflects the intensity of the intervention and the high health and socioeconomic burden faced by the target population. A similar intervention in New Haven noted that CHWs needed to contact clients 11 times each before the first primary care provider visit, and that CHWs spent an average of 1.75 hours for each primary care visit.[80] Similarly, a study of the Denver intervention reported that nearly half of available working hours were devoted to conversations with clients to check on basic needs and insurance.[86]

Table 3.1: Projected Caseload and Number of Participants per Cohort (over 1 year)

Caseload Components (per CHW)	Estimate	Assumptions and Data Sources
Caseload assumptions		
Assumed number of clinic patients	6,000	
5% of high-use patients (number of patients)	300	Proposed intervention would target the 5% of patients that incurred the highest health care costs, experienced multiple chronic conditions, and reported multiple ED visits per year[79]
Number of full-time equivalent CHWs required to implement intervention	2	
Number of individuals contacted in cohort 1	270	Based on caseload for 2 full-time equivalent CHWs/year
Number of participants enrolled in cohort 1	124	46% enrollment rate estimate based on New Haven-based patient navigation program[80]
Number of participants engaged at cohort 1 end	72	42% dropout rate (58% complete the intervention) based on New Mexico[3] and New Haven[80] interventions
Caseload	**36**	**Estimates based on New Mexico program[3]**

Abbreviations and definitions: CHW = community health worker; dropout rate = percent of participants that enroll, but do not complete intervention; enrollment rate = percent of individuals contacted for potential participation who enroll in intervention. For details on calculations and data sources, see the Technical Appendix.

Cost Estimates

The CHW intervention is expected to cost $128,000 to $135,000 per year for two full-time CHWs, a total cost of $394,000 over three years.

As shown in Table 3.2, the proposed CHW intervention is estimated to cost between $128,000 and $135,000 per year for two full-time CHWs, each working at sites across New London County. The authors estimate that total costs over three years would be $394,000, with an annual cost of $1,800 to $1,900 per participant.

The calculations assume that the same CHWs would remain employed over three years. As a result, the projections include costs for initial training in year 1 and ongoing training costs in all three years.

Table 3.2: Projected Cost Estimates for Cohort 1 (over 1 year) and Cohorts 1-3 (over 3 years)

Budget Item	Estimate	Assumptions
Number of participants	72	Per cohort
Number of full-time equivalent CHWs required	2	
Costs per CHW		
Salary	$39,500	$19/hour (median FTE wage according to Connecticut CHW employers)
Fringe	$12,600	32%
Travel costs	$2,400	375 miles/month (average reported by three Connecticut employers) at $0.535/mile (federal rate)
Supplies		
Office supplies	$100	Average annual spending (according to three Connecticut CHW employers)
Computer	$300	One-time cost of cloud-based laptop
Cell phone	$600	$50/month
Training	$1,200	$1,000 for initial training at the Harold Freedman Patient Navigator Training Institute;[87] $200 for ongoing training (average spending according to three Connecticut CHW employers)
Total cost per CHW	$56,800	

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Budget Item	Estimate	Assumptions
TOTAL CHW COST	**$113,700**	
Supervision costs	$14,300	0.1 FTE/CHW average annual supervisor salary (according to five Connecticut CHW employers) + 32% fringe
TOTAL INTERVENTION COST, COHORT 1 (over 1 year)	**$128,000**	
Cost per participant	$1,800	
TOTAL INTERVENTION COST, COHORTS 1–3 (over 3 years)	**$394,000**	**Cohorts 2 and 3 costs = Cohort 1 costs, less laptop and initial training costs, plus 3.3% inflation adjustment based on the Congressional Budget Office annual average Employment Cost Index forecast for 2018-2020**[16]

Abbreviations: CHW = community health worker; FTE = full-time equivalent. Total costs were rounded to the nearest thousand and other costs to the nearest hundred. All costs were adjusted for inflation. For details on cost estimates see Section 5, Interviews with Connecticut Community Health Worker Employers.

PROJECTED OUTCOMES

Health Outcome Improvements

In the first year, this CHW intervention is expected to result in decreased hospitalizations and emergency department use, as well as decreased use of narcotic and non-narcotic medications.

The authors project that this CHW intervention would produce improvements in a number of quality measures in the target population. As summarized in Table 3.3, the authors estimate that the intervention would result in 81 percent fewer inpatient hospitalizations and 69 percent fewer ED visits relative to before the intervention, over one year. These results are estimated based on results in the Molina Healthcare study, which measured health care utilization over three six-month periods: before, during, and after the intervention.[3] Health care utilization decreased over time, with greater reductions seen at one year (six months after intervention) than during the intervention.* These decreases were greater for those receiving the CHW intervention than for those who did not receive the intervention (except for ED visits; data was not shown).

* The number of non-narcotic prescriptions per person increased slightly during the intervention relative to before the intervention (baseline).[3] This is not surprising when individuals with a burden of chronic diseases engage with the health system (primary care). However, non-narcotic prescription use decreased more at year 1 for those in the CHW intervention (-63%) than those who did not receive the intervention (-36%), relative to baseline.[3]

Table 3.3: Projected Health Care Utilization and Medication Use Improvements in Cohort 1

	Baseline (6 months before intervention)	During Intervention (6 months)			Cohort 1 End (6 months after intervention)		
			Difference vs. Baseline			Difference vs. Baseline	
	Number	Number	Number	Percent	Number	Number	Percent
Number of participants	72	72			72		
Hospitalizations	27	16	-11	-41%	5	-22	-81%
ED visits	427	279	-148	-35%	131	-296	-69%
Narcotic prescriptions	476	442	-34	-7%	168	-308	-65%
Non-narcotic prescriptions	3,586	3,780	194	5%	1,336	-2,250	-63%

Abbreviation: ED = emergency department. For details on calculations and data sources, see the Technical Appendix.

Other interventions delivered by CHWs to Medicaid and/or uninsured patients in Denver, New York City, and Houston have produced similar reductions in inpatient and ED use. These studies have reported increases in primary care visits among both adults and children,[14,86,88,89] in addition to increased use of outpatient behavioral health and other medical specialty care.[85]

Interventions in Connecticut have also produced encouraging results. In New Haven, patients with high ED use (four to 18 visits/year) who received CHW services were more likely to attend a first primary care provider visit (81 percent) than patients who did not receive CHW patient navigation (50 percent).[80] At Middlesex Hospital in Middletown, Medicaid patients who had 12 to 80 ED visits per year were enrolled in an intensive Community Care Team case management program. This program included a "health promotion advocate" who served as a link between the patients, hospital, and community resources, and provided regular check-ins with the patients. More than one-third of enrolled patients had chronic alcoholism, 28 percent had serious mental illness, and 22 percent had a coexisting severe mental illness and substance abuse disorder. Among patients who were enrolled in the program for six months or longer, the rate of inpatient hospitalizations was reduced by 59 percent, and ED visits decreased by 51 percent.[77]

Effects on Other Quality Measures

Many of the measures listed in Table 3.3 are key outcome measures used in public reporting and in value-based payment arrangements. Because the concept behind the proposed CHW intervention has been demonstrated to improve health outcomes, a provider organization that receives higher payments for meeting targets related to these measures would achieve a higher return on investment. In addition, the proposed CHW intervention would be expected to produce improvements in the measures listed in Table 3.4. The authors of the New Mexico intervention recommended using Healthcare Effectiveness Data and Information Set (HEDIS) measures to document the effects of this intervention.[3]

Table 3.4: Other Quality Measures Potentially Affected by Proposed Intervention

NQF #	Quality Measure Title	Quality Measure Set
2605	Follow-Up After Discharge From the ED for Mental Health or Alcohol or Other Drug Dependence*	**HEDIS Measures Used in QC**
N/A	ED Utilization	**HEDIS Measures Used in QC**
N/A	Hospitalization for Potentially Preventable Complications	**HEDIS Measures Used in QC**
N/A	Inpatient Hospital Utilization	**HEDIS Measures Used in QC**
N/A	Hospital Admissions for Ambulatory Sensitive Care Conditions Through the ED (PQI #90)*	**AHRQ Quality Indicators, PQI**
N/A	Adults With a Specific Source of Ongoing Care	**AHRQ Quality Indicators**
N/A	Overall Adult Prevention Quality Indicator Composite (PQI #90)	**AHRQ Quality Indicators**
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 Past 2 Years	**ACO 33**
0421	ACO #16. Preventative Care and Screening: BMI Screening and Follow Up*	**ACO 33**
0018	Controlling High Blood Pressure*	**UDS**
N/A	Cholesterol Management for Patients With Cardiovascular Conditions: LDL-C Screening and LDL-C Control < 100	**QC**
N/A	Adult BMI Assessment	**QC**
0061	Comprehensive Diabetes Care: Blood Pressure Control (< 140/90 mmHg)	**QC**

* Connecticut SIM Quality Council recommended measures for value-based payment arrangements.

Abbreviations: ACE = angiotensin-converting enzyme inhibitor (hypertension medication); ACO = Accountable Care Organization; AHRQ = Agency for Healthcare Research and Quality; ARB = angiotensin receptor blocker (high blood pressure medication); BMI = body mass index; CAD = coronary artery disease; ED = emergency department; HEDIS = Healthcare Effectiveness Data and Information Set; LDL/LDL-C = low density lipoprotein cholesterol; LVSD = left ventricular systolic dysfunction; mmHg = millimeters of mercury; NQF = National Quality Forum; PQI = Prevention Quality Indicator; QC = Quality Compass; and UDS = Uniform Data System.

Change in Medical Costs

In its first year of implementation, the CHW intervention is expected to reduce inpatient costs by $290,000 – a savings of $4,000 per patient.

Table 3.5 presents projected savings from medical costs in the model population of 72 individuals in New London County who complete the intervention each year. The authors estimate cost savings due to a reduction in hospitalizations and narcotic and non-narcotic prescription use, using results from the Molina Healthcare study.[3] The proposed New London County CHW intervention is estimated to save approximately $290,000 in the first year, or $4,000 per patient.

The CHW model is likely to produce additional savings through reduced emergency department utilization and from patients receiving appropriate management of their health conditions in lower-cost primary care settings. Several studies cited savings in these areas, but insufficient data was available to apply the savings figures to this CHW model.

- 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 costs per patient per month.[90]
- 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.[91]

Table 3.5: Projected Medical Costs and Savings in Cohort 1 (over 1 year)

Direct Medical Costs	Baseline (2017)	Year 1 (2018)	Difference vs. Baseline	Savings (with vs. without intervention)
Number of participants	72	72		
Narcotic Prescriptions				
With intervention	**$18,500**	**$8,000**	**-$10,400**	**$9,600**
Without intervention	$3,200	$2,400	-$800	
Non-narcotic prescriptions				
With intervention	**$247,300**	**$90,800**	**-$156,500**	**$154,900**
Without intervention	$44,000	$42,400	-$1,600	
Hospitalizations				
With intervention	**$242,000**	**$43,900**	**-$198,100**	**$125,600**
Without intervention	$121,500	$49,000	-$72,500	
TOTAL MEDICAL COSTS = narcotic prescriptions + non-narcotic prescriptions + hospitalizations				
With intervention	**$507,800**	**$142,700**	**-$365,100**	**$290,100**
Per participant	*$7,100*	*$2,000*	*-$5,100*	*$4,100*
Without intervention	$168,700	$93,800	-$75,000	
Per participant	*$2,300*	*$1,300*	*-$1,000*	

Costs were rounded to the nearest hundred; costs were also adjusted for inflation. Emergency department visits were not included because cost reductions were similar with and without intervention. For details on calculations and data sources, see the Technical Appendix. Figures may not total due to rounding.

The Denver intervention, a program similar to the proposed intervention, has realized cost savings of nearly $96,000 per year from reduced urgent care use among 590 underserved men who received navigation services from CHWs.[85]

In Connecticut, the Community Care Team intervention delivered to patients with high ED use (12 to 80 visits/year) at Middlesex Hospital realized a 72 percent cost reduction relative to before the intervention, for patients who received the intervention for six months or more. These savings amounted to nearly $500,000 over less than one year.[77]

Financial Return on Investment

The New London County CHW intervention is projected to produce a return of $2.40 for every $1 spent over three years. The program is estimated to cost $394,000 and save $944,000 in direct medical costs, a net savings of $550,000 over 3 years, or $2,500 per patient/year.

As shown in Table 3.6 below, the authors project a return on investment (ROI) over three years of $2.40 for every $1 spent. The authors project reduced hospitalizations and prescribed drugs would save $944,000 over three years, while program costs would be approximately $394,000, producing a net savings of $550,000. The calculated ROI is comparable to that of the Denver Community Voices Men's Health Initiative, which reported a $2.28 savings for every dollar invested in the patient navigation program.[85]

Table 3.6: Projected Financial Return on Investment (ROI) for Cohorts 1-3 (over 3 years)

	Cohort 1 (2017)	Cohort 2 (2018)	Cohort 3 (2019)	Cohorts 1-3 (2017-2019)
Number of participants	72	72	72	216
Estimated direct medical cost savings	$290,000	$319,000	$335,000	$944,000
Estimated intervention cost	$128,000	$131,000	$135,000	$394,000
FINANCIAL ROI	**$2.27**	**$2.44**	**$2.48**	**$2.40**
TOTAL NET SAVINGS (direct medical cost savings - intervention cost)	**$162,000**	**$188,000**	**$200,000**	**$550,000**

Costs were rounded to the nearest thousand. Costs in Cohorts 2 and 3 were adjusted for inflation. Figures do not total due to rounding. For details on calculations and data sources, see the Technical Appendix.

Community Health Worker **Model 4**:

Preventing Cardiovascular Disease Complications in Windham County

Intervention goal: Improve cardiovascular disease management and reduce disease risk factors and complications

Target population: Adults in Windham County with cardiovascular risk factors including diabetes, hypertension or high cholesterol

Area: Windham County

CHW employer: Federally qualified health center

Caseload: 148 participants per CHW per year

Timeframe: One-year intervention for cohort 1 (2017), cohort 2 (2018), and cohort 3 (2019)

Model: Community Outreach and Cardiovascular Health in Baltimore, a year-long, nurse-led intervention that included diet modification, stress management, smoking cessation, exercise, and medication management

Projected intervention cost: $194,000 for 1 CHW over 3 years

Projected outcomes:

- 230 percent more adults would have controlled blood pressure compared to no intervention
- 170 percent more adults would have controlled cholesterol levels compared to no intervention
- 130 percent more adults would have controlled blood glucose levels compared to no intervention
- 16 percent reduction in emergency department visits compared to before the intervention
- 12 percent decline in hospitalizations compared to before the intervention
- Savings in direct medical costs: $388,000 over 3 years, or $830 per participant in year 1
- Financial return on investment: $2.00 for every $1 invested over 3 years
- Social return: 123 recovered workdays, in aggregate, for working participants with diabetes, valued at $24,000 per year

IMPACT OF CARDIOVASCULAR DISEASE COMPLICATIONS IN WINDHAM COUNTY

- Windham County has the highest heart disease mortality rate[92] and the highest overall premature death rate* in Connecticut[93]
- Adults in Windham County face a high burden of cardiovascular disease risk factors compared to other parts of the state, including:
  - 10 percent of Windham County adults have diabetes[94]
  - 30 percent are obese[92]
  - 25 percent report having high blood pressure or hypertension[95]
  - 39 percent report high cholesterol levels[95]
  - 18 percent report smoking cigarettes[95]

* Premature mortality (years of potential life lost before age 75) = 6,100 per 100,000 residents in Windham County compared to 4,300 to 5,800 per 100,000 residents in other Connecticut counties.[93] Heart disease death rate = 124.5 per 100,000 residents in Windham County compared to 88.5 to 115.6 per 100,000 residents in other counties.[92]

Cardiovascular disease – which includes heart attacks, angina, coronary artery disease, stroke, and other diseases affecting blood vessels – is the leading cause of death in Connecticut, and rural regions of the state are particularly hard-hit by the condition.[96,97] Its incidence is linked to a variety of medical conditions and health behaviors, including smoking, unhealthy diet, physical inactivity, stress, obesity, uncontrolled diabetes, high blood pressure, and high cholesterol. Many of these risk factors are more common among people with lower education levels and lower incomes, who are more likely to smoke and less likely to be physically active or eat a healthy diet.[21]

Four of the key risk factors for cardiovascular disease – diabetes, obesity, hypertension, and high cholesterol – are particularly common in Connecticut: Among state residents, 42 percent have two or more of these risk factors, and 19 percent have three or more.[98] The situation is particularly dire in Windham County, where 10 percent of residents have diabetes – compared to 7 percent to 9 percent in other Connecticut counties[94] – and 30 percent of adults are obese, a higher rate than the rest of the state.[92]

Although complications from heart disease can be avoided through access to appropriate outpatient care and better disease management,[99] data suggests that many Windham County residents with coronary heart disease did not receive all recommended care to avoid complications of the condition. According to 2015 data from a federally qualified health center (FQHC) in Windham County:[100]

- Nearly 32 percent of FQHC patients reported having high blood pressure (hypertension)
- Almost 16 percent of FQHC patients had diabetes
- More than 33 percent of patients diagnosed with cardiovascular disease did not receive an aspirin therapy regimen to prevent secondary heart attacks or strokes
- More than 23 percent of patients treated for coronary artery disease did not receive cholesterol treatment (lipid therapy)

To address the unmet needs of these rural residents, the authors propose a community health worker intervention to reduce cardiovascular disease risk factors and improve disease management.

SUMMARY OF PROPOSED INTERVENTION MODEL

The proposed intervention is designed to focus on adults with multiple cardiovascular disease risk factors and is modeled for implementation at a federally qualified health center located in a medically underserved area of Windham County.

Under the proposed intervention, a nurse practitioner and community health worker (CHW) would work closely together, preferably as members of an interdisciplinary clinical care team. The nurse practitioner and community health worker would recruit adults who meet two clinical criteria:

- Received a cardiovascular disease diagnosis
- Had one or more of the following risk factors for complications of heart disease within the past six months: 1) elevated levels of "bad" cholesterol (LDL), 2) high blood pressure, or 3) if diabetic, poor glycemic control or high glucose levels**

** This proposed intervention focuses on three clinical indicators that measure changes in cardiovascular risk factors, as developed by the COACH intervention (see "Evidence used in developing proposed intervention model" section).[4] Clinical guidelines define the level of risk using the following:[101] 1) Uncontrolled high blood pressure (high risk): > 140/90 mmHg (> 130/80 if diagnosed with diabetes); controlled hypertension (low risk): ≤ 140/90 mmHg (≤ 130/80 if diagnosed with diabetes); 2) Uncontrolled cholesterol levels (high risk): LDL-C <130 mg/dL (< 100 mg/dL if diagnosed with CVD/diabetes); controlled cholesterol levels (low risk): LDL-C < 130 mg/dL (< 100 mg/dL if diagnosed with CVD/diabetes); and 3) Uncontrolled glycemic levels (high risk among individuals with diabetes): HbA1c ≥ 7 percent; controlled glycemic levels (low risk among individuals with diabetes): HbA1c < 7 percent. Abbreviations: CVD = cardiovascular disease; LDL-C = low-density lipoprotein cholesterol; HbA1c = hemoglobin A1c, a measure of blood glucose.

The nurse practitioner would conduct an initial assessment of each participant and would consult with the patient's clinical team to develop a personalized plan to reduce these risk factors. Each participant's plan would include goals for improved adherence to medication regimens and treatment protocols, as well as lifestyle modification.

The community health worker would work with patients to identify and overcome barriers that could interfere with adherence to care recommendations, and access necessary health and social services. Community health workers would meet with patients when they come into the clinic for other scheduled visits and follow up by telephone and, when needed, with home visits.

EVIDENCE BASE FOR PROPOSED INTERVENTION MODEL

The proposed heart disease intervention is based on Community Outreach and Cardiovascular Health (COACH), a Baltimore-based case management program that teamed community health workers with nurse practitioners.[4] Although COACH was implemented in an urban setting, the authors selected this intervention to model for rural Windham County based on its effectiveness in managing cardiovascular disease risk factors among high-risk patients and thorough evaluation of outcomes relative to a control group. Other interventions in rural settings have also reported improved heart disease risk factor profiles with associated cost savings, but did not include control groups.[90,102]

In the COACH intervention, a community health worker and nurse practitioner worked with patients to improve their cholesterol, blood pressure, and blood glucose (HbA1c), and improve patients' health care experiences. Patient eligibility requirements included: living in a medically underserved area, receiving a cardiovascular disease diagnosis, and having elevated cholesterol levels, high blood pressure, or uncontrolled blood glucose levels six months prior to enrollment. Each patient received a personalized treatment plan focused on therapeutic lifestyle changes, such as healthy eating, home-based physical activity, and smoking cessation.[4]

Serving as a case coordinator, the nurse practitioner conducted initial assessments, created individualized treatment plans, led counseling and medication self-management sessions, and communicated with each patient's physician. Working in parallel, community health workers helped patients overcome obstacles to following their treatment plans, and identify ways to make lifestyle changes and effectively manage their diseases. In addition, CHWs helped patients develop organizational systems and reminders to help them follow complex treatment regimens, connected patients to other health and social services, and aided patients in navigating multiple appointments.

Community health workers' unique ability to reach patients outside the doctor's office and provide culturally appropriate coaching on meeting clinical care recommendations contributed to the COACH model's success in providing positive health outcomes and producing cost savings.

Caseload Estimates

The proposed Windham County intervention would enroll 162 adults with uncontrolled chronic conditions each year. The authors expect approximately 148 would persist with the full intervention each year.

To estimate the number of participants who would enroll and successfully complete the intervention each year, the authors use caseload and patient retention data from the COACH intervention, as well as data from a similar intervention delivered in Minnesota.[103] The authors estimate that over the course of a year, one nurse and CHW team could contact 267 potential participants, of whom 162 would be expected to enroll. Of those 162, 91 percent would remain engaged at year end, resulting in a caseload per CHW of 148 patients per year.

This caseload estimate assumes some patients will continue participating in the intervention for several years, and that newly recruited participants would replace those who leave the program. This caseload is slightly higher than that of two other interventions in rural areas – Community Health Teams in Vermont, which had caseloads of 105 patients per CHW,[104] and Care Guides in Minnesota, which had caseloads of 111[103]– because travel time is expected to be shorter in Windham County.

Table 4.1: Projected Caseload and Number of Participants per Cohort (over 1 year)

Caseload Components (per CHW)	Estimate	Assumptions and Data Sources
Number of CHWs and participants		
Number of full-time equivalent CHWs required to implement intervention	1	
Number of individuals approached for participation in cohort 1	267	
Number of individuals successfully contacted in cohort 1	224	16% cannot be reached (84% successfully contacted) based on percent of unreachable individuals in the Baltimore intervention[4]
Number of individuals agreeing to enroll in cohort 1	162	77% enrollment rate estimate based on Baltimore[4] and Minnesota[103] interventions
Number of participants engaged at cohort 1 end	148	9% dropout rate (91% complete the intervention) based on Baltimore[4] and Minnesota[103] interventions
Caseload	**148**	

Abbreviations and definitions: CHW = community health workers; dropout rate = percent of participants who enroll, but do not complete intervention; enrollment rate = percent of individuals contacted for potential participation who enroll in intervention. For details on calculations and data sources, see the Technical Appendix.

Cost Estimates

The estimated annual cost of the CHW intervention is between $63,000 and $66,000 per year for one full-time CHW, totaling $194,000 over three years.

Table 4.2 shows the estimated cost of the proposed CHW intervention. The budget includes the cost of training and hiring a CHW over three years and assumes that the same CHW would be employed over all three years. It does not include the costs of a nurse practitioner, based on the expectation that nurse practitioner services would be fully billable to payers. The proposed intervention is estimated to cost between $63,000 and $66,000 per year for a full-time CHW working at an FQHC in Windham County. Total costs over three years would be approximately $194,000, with an annual cost of $430 to $450 per patient. The estimated per-person cost is comparable to that reported for a similar CHW intervention delivered in Minnesota ($392/person).[103]

Table 4.2: Projected Cost Estimates for Cohort 1 (over 1 year) and Cohorts 1-3 (over 3 years)

Budget Item	Estimate	Assumptions
Number of participants	148	Per cohort
Number of full-time equivalent CHWs required	1	
Costs per CHW		
Salary	$39,500	$19/hour (median FTE wage according to Connecticut CHW employers)
Fringe	$12,600	32%
Travel costs	$1,900	300 miles/month (according to a Windham County federally qualified health center CHW employer) at $0.535/mile (federal rate)
Supplies		
Office supplies	$100	Average annual spending (according to three Connecticut CHW employers)
Computer	$300	One-time cost of cloud-based laptop
Cell phone	$600	$50/month
Training	$1,200	$1,000 for core training; $200 for ongoing training (average spending according to three Connecticut CHW employers)

Table continued on page 52

Table continued from page 51

Budget Item	Estimate	Assumptions
TOTAL CHW COST	**$56,300**	
Supervision costs	$7,200	0.1 FTE/CHW average annual supervisor salary (according to five Connecticut CHW employers) + 32% fringe
TOTAL INTERVENTION COST, COHORT 1 (over 1 year)	**$63,000**	
Cost per participant	$400	
TOTAL INTERVENTION COST, COHORTS 1–3 (over 3 years)	**$194,000**	**Cohorts 2 and 3 costs = Cohort 1 costs, less laptop and initial training costs, plus 3.3% inflation adjustment based on the Congressional Budget Office annual average Employment Cost Index forecast for 2018-2020**

Abbreviations: CHW = community health worker; FTE = full-time equivalent. Total costs were rounded to the nearest thousand, and other costs to the nearest hundred. All costs were adjusted for inflation. For details on cost estimates see Section 5, Interviews with Connecticut Community Health Worker Employers.

PROJECTED OUTCOMES

Health Outcome Improvements

In the first year, the proposed CHW intervention is projected to result in 16 more adults gaining control of their blood pressure, 15 more gaining control of their cholesterol levels, and five more gaining control of their blood glucose, compared to without the intervention.

The authors project improvements in patient outcomes for each cohort of 148 patients based on the results obtained in the COACH trial. At 12 months, the COACH patients in the intervention group had significantly greater overall improvement in total cholesterol, LDL cholesterol, triglycerides, systolic and diastolic blood pressure, blood glucose, and perceptions of the quality of their chronic illness care.[4] The COACH investigators noted that these changes were clinically meaningful.

Table 4.3 shows the projected effects of the Windham County intervention on systolic blood pressure, LDL cholesterol levels, and HbA1c. The authors estimate that 16 more individuals would gain control of their blood pressure as defined by national treatment guidelines, 15 more individuals would gain control of their cholesterol levels, and five more individuals would gain control of their blood glucose, compared to if they had not received the intervention.

Table 4.3: Projected Health Outcome and Quality Measure Improvements in Cohort 1 (over 1 year)

	Baseline (2017)	Cohort 1 (2018)	Difference vs. Baseline	
	Number	Number	Number	Percent
Number of participants	148	148		
Systolic blood pressure				
Meeting goal (< 140 mmHg)				
With intervention	**75**	**98**	**23**	**31%**
Without intervention	75	82	7	9%
Difference with intervention vs. without intervention			*16 more participants*	
Relative change with intervention vs. without intervention				*229% more participants*
Cholesterol levels (LDL-C)				
Meeting goal (< 130 mg/dL)				
With intervention	**83**	**107**	**24**	**29%**
Without intervention	83	92	9	11%
Difference with intervention vs. without intervention			*15 more participants*	
Relative change with intervention vs. without intervention				*167% more participants*
Blood glucose (HbA1c)				
Meeting goal (< 7%)				
With intervention	**20**	**29**	**9**	**46%**
Without intervention	20	24	4	20%
Difference with intervention vs. without intervention			*5 more participants*	
Relative change with intervention vs. without intervention				*125% more participants*

Abbreviations: HbA1c = hemoglobin A1c, a measure of blood glucose; LDL-C = low density lipoprotein cholesterol; mg/dL = milligrams (mg) of cholesterol per deciliter (dL) of blood; mmHg = millimeters of mercury. The proposed intervention assumes the majority of participants with hypertension would also have concomitant diabetes or cardiovascular disease. For details on calculations and data sources, see the Technical Appendix.

"FIRST, WE TALK ABOUT SOCIAL DETERMINANTS. 'WHY AREN'T YOU TAKING YOUR ASTHMA [MEDICATIONS] REGULARLY?' 'WELL, BECAUSE I WORK UNTIL MIDNIGHT AND I CAN'T PICK UP THE [MEDICATIONS] AFTER WORK' – AND THREE DAYS LATER HE'S IN THE ED BECAUSE WE HAVEN'T DONE THAT."

– Official at a behavioral health clinic that employs community health workers

EFFECTS ON OTHER QUALITY MEASURES

Many of the measures listed in Table 4.3 are key outcome measures used in public reporting and in value-based payment arrangements. Because the concept behind the proposed CHW intervention has been demonstrated to improve health outcomes, a provider that receives higher payments for meeting targets related to these measures would achieve a higher return on investment.

In addition to the improved outcomes already discussed, the authors would expect the proposed CHW intervention to produce improvements in the measures listed in Table 4.4. Improving control of hypertension and diabetes are two of five priority areas under the Connecticut State Innovation Model (SIM),[15] and many of the quality measures listed below are also recommended by the SIM Quality Council for use by commercial payers and Medicaid in value-based payment arrangements.[17]

Table 4.4: Other Quality Measures Potentially Affected by Proposed Intervention

NQF #	Quality Measure Title	Quality Measure Set
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 Past 2 Years	**ACO 33**
0421	ACO #16. Preventive Care and Screening: BMI Screening and Follow Up*	**ACO 33**
0018	Controlling High Blood Pressure*	**UDS**
N/A	Hypertension Admission Rate (PQI #07)	**AHRQ Quality Indicators, PQI**
N/A	Overall Adult Prevention Quality Indicator Composite (PQI #90)	**AHRQ Quality Indicators**
N/A	Cholesterol Management for Patients With Cardiovascular Conditions: LDL-C Screening and LDL-C Control < 100	**QC**
N/A	Adult BMI Assessment	**QC**
0061	Comprehensive Diabetes Care: Blood Pressure Control (< 140/90 mmHg)	**QC**

*Connecticut SIM Quality Council recommended measures for value-based payment arrangements.

Abbreviations: ACE = angiotensin-converting enzyme inhibitor (hypertension medication); ACO = Accountable Care Organization; AHRQ = Agency for Healthcare Research and Quality; ARB = angiotensin receptor blocker (high blood pressure medication); BMI = body mass index; CAD = coronary artery disease; LDL/LDL-C = low density lipoprotein cholesterol; LVSD = left ventricular systolic dysfunction; mmHg = millimeters of mercury; PQI = Prevention Quality Indicator; QC = Quality Compass; and UDS = Uniform Data System.

Change in Medical Costs

In its first year of implementation, the proposed CHW intervention is expected to reduce direct medical costs by $123,000, representing annual savings of $830 per patient.

The authors estimate savings in medical costs based on results reported by the Care Guides CHW pilot study in Minnesota showing reductions in emergency department (ED) use and hospitalizations. The Care Guides study reported improvements in blood pressure and LDL cholesterol control similar to the COACH intervention in Baltimore. (The COACH study did not report health costs nor utilization.)[103]

Table 4.5 presents projected savings in direct medical costs that would accrue if the proposed Windham County intervention achieves the same results as the Care Guides study: a 16 percent reduction in ED visits and a 12 percent reduction in hospitalizations. This reduced utilization translates to projected savings of $123,000 in the first year, or $830 per patient, an 8 percent saving compared to baseline (no intervention). The Care Guides study found that these effects persisted for one year after the CHW intervention ended, although reductions in health care use during the year with CHW involvement were greater than during the following year.[103]

Table 4.5: Projected Medical Cost and Savings in Cohort 1 (over 1 year)

Direct Medical Costs	Baseline (2017)	Year 1 (2018)	Difference vs. Baseline	Savings (with vs. without intervention)
Number of participants	148	148		
Hospitalizations				
With intervention	**$1,298,000**	**$1,195,000**	**-$103,000**	**$115,000**
Without intervention	$1,298,000	$1,310,000	+$12,000	
ED visits				
With intervention	**$68,000**	**$60,000**	**-$9,000**	**$8,000**
Without intervention	$68,000	$68,000	-$300	
TOTAL MEDICAL COSTS = hospitalizations + ED visits				
With intervention	**$1,366,000**	**$1,255,000**	**-$111,000**	**$123,000**
Per participant	*$9,200*	*$8,500*	*-$800*	*$800*
Without intervention	$1,366,000	$1,378,000	+$12,000	
Per participant	*$9,200*	*$9,300*	*+$100*	

Cohort costs were rounded to the nearest thousand (or hundred, if < 1,000) and adjusted for inflation. For details on calculations and data sources, see the Technical Appendix. Figures may not total due to rounding.

These projected savings, and the associated reductions in utilization, are modest compared to outcomes reported by other CHW intervention studies. However, those studies have not published sufficient data to allow the UMass researchers to model cost savings generated by the CHW intervention relative to no intervention, as they did in Table 4.5. Outcomes reported elsewhere include:

- A study of CHWs integrated into community health teams targeting patients with chronic diseases in rural Vermont, which reported a 31 percent decline in ED use,[90] compared to the 16 percent reduction estimated for the proposed Windham County model.
- The Vermont study also reported a 21 percent decline in inpatient care use,[90] compared to the 12 percent reduction estimated for the proposed Windham County model.
- A CHW intervention in Maryland that targeted Medicaid patients with hypertension and/or diabetes reported a 30 percent to 38 percent reduction in emergency department visits and hospitalizations, resulting in a 27 percent reduction in Medicaid hospital costs.[105]
- A recent systematic review found that CHW interventions that targeted individuals with multiple chronic conditions have reported reductions in health care costs ranging from $19 per person to $3,600 per person.[106]

Some of the medical cost savings projected for the proposed Windham County intervention are expected to result from improved medication adherence, which has been shown to produce medical cost savings. For example, an analysis of commercially insured patients found that medical spending for individuals with diabetes, hypertension and/or high cholesterol and at least three or more chronic conditions in total declined between $2,081 and $5,341 per patient within one year when they achieved adherence with medication protocols.[107]

Social Return

Of the 148 Windham County residents who participate each year, the authors estimate that 81 individuals with diabetes and 46 individuals with hypertension would be working. As a result of the CHW intervention, the 81 participants with diabetes would miss a total of approximately 120 fewer work days, and the 46 with hypertension would miss 10 fewer work days, valued at $24,000 and $2,000 per year respectively.

The authors estimate the social return on investment arising from the proposed CHW intervention by calculating the value of wages from recovered working days. The estimated reductions in work absences are based on participants achieving improved diabetes blood glucose control[34] and blood pressure control.[108] The projections for average days lost from work due to diabetes and hypertension are stratified by health outcomes (for HbA1c measures: <7, 7, 8, 9 or >9 percent;[34] for blood pressure: <140/90 mmHg representing controlled blood pressure or ≥140/90 mmHg representing uncontrolled).[108]

As shown in Table 4.6, the authors estimate that 55 percent[34] of individuals with diabetes (81 individuals) and 31 percent[109] of individuals with hypertension (46 individuals) would be working. The estimated value of recovered working days is based on the average wages in Windham County. These calculations

produced a projected social return of $24,000 per year for working individuals with diabetes and nearly $2,000 for working individuals with hypertension. Recovered workdays per year are projected to total 120 days for all working diabetes patients, and 10 days for patients with hypertension.

Table 4.6: Projected Social Return of Recovered Workdays in Cohort 1 (over 1 year)

	Baseline (2017)		Year 1 (2018)		Difference vs. Baseline	
Cardiovascular Risk Population	**Missed Days**	**Wage Value**	**Missed Days**	**Wage Value**	**Recovered Days**	**Wage Value**
Diabetes						
Number of working adults among participant population with diabetes	81		81			
With intervention	**1,370**	**$256,000**	**1,240**	**$240,000**	**-140**	**-$16,000**
Per participant	*17*	*$3,100*	*15*	*$2,900*	*-2*	*-$300*
Without intervention	1,370	$256,000	1,360	$264,000	-10	$8,000
Per participant	*17*	*$3,100*	*17*	*$3,200*	*-0.2*	*$100*
TOTAL RECOVERED WORKDAYS AND WAGE VALUE					**120**	**$24,000**
Per participant with diabetes					**2**	**$300**
Hypertension						
Number of working adults among participant population with hypertension	46		46			
With Intervention	**160**	**$29,000**	**140**	**$27,000**	**20**	**$2,000**
Per participant	*3*	*$630*	*3*	*$590*	*-0.3*	*-$40*
Without intervention	160	$29,000	150	$29,000	10	$100
Per participant	*3*	*$630*	*3*	*$630*	*-0.1*	-
TOTAL RECOVERED WORKDAYS AND WAGE VALUE					**10**	**$1,900**
Per participant with hypertension					**0.2**	**$40**

Lost workdays per cohort were estimated for the entire group of participants with the same medical condition, unless specified. Figures do not total due to rounding. Cohort costs were rounded to the nearest thousand or hundred and per-participant costs to the nearest hundred, or ten if <$1,000. Cohort days were rounded to the nearest ten while per-participant days were not rounded. All costs and recovered wage values were adjusted for inflation. For details on calculations and data sources, see the Technical Appendix.

This estimate of recovered workdays is somewhat conservative. The authors evaluated diabetes and high blood pressure as separate cohorts with unique cardiovascular risk factors. However, it is likely that many individuals enrolled in this intervention would have concomitant hypertension and diabetes. Nationally, 71 percent of adults with diabetes also have high blood pressure.[110] Among individuals with two or more

chronic conditions (including cardiovascular risk factors such as diabetes and hypertension), the number of days lost from work is more than two times higher than among those with one chronic condition.[111] If given an intervention like the proposed Windham County CHW program, these individuals could likely regain more working days than the authors project.

Financial Return on Investment

The proposed CHW intervention for Windham County residents with cardiovascular risk factors is projected to produce a financial ROI of $2 for every $1 spent over three years. The program is estimated to cost $194,000 and save $388,000 in direct medical costs over three years.

As shown in Table 4.7 below, the authors project a return on investment over three years of $2.00 for every $1.00 spent. They project that reductions in hospitalizations and ED use would save nearly $390,000 over three years, with a social return from recovered working days of more than $80,000.

Table 4.7: Projected Financial Return on Investment (ROI) for Cohorts 1-3 (over 3 years)

	Cohort 1 (2017)	Cohort 2 (2018)	Cohort 3 (2019)	Cohorts 1-3 (2017-2019)
Number of participants	148	148	148	444
Estimated direct medical cost savings	$123,000	$129,000	$136,000	$388,000
Estimated intervention cost	$63,000	$64,000	$66,000	$194,000
FINANCIAL ROI	**$1.95**	**$2.02**	**$2.06**	**$2.00**
Estimated social return from recovered workdays	$26,000	$27,000	$28,000	$80,000
TOTAL NET SAVINGS (direct medical cost savings – intervention costs)	**$60,000**	**$65,000**	**$69,000**	**$194,000**

Costs were rounded to the nearest thousand. Costs in cohorts 2 and 3 were adjusted for inflation. Figures do not total due to rounding. For details on calculations and data sources, see the Technical Appendix.

5. Interviews with Connecticut Community Health Worker Employers

The UMass team interviewed representatives from seven Connecticut organizations that employ community health workers (CHW) – a federally qualified health center (FQHC), two community-based organizations, a mental health clinic, a community-based collaborative, a hospital, and a hospital-based community health care system. The interviews were conducted between December 2015 and January 2016 and were used to compile state-specific community health worker cost data, which was then used to estimate CHW employment costs for the budgets in each of the four proposed intervention models.

Community health workers and their employers also provided information about the work that CHWs do, the types of challenges that their clients face, whether they provide home visits or telephone follow-ups, the amount of time they spend during each visit, the amount of time they spend travelling, and the cost of supplies and training.

KEY INTERVIEW FINDINGS

- **A number of CHW programs currently operate in Connecticut; some have been operating for decades. Programs vary in terms of target populations, community health worker roles, and intervention intensity.**
    - Community health workers were commonly described as peer counselors, life coaches, patient navigators, or care coordinators.
    - Community health workers provided an assortment of services: 1) needs assessments; 2) care planning and coordination; 3) case management; 4) health education and advocacy; 5) health insurance enrollment assistance; 6) connection to health care providers; and 7) connection to social services, including food pantries, housing, employment programs, transportation for medical appointments, and judicial assistance.
    - Community health worker programs focused on providing health screenings (such as oral health and cancer), chronic disease management, maternal and child health, and school-based interventions.
    - Most community health worker interventions received referrals from hospital clinics, FQHCs, and primary care settings, while some participants were recruited through community outreach.
    - Interventions occurred in a variety of settings: in the community at libraries, colleges, or businesses; in an office environment; or in a participant's home.
    - Participant engagement typically ranged between a few weeks to a few months, although some programs followed participants for several years.
    - Some organizations formally evaluated the efficacy and cost effectiveness of their community health worker interventions.

- **Community health workers served people who face multiple barriers to accessing appropriate health care, including limited knowledge of the health care system, insufficient or no health insurance, and a lack of empowerment and engagement in their own care.**
- **Because they meet with clients in their own communities, rather than working in offices as clinicians typically do, CHWs were able to see aspects of their clients' lives that are not necessarily apparent to other providers. Community health workers' whole-person focus allowed them to identify non-medical issues and barriers that could have a negative effect on clients' health.**
- **Community health workers reported that their clients typically had needs – such as lack of food, fuel, and transportation – that had to be addressed before the client could focus on medical issues.**
- **Most organizations hired bilingual community health workers from the target communities. CHWs reported that their language skills and community knowledge were key in developing trusting relationships with the vulnerable people they served.**
- **Several organizations described their community health workers as equal and valuable team members who are highly respected by clinical staff. Some also described having good relationships with referring providers. However, one organization said that referring providers did not understand the benefits that community health workers can bring to their health care team.**
- **All employers worried about securing consistent financing for community health workers because most interventions operated with time-limited grant funding from private foundations and/or state and federal government programs.**
- **Several employers indicated a per-person, per-month payment would be the best way to sustain community health worker services in a value-based insurance payment landscape.**

Table 5.1: Connecticut Community Health Worker Employment Costs

Parameter	Mean	Median	Minimum Reported	Maximum Reported	Number of Responses and Notes
Full-time work hours (per week)	**36.40**	**36.00**	**35**	**40**	Six of seven organizations reported employing CHWs full time (FT). Five reported the number of working hours per week.
Part-time work hours (per week)	**23.25**	**23.25**	**22.5**	**24**	Four of seven organizations reported employing CHWs part-time (PT). Two reported working hours per week.

Table continued on page 61

Table continued from page 60

Parameter	Mean	Median	Minimum Reported	Maximum Reported	Number of Responses and Notes
Benefit costs for full-time CHWs (as percent of income)	**33%**	**32%**	**26%**	**43%**	All seven organizations provide benefits to CHWs. Benefit costs reported here reflect responses from all six employers of FT CHWs. In addition, one employer provided benefits to part-time CHWs, budgeted at 28% of their part-time salary.
Hourly pay	**$19.12**	**$19.00**	**$13.85**	**$23.51**	Six organizations reported hourly pay – five that employed FT CHWs and one that employed only PT CHWs. One organization reported a weekly salary range; the authors divided the midpoint of this range by weekly work hours to estimate an hourly pay rate.
Supervisor salary (annual)	**$66,857**	**$54,288**	**$50,000**	**$92,500**	Six organizations reported salary data, which the authors used to calculate annual salary amounts. Four employers reported an annual salary, one a weekly salary, while one reported the value of supervision work hours per week.
Supervision time per full-time equivalent CHW (as percent of supervisor's work time)	**11%**	**8%**	**5%**	**22%**	All seven organizations reported the amount of time that supervisors spent supervising CHWs. One organization reported the percent of time a full-time equivalent (FTE) supervisor managed each CHW. Four employers reported supervision hours spent on each CHW per week (1-4 hours/week). Two employers reported the number of FTE supervisors who spend 100% of their time managing CHWs. The authors used this data to calculate the percent of time devoted to supervising each FTE CHW.

Abbreviations: FT= full-time; PT= part-time; FTE = full-time equivalent. Minimum responses reflect minimum values for those employers that reported a value; some questions were not applicable to all employers. For example, some employers use unpaid volunteers as community health workers.

6. Technical Appendix: Assumptions Made in Four CHW Models

CHW Model 1: Controlling Diabetes Among Hartford Latinos

Population

Diabetes Burden of Connecticut and City of Hartford Latinos: The estimated number of Latino residents in the city of Hartford came from U.S. Census Bureau data. [112]

Estimates for the number of Hartford Latinos with diabetes were based on statewide diabetes prevalence among Hispanic residents (10.7 percent) from Behavioral Risk Factor Surveillance System (BRFSS) 2014 data,[20] applied to U.S. Census Bureau data.

The contribution of poorly controlled diabetes to the annual number of deaths, foot amputations, and hospitalizations was estimated from statewide age-adjusted data of diabetes complications among Hispanic residents from 2008-2012 Connecticut Department of Public Health (DPH) data.[18]

The number of emergency department (ED) visits was estimated from state Office of Health Care Access 2007-2011 data reported by DPH for diabetes-related ED visits among Hispanics.[21]

Caseload and estimated number of participants: Calculations in Table 1.1 were based on available work hours per year. Required administrative and client work time assumptions were based on published CHW diabetes studies.

Patients engaged at the end of the 18-month intervention: Since the dropout rate was not reported in the UTCO model study,[1] the rate used in the proposed intervention was based on another program that combined home visits and group classes.[27] This rate was similar to those reported in other studies that delivered other types of interventions (e.g. home visits only, office delivery only, group setting only).[26,31]

Population at years 1–3:
Assumptions: The number of patients per year would remain constant (new patients would be enrolled to replace dropouts). Outcomes were modeled for approximately two cohorts of patients followed for 18 months.

Outcomes

Number of patients (percent) at HbA1c control levels: The expected number of individuals at each A1c level (5 percent to 11 percent) was based on the UTCO model's mean (average) and standard deviation data reported for baseline and ending A1c for individuals who reached good control (<7 percent A1c) and those who did not reach good control (≥7 percent A1c) by the end of the intervention.[1] The percent of individuals in each category was predicted assuming a normal distribution and using the Microsoft Excel NORMDIST statistical function. Then the expected number of individuals at each A1c level within the intervention population was calculated by multiplying the expected proportions with the number of individuals. Numbers of individuals at discrete A1c levels were then combined into three categories shown in Table 1.3, which were based on control levels defined by the National Quality Forum (NQF), National Committee for Quality Assurance (NCQA), and the Medicare Shared Savings ACO Program.

NOTE: Table 1.3 illustrates expected results only for patients who participated in the CHW intervention, but does not make assumptions about those who did not participate because no data exists. The UTCO model study was a pre-post intervention without a control group.[1]

Cost Projections

Per-person direct medical costs over 18 months: Data was used from a Minnesota study that reported 3-year, per-person direct medical costs for individuals with diabetes, by A1c control level.[33] These 3-year costs were halved to generate an 18-month cost estimate. These costs were converted to expected Connecticut costs, using a ratio (Minnesota : Connecticut) of inpatient expenses per day published by the Kaiser Family

Foundation.[113] The 2002 dollars reported in the Minnesota study were projected to 2017-2020 costs, which were based on compounded rates computed from National Health Expenditure per capita projections.[114] Lastly, per-person costs at each A1c control level for the cohort were estimated for before (at baseline) and after the CHW intervention.

Assumptions: In the absence of the proposed CHW intervention, patients would remain at the same control level at the end of the 18-month period (as at baseline). This was a conservative estimate, since the UTCO model did not include control group results.[1]

Social Return

Number of adults working: Calculations were based on the proportion of adults ages 30 to 64 with diabetes who were employed (55%), as reported in a Michigan-based study.[34]

Assumptions: All 158 participants per CHW intervention cohort are working-age adults, and the 87 (55%) who are assumed to work have full-time jobs.

Number of days lost from work: Calculations were based on the number of hours lost per week in the past four weeks, converted to number of days per 18 months, by level of HbA1c control, from the Michigan study.[34] The Michigan study reported data (work hours missed/week) for males and females separately, which were summed to give a total number of average hours lost/week for all workers.

Assumptions: The effects of the proposed CHW intervention, modeled after the UTCO study, were estimated for six different HbA1c control levels, while the Michigan study reported data for only four levels (7 percent to 7.99 percent, 8 percent to 8.99 percent, 9 percent to 9.99 percent, and ≥10 percent). Lost workdays for the 6 percent HbA1c control level participants in the CHW intervention were assumed to be similar to those in the 7 percent to 7.99 percent HbA1c category reported in the Michigan study (lowest category available). Similarly, lost workdays for Connecticut participants at the 11 percent HbA1c control level were assumed to be similar to those in the ≥10 percent HbA1c category (highest available category), as reported in the Michigan study.

The total number of lost workdays for all patients was calculated by multiplying the number of patients at each HbA1c control level with the average number of lost workdays per year for patients at the same control level (as outlined above).

Assumptions: (1) The absence of a CHW intervention would not improve glycemic levels – without the intervention, all patients would remain at baseline levels at 18 months. (2) CHW intervention participants would recover lost workdays according to A1c control level improvements, per the UTCO study.[1]

Value of lost work days: Estimated number of lost work hours per person per year was multiplied with the projected hourly salary in that year. The mean hourly salary for the Hartford area was $27.30 in the third quarter of 2015, according to the Bureau of Labor Statistics.[36] Estimated hourly wages between 2017 and 2020 – the time period for the proposed intervention – were calculated by inflating the mean hourly rate by 2.25 percent (the historic annual average weekly wage change for the years 2012-2015 in Hartford County).[115]

CHW Model 2: Improving Asthma Control of Children in Greater New Haven

Population

Burden of poorly controlled asthma on children in Greater New Haven: The number of children with asthma in Greater New Haven was based on 2008-2010 prevalence data from the Behavioral Risk Factor Surveillance Survey (BRFSS) for New Haven County (12.1 percent),[40] applied to the estimated number of children in the city of New Haven (U.S. Census Bureau American Community Survey data).[116] Estimated number of children with 'very poorly' and 'not well' controlled asthma was based on the proportion of children with asthma in Connecticut in these two categories (based on 2007-2009 data from the Asthma Call-back Survey, an optional module of the BRFSS).[40] The number of emergency department (ED) visits and hospitalizations was estimated from 2005-2009 Department of Public Health (DPH) data on the number of ED visits and hospitalizations with asthma as the primary diagnosis by age group for the city of New Haven.[117] The calculation of an annual rate for children ages 0-18 was based on summed data for the following age categories: 0-4, 5-9, and 10-14. Estimates for

the number of asthma events for ages 15-17 (not included in the previous data source) was calculated by computing 20 percent of the number of events for ages 15-24 and adding this sum to the number of events for ages 0-14. This number was divided by 5 (events over 5 years) to predict an annual rate. The estimated annual number of asthma events was divided by the number of children in the city of New Haven in 2009 (U.S. Census Bureau data)[118] to predict a crude annual rate per 10,000 children (ED visits: 233; hospitalizations: 96).

Caseload and estimated number of participants: Calculations illustrated in Table 2.1 were based on available work hours per year, and assumptions on required administrative and client work time came from published CHW diabetes studies.

Patients engaged at the end of year 1: The estimated average dropout rate at 12 months was based on similar data from existing programs implemented in New York City and Boston.[13,46,47,57] These studies were conducted in a more realistic setting than in the King County model,[2] which was a randomized controlled trial (RCT) conducted under experimental conditions. The dropout rate estimated from the New York and Boston studies (46 percent; median of 52 percent in NY and 40 percent in Boston) was higher than those reported in other RCTs, including the King County model (15 percent to 18 percent), and represents a more conservative estimate.[2,52]

Population at years 1–3:
Assumptions: The number of patients per year would remain constant (new patients would be enrolled to replace dropouts). Outcomes were modeled for approximately three cohorts of 96 patients followed for 12 months.

Outcomes

Rescue medication use and symptom-free days (per 2 weeks/person): Baseline rates from the King County model were used by averaging baseline values for control and intervention groups.[2] The resulting baseline rates (rescue medication: 5.3 use days per two weeks; symptom-free days: 6.6 days per two weeks) were comparable to those reported in Connecticut's Putting on AIRS home visit program, where the majority of children had 'poorly' or 'not well' controlled asthma (rescue medication: 6.4 use days per two weeks; symptom-free days: 8.9 days per two weeks).[63] For asthma event rates at 12 months, the percent improvement in event rates observed for control and intervention groups in King County was applied to proposed CHW intervention baseline rates. The King County rates were: rescue medication: intervention -63 percent, control -22 percent; symptom-free days: intervention +78 percent, control +32 percent.

Well-controlled asthma (percent of children): At baseline, it was assumed no children enrolled in the proposed Greater New Haven CHW intervention would meet National Asthma Education and Prevention Program's criteria for well-controlled asthma (3 percent of enrolled children in the King County model study were at this control level at baseline).[2] The authors also assumed that 45 percent of children enrolled in the CHW intervention and 16 percent of children not receiving the CHW intervention would be well-controlled at 12 months; these percentages reflected the changes observed in the King County study.[2]

ED, hospitalization, and urgent care clinic visit rates at baseline: Average utilization rates per year and per person were based on the King County model study: Emergency department (ED) visits (1.77), hospitalizations (0.61), and urgent care clinic visits (2.73).[2]

The rates for ED visits and hospitalizations were comparable to those calculated for children in the city of New Haven with 'very poor' control: 1.6 ED visits/year (693 visits/443 children with very poor control); 0.6 hospitalizations/year (285 hospitalizations/443 children with very poor control); see 'Population' section for calculations of event rates and number of children at each asthma control level.

ED, hospitalization, and urgent care clinic visit rates following intervention (at 12 months): The authors calculated 12-month event rates per person for the control (without intervention) group and CHW (with intervention) group, using baseline event rates and costs per event (ED visit, hospitalization, or urgent care clinic visit) reported in the King County study.

Example: The King County model used a cost of $330/ED visit, and reported a cost reduction of $307/person in the intervention group and $282/person in the control group. Given a baseline event rate of 1.77/person per year and a per-visit cost of $330, estimates for the per-person baseline ED visit cost totaled $584 for both

groups (1.77 event rate multiplied by $330/ED visit). Researchers estimated per-person ED visit cost at 12 months (post-intervention) as $302 in the control group ($584 minus $282) and $277 in the CHW group ($584 minus $307). Based on these costs, 12-month event rate estimates were based on the event cost of $330. For the control group, the estimated event rate of 0.91 was based on a 48 percent reduction in per-person costs ($282 divided by $584 = 0.48, 1.77 multiplied by 0.52 [1 minus 0.48] = 0.91), and 0.84 visits/year for the CHW group based on a 53 percent reduction in per-person costs ($307 divided by $584).

Assumptions: Average costs per event would remain constant over 12 months; any reduction in average per-person costs would reflect only a decrease in the number of events, rather than other factors affecting per-person costs.

Group number of events: Number of children multiplied by per-person, per-year event rates.

Cost Projections

Event rates for ED visits, hospitalizations, and urgent care clinic visits: Baseline and 12-month per-person, per-year rates were based on the King County model. See 'Outcomes' section for method used for calculating 12-month rates with and without the intervention.[2]

Average unit costs per event: Estimated charges per ED visit ($1,186) and hospitalization ($17,538) for children in Connecticut were calculated by dividing the number of events by total charges for children in the proposed intervention population.[40] ED visit and hospitalization charges were converted to costs using the statewide cost-to-charge ratio in 2012 (0.36).[39] For urgent care clinic visits, the average Medicare payment for a physician office visit in 2012 was used for Connecticut (new patient office or other outpatient visits are typically 60 minutes, according to HCPCS Code 99205),[70] similar to what was used in a Connecticut asthma cost-benefit study.[63] All unit costs were converted to 2017-2020 dollars using medical cost inflation rates published in National Health Expenditure data.[119]

Group costs: These were calculated by multiplying event rates at baseline and at year 1 by unit costs per event, and summing for each group (with intervention, and without intervention).

Social Return

Number of missed school days and days when caretaker plans were disrupted due to child's asthma symptoms: Baseline and 12-month event rates from the Inner-City Asthma Study, a RCT carried out in seven large U.S. cities,[69] were used for both control (without CHW intervention) and intervention (with CHW intervention) groups. The study asked participants about the number of days missed or disrupted over the previous two weeks; researchers asked participants this question before and after the intervention. The asthma study reported a 9 percent reduction in missed school days in the control group and a 41 percent reduction in the intervention group; and a 13 percent reduction in caretaker days disrupted in the control group and a 43 percent reduction in the intervention group. For the proposed New Haven CHW intervention, the authors calculated 12-month rates based on the asthma study's two-week rates.

Assumptions: All parents (adults) in the intervention would be working full time. Caretaker days were modeled for one parent only. The rate of missed school days and days when a caretaker's plans were disrupted would continue at a constant rate for 12 months.

CHW Model 3: Connecting Individuals with Complex Health Needs to Appropriate Health Care Services in New London County

Population

Average number of patients at a hospital clinic: Assumed at 6,000 (assuming 3.0 full-time equivalent physicians who each have a panel of 2,000 patients).

Average number of individuals with multiple chronic conditions and high health care use: Since individuals with more than one chronic condition are two to three times more likely to be among the top 5 percent most expensive patients[79] and frequent users of the emergency department (ED) (four or more visits/year), researchers determined the proposed CHW intervention would target this group of patients at the hospital clinic (6,000 individuals multiplied by 0.05 = 300 individuals).

Estimated number of patients agreeing to participate in intervention: This figure was based on a patient navigation study in New Haven, which found 46 percent of those approached agreed to participate.[80]

Estimated number of patients completing intervention: An estimated 58 percent of participants would be expected to complete the intervention (remain for up to six months). This estimate was based on the average (median) retention rate of Molina Healthcare's CARE model in New Mexico (65 percent; 448 of 691 participants reported complete data at study end)[3] and a patient navigation study in New Haven (51 percent).[80]

Estimated caseload/CHW/year: The predicted caseload of 36 patients/CHW/year was based on CARE model calculations:[3] 691 patients at program start divided by six CHW employees divided by 2.083 years (2 years and 1 month) = 55 patients enrolled/CHW, of whom 65 percent completed the full duration of the intervention.

Estimated number of patients approached for intervention participation: Based on caseload, retention and enrollment rates (see above).

Outcomes

Event rates: Event rates were based on New Mexico's CARE model study[3] and calculated by dividing the number of events during the 6-month period at baseline (before), during, and after the intervention, among the 448 enrolled participants. The resulting event rates (per participant over 6 months) were applied to the estimated number of individuals participating in the proposed New London County CHW intervention (72 individuals).

Hospitalizations: There were 171 events reported in the CARE intervention at baseline, 100 during intervention implementation, and 29 at intervention completion. The CARE model found a greater reduction in inpatient admissions for the CHW group compared to the control group both between the 6 months during and after ($p<0.01$) the intervention, and over the entire 6-month period between baseline and after intervention ($p<0.01$) completion.

ED visits: There were 2,655 events in the CARE model at baseline, 1,734 during implementation, and 815 after intervention completion. The study found a greater reduction in the CHW group than the control group between the 6 months during and after the intervention ($p<0.01$).

Narcotic prescriptions: There were 2,962 events in the CARE model at baseline, 2,748 during implementation, and 1,044 after intervention completion. The study reported a greater reduction in the CHW intervention group than the control group between the 6 months before (at baseline) and during the intervention ($p<0.01$).

Non-narcotic prescriptions: There were 22,311 events in the CARE model at baseline, 23,519 during implementation, and 8,311 after intervention completion. The study found a greater reduction in the CHW group compared to the control group between the 6 months during and after the intervention ($p<0.01$).

Cost Projections

Approach: Medical cost savings were based on decreased per-person payments for inpatient hospitalizations, narcotic prescriptions, and non-narcotic prescriptions observed between the 6-month period before (baseline) and after the intervention, as reported in the CARE New Mexico intervention.[3] Per-person mean costs were first adjusted to Connecticut costs using the ratio between Connecticut and New Mexico's Hospital Adjusted Expenses per Inpatient Day published by the Kaiser Family Foundation.[113] These cost estimates were adjusted to predict future costs in years 2017-2020 using projected National Health Expenditure inflation rates published by the Centers for Medicare & Medicaid Services.[114]

NOTE: Baseline costs were not comparable for the CHW and control groups in the CARE study. For all three outcomes (hospitalizations, narcotics, and non-narcotic prescriptions), the number of events and resulting costs per person were considerably lower in the control group. It would have been ideal to find a study that identified a more closely matched control group, however, none was available. Calculations in the proposed New London County intervention did not adjust for this disparity.

Social Return

Social return was not estimated for this model due to a lack of reliable data.

CHW Model 4: Preventing Cardiovascular Disease Complications in Windham County

Population

Caseload: Published CHW study results were used to estimate a reasonable caseload for CHWs, which was based on available work hours per year, and required administrative and client work time assumptions. The time required for client work was based on the COACH intervention in Baltimore.[4] Proposed CHW intervention calculations estimated that one CHW working with a nurse practitioner could work with an annual patient caseload of 148 (after accounting for dropouts, see below). This result is comparable to the estimated annual caseload for the COACH study (147, calculated as follows: of 525 patients who completed an initial visit, over 3 years, 84 percent (or 441 individuals) participated in the intervention, which was staffed by a CHW and nurse practitioner team).

Recruitment time: It was estimated that each CHW would require 32 hours each year to attempt to make initial contact with 267 individuals, of whom 16 percent would not be reached (based on the COACH study).[4] Another 23 percent would not participate (based on the COACH study and a similar study, Care Guides in Minnesota).[103]

Participation and dropout rate: The proposed model assumes an estimated 162 individuals would enroll in the intervention, of whom 148 (91 percent) would complete the intervention. This assumption was based on the COACH (Baltimore) and Minnesota studies.[4,103]

Assumptions: The published studies did not provide data on the number of people who would continue in the program longer than one year. The researchers assumed that the caseload would remain constant at 148 patients, with new participants being enrolled to replace those who leave the program. This assumption is consistent with standards of practice as reported by CHWs and their employers in interviews.

Outcomes

Approach: Improvements were projected for three clinical measures: systolic blood pressure (SBP), low-density lipoprotein (LDL), and HbA1c, based on results of the COACH intervention.[4] The expected distribution of participants at each clinical reading level (percent of total) was estimated using the naturally occurring range for each reading (SBP: 70-190 mmHg; LDL: 70-190 mg/dL; HbA1c: 4 percent to 13 percent). The authors calculated four theoretical distributions for each measure using Microsoft Excel's NORMDIST function: baseline and year 1 for the CHW group, and baseline and year 1 for the control group (not receiving the CHW intervention). The percent of individuals at each clinical reading level was calculated using mean and standard deviation values published in the COACH model.

Assumptions: Patient clinical readings were normally distributed (with no skew present) around the arithmetic mean.

Each clinical reading was divided into two categories based on whether they were above or below recommended clinical target goals proposed by national guidelines, which were also used in the COACH model:
HbA1c: Meeting goal: <7 percent.
SBP: Meeting goal: <140 mm Hg.
LDL: Meeting goal: <130 mg/dL.

Number of individuals meeting guideline recommendations: The calculated percent (distribution) of individuals at each clinical reading level was summed into two categories; those who meet the above national guideline-recommended goals, and those who do not. The resulting total percentages were multiplied with the number of patients in the Windham County cohort (148 individuals).

Cost Projections

Baseline event rates: Since the COACH model did not report data for health care use or spending, estimated event rates were based on the Minnesota Care Guides study[103] (hospitalizations: 188 events over one year among 280 patients = 0.67; emergency department (ED) visits: 310 events/280 patients = 1.11).

Event rates at year 1 (post-intervention): Since the Minnesota study did not include a control group, the authors estimated regression to the mean without a CHW intervention based on the average clinical improvement of the control group in the COACH study. For the proposed CHW intervention, the improvement in the mean (average) SBP, LDL, HbA1c, and diastolic blood pressure readings during year 1 were calculated for the CHW group relative to the control group. For these four measures, mean readings for individuals in the CHW group improved between 2.1 and 5.6 times more than for those in the control group, on average 3.6 times more.

Example: The control group's average LDL readings improved 5 percent, from 116.30 to 110.60, while the CHW group's average readings improved 18 percent, from 121.60 to 100.10. This shows how patients participating in the intervention improved their LDL readings on average 3.6 times more than those of the control group (18/5).

Estimated ED and hospitalization event rates at year one without the CHW intervention were calculated by adjusting the percent improvement reported for the CHW group in the Care Guides study[103] by a factor of 3.6 (average relative greater clinical improvement).

Assumptions: A clinical improvement (reduction) in blood pressure, cholesterol, and glycemic index, will result in a corresponding decrease in ED and hospital use. The improvements in blood pressure (SBP) and cholesterol (LDL) reported by the Care Guides model were comparable to those found in the COACH study. Percent of individuals with blood pressure control (<140/90 mmHg) in the Care Guides intervention were 54 percent at baseline versus 71 percent at one year (post-intervention). Corresponding figures for the COACH cohort were calculated based on mean and standard deviation values for SBP (<140 mmHg): 50 percent (baseline) and 66 percent (one year).

Costs of an ED visit: The average statewide cost per ED visit for Medicaid enrollees in 2012 was $342, which was based on Connecticut Department of Social Services data published by the Connecticut General Assembly.[77]

Costs of a hospitalization: The average (median) statewide hospital charges for patients diagnosed with circulatory system diseases (ICD-9 codes 390-459) was $32,043 in 2014, according to Connecticut Department of Public Health (DPH) data. These charges were converted to costs by applying the statewide cost-to-charge ratio of 0.36, according to 2012 DPH data.[39]

Both costs were trended to future costs (2017-2020) using medical inflation rates based on National Health Expenditure projections.[114]

Social Return

Approach: The social return was calculated by estimating the number of individuals expected to be working, the number of workdays lost, and the value of lost workdays, using average wages in Windham County.

Diabetes: More than half (55 percent) of the cohort was estimated to work with a diabetes diagnosis, based on results of a Michigan study.[34] The number of people at each glycemic control level (between 6 percent and 10 percent or more) were estimated using the distribution of individuals at each glycemic level (see explanation in the 'Outcomes' section). Estimates for hours of work lost per year for patients at each glycemic control level were based on the Michigan study (see calculations in the 'Social Return' section for Model 1).[34]

Assumptions: Lost workdays for patients in the '6 percent or lower' category were projected to be similar to those in the 7 percent to 7.99 percent category in the Michigan study (lowest category available).

Hypertension: One-third (31 percent) of the cohort was predicted to work with a hypertension diagnosis, based on national data.[109] Estimates of the number of patients who recorded controlled and uncontrolled blood pressure were calculated using the distribution of individuals with SBP that met and did not meet national guidelines (met: < 140 mmHg; did not meet: ≥ 140 mmHg) (see 'Outcomes' section and Table 4.3). Lost workdays

per year per patient at each blood pressure control level estimates were based on a Washington state study, for individuals with controlled and uncontrolled hypertension (controlled: <140/90 mmHg; uncontrolled: ≥140/90 mmHg).[108]

Value of lost work days: The estimated lost workdays per person per year were multiplied by the projected daily salary in that year (between 2017 and 2020). The mean weekly salary data for Windham County was $862.00 in the third quarter of 2015, according to the Bureau of Labor Statistics.[35] This was converted to a daily rate by dividing by five ($172.40). Daily wage estimates between 2017 and 2020 were calculated by inflating this rate by 4.0 percent (using the historic annual average weekly wage change data for the years 2013-2015 in Windham County).[120]

Note: Researchers did not adjust for the impact of concomitant hypertension and diabetes on those patients' ability to work.

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