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Abstract

Introduction
Cardiovascular disease (CVD) is an important threat to public health, especially in rural communities. Clinical medical students at a rural regional campus can be a valuable resource to plan and implement CVD risk factor case finding project in the host community.

Methods
Directed by a representative county advisory council and supervised by a regional dean, clinical medical students designed and implemented CVD screenings at several public locations, recording health history and measurements of blood glucose, total blood cholesterol, and blood pressure. Those screened with abnormal readings were directed to definitive care including the local student-directed free clinic. Students were surveyed using a Likert scale before and after participation to assess their confidence in executing a community health project. The host health system IRB approved the protocol as exempt, and the authors have no conflicts of interest.

Result
Over a period of almost 2 years in 2017 and 2019, a total of 572 participants were screened. The demographics reflected those of the entire county, except screening was focused on adults. High blood pressure was found in 43%, high glucose in 28%, and high cholesterol in 48%. These values were similar to published countywide prevalence proportions. The student pre- to post- increase in confidence was remarkable (p< 0.001).

Conclusions
Our results show that regional campus medical students directed by a representative county advisory council and supervised by a regional dean can successfully implement a community CVD screening effort. The students also expressed a dramatic increase in their confidence in designing and implementing such a project. Lessons learned are shared for consideration by those at other regional health campuses.

Introduction

Cardiovascular disease (CVD) remains one of the greatest threats to public health in both urban and rural communities in the United States. The burden of cardiovascular disease is heavier in rural communities, due to higher prevalence of diabetes, obesity, hypertension, lack of physical activity, and tobacco usage.[1,2] Many interventions have targeted individual CVD risk factors, aiming to reduce one risk factor at a time, while failing to include in the intervention the local health care facilities that provide definitive care.[3-7] Medical students at a regional medical school campus can be valuable contributors in rural communities' CVD prevention programs.[8] Teaching future physicians to design a community-based project also gives them valuable

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skills for designing and implementing future screening efforts after graduation.[9]

The most comprehensive rural community project reported in the United States was implemented and sustained in Franklin County, Maine from 1970 to 2010.[10] The prevention program included educating residents on healthy lifestyle habits such as smoking cessation as well as screening for hypertension and hyperlipidemia in an effort to decrease CVD, hospitalization, and mortality. Participants who were found to have uncontrolled risk factors for CVD were referred to local clinicians for treatment. This 40-year effort started with just screening and included active involvement of the community driven by an advisory council made up of local physicians and community leaders including local business owners, teachers, and nurses. Early on, this group found that there were not enough easy access, low-cost options for primary care in their community, so they established a nonprofit medical practice dedicated to providing this care.[10] Later, they also partnered with the local hospital and regional campus of the state university.[11-12] The program resulted in hypertension control rates increasing from 18.3% to 43.0% and elevated cholesterol control rates increasing from 0.4% to 28.9%, leading to 1.7% fewer hospitalizations per capita and a lower age adjusted mortality rate of 60 fewer deaths per 100 000 residents.[10] These results suggest that CVD screening and intervention programs implemented in rural, low income, and predominantly white communities can have significant positive outcomes.

From 1972 to 2012, a community CVD screening and education program in North Karelia, Finland used community-based interventions and national level policy changes to reduce the levels of smoking, hyperlipidemia, and hypertension in the population.[13] The program utilized legislation, local media outlets, community meetings, and pamphlets to educate the population on CVD behavioral risk factors. The aim was to reduce smoking rates and reduce intake of saturated fat and salt. The program resulted in 20% lower cholesterol levels and a reduction of mean systolic blood pressure measures from 149 to 134 mm Hg in men and 153 to 127 mm Hg in women. Smoking rates decreased from 51% to 36%. The reduction of these 3 CVD risk factors resulted in a

decrease of cardiovascular mortality from 690 deaths per 100 000 to 100 deaths per 100 000.[13]

Another CVD screening and intervention program implemented in rural Västerbotten County, Sweden resulted in a 12.1% reduction in all-cause mortality for women and a 7.8% reduction in all-cause mortality for men.[14] The program was overseen by a scientific advisory board from Umeå University, consisting of cardiologists, family medicine physicians, and epidemiologists as advisory board members. From 1990 to 2006, all citizens aged 30, 40, and 60 years in the county were invited to a health screening where participants would undergo an oral glucose tolerance test, along with screenings for blood lipids, body mass index, and blood pressure. Participants also completed a comprehensive questionnaire to assess their socioeconomic status, psychosocial conditions, self-reported health, family history of CVD and diabetes, quality of life, and lifestyle habits including level of physical activity, alcohol and tobacco usage, and diet. Following the questionnaire and screening, results and responses were discussed with the patient by a nurse employed by the program using motivational interviewing.[15] The nurse would present each participant with a visual representation of their risk factors for CVD to encourage lifestyle modification. All the screening measures took place at a participating primary healthcare facility in the county. Follow-up visits were scheduled with the nurse at the same healthcare facility when warranted, along with referrals to the participant's family physician for further assessment and therapy as needed.

Another rural community program was completed in 2009 in rural New Ulm, MN, population of 13 522. Heart health screenings, a local weight loss competition, nutrition education sessions, and a phone coaching program for those with high CVD risk factors were implemented to engage the community.[16] The program resulted in increased physical activity from 62.8% to 70.5% and improved nutrition as defined by eating 5+ fruits/vegetables per day from 16.9% to 28.1%. Limited changes were seen for smoking, alcohol consumption, and stress.[17]

In 2010, Johns Hopkins University began an interdisciplinary CVD disparities training and career

development fellowship program.[18] The curriculum included monthly CVD disparities didactic lectures along with participation in mentor-guided research of CVD health disparities among African American women.

A student-directed program at the University of Miami Miller School of Medicine provides free blood glucose, blood lipids, and blood pressure screenings and other examinations at free health clinics throughout the rural Florida Keys.[19] When abnormal results were found, students referred participants to seek care at reduced cost clinics. Students that participated in the rural health fairs tended to practice in low-density populated areas after graduation.

One systematic review of student-run CVD community health interventions found that the projects demonstrated a short-term decrease in HbA1c ranging between 0.9 and 1.7%, a decrease in LDL ranging between 12 and 34.5 mg/dL, and a decrease in blood pressure ranging between 5.2 mm and 9.5 mm systolic pressure and 5.7 mm and 6.8 mm diastolic pressure.[20] The studies included in this review ranged from 6 to 12 months of intervention.

We report here the initial results of a community-based CVD screening effort led by medical students at a regional medical school campus, directed by a county advisory council, and supervised by the regional dean. The host community for the campus is remarkably similar in demographics, population, and socioeconomic descriptors to Franklin County, Maine. This screening effort was considered the first step to a long-term plan to replicate the interventions that were part of the later years of the Franklin County Maine project.

Methods

The regional campus is located in a town of 20 000 in the upper southeast.[8] Clinical medical students are active in the community and have managed a local free clinic since 2004. The purpose of the campus is to produce physicians for the region's small towns by training students with rural upbringing in a rural community setting. As a part of the longitudinal community medicine training of these regional campus medical students, community screenings were performed beginning in 2017. A student free

clinic director scheduled M-3 volunteers for each screening, working around the most demanding rotations. Every M-3 student volunteered for at least one session, and most did several. During the summer pathways programs, rising M-1 and M-2s joined the M-3s, with all volunteering at least once. Screenings at typical "health fair" events resulted in reaching those who had the resources to get to the typical mall or civic-club sponsored events, which was not the low resource target population. To solve this problem, a steering committee was formed that, over the next 2 years, became an advisory council. Council members were chosen from those who were in touch with underserved populations and knew when the target population would be gathered for some other purpose (see Table 1). This resulted in a dramatic shift for screening to be scheduled where and when requested by informal and formal leaders of the target groups, even if this was inconvenient for the medical students, such as a Saturday morning food bank.

Table 1: Advisory Council Positions

President, City-County Economic Development
Director, Housing Authority
Co-Director, Saturday Session Food Bank
Pastor, Prominent Black Congregation
Director, Weekday Food Bank
President, Local Community College
Business Liaison, Regional Jobs Program.

A screening station was set up where people were waiting in line to receive free goods or services unrelated to the screening with a large sign and a community volunteer who walked along the line explaining the screening. The first step was a simple risk assessment written at the sixth grade reading level and, if necessary, administered verbally to the screened individual (see Table 2). The health risk assessment recorded the participant's past medical history of CVD-related illnesses and events, level of physical activity, quality of diet, tobacco product usage, form or lack of health insurance coverage, and

use of a primary care provider. Next, the client moved one chair over where a single finger-stick was performed resulting in a total cholesterol and blood glucose. The medical-quality machine took about 3 minutes to produce a result, and the medical student used this time to review the health history on the form and address the client's questions. The client then moved one chair over again to a medical student who measured the blood pressure with an automatic, validated machine, then the student reviewed all the results with the client. The students were careful not to provide any medical advice, but each participant was provided with individualized lifestyle advice. If the client had a primary care provider (PCP), the student did advise how soon the client might seek an appointment based on the results. The client was provided a card showing all the results to be taken to the PCP. If the client did not have a PCP, the student explained how the student -directed free clinic works and added the date and time of the client's appointment at the clinic to the results card. The back of the card included information about available low-cost transportation options. All free clinic appointments were scheduled within 6 days from the screening date.

Table 2: Cardiovascular Screening Health Risk Assessment

Mark all known health conditions that you have had in the past.	• Congestive Heart Failure • Stroke • Diabetes Mellitus • Heart Attack • Hyperlipidemia • Hypertension
Circle the number which best identifies your response to each of the statements (1 indicating almost never, 2 indicating sometimes, and 3 indicating almost always.)	• I exercise 20-30 minutes each day for at least five days each week. (1…..2…..3) • I eat five servings of fruits and vegetables every day. (1…..2…..3) • I enjoy sitting more than physical activity. (1…..2…..3) • I eat foods high in fat. (1…..2…..3) • I see my doctor for regular checkups. (1…..2…..3)
Circle TRUE or FALSE to answer each statement.	• I use tobacco products or e-cigarettes. (TRUE or FALSE) • I have a physical limitation that keeps me from exercising. (TRUE or FALSE)
Circle YES or NO to answer each question.	• Have you completed a screening with us before today? (YES or NO) • Have you seen your doctor within the past 12 months? (YES or NO) • Do you have health insurance? (YES or NO)
If you do not have a primary care doctor, may we contact you to help you find a doctor? If yes, please fill in your contact information.	• YES or NO • Phone: • Name: • Address:
Today's test results:	Blood pressure: Blood cholesterol: Blood glucose:

Results:

Table 3 describes sites where CVD screenings were conducted. The greatest participation was at food banks, where a large number of would-be-participants were available while waiting in line. Some other successful venues included street fairs and job fairs.

Table 3: Sites of CVD Screenings

Food Banks	320
Community Fairs	125
Job Fairs	58
Civic Club Meetings	32
Churches	16
Immunization Clinics	14
Hospital Housekeeping	7
TOTAL	572

Table 4 displays the demographics of screened participants. Most of the participants were white, which is representative of the county as a whole. The age of participants ranged from 19 to 59 years, and more males were screened.

Table 4: Demographics of Population Screened

Gender n = 531[a]	n (%)	Percent Population of County[b]
Male	344 (64.8%)	48.8%
Age at time of Screening n = 515[a]	n (%)	Percent Population of County[b]
19 – 59	327 (63.5%)	58.3%
60+	179 (34.8%)	19.0%
0 – 18	9 (1.7%)	22.7%
Race/Ethnicity n = 490[a]	n (%)	Percent Population of County[b]
White	395 (80.6%)	90.0%
Black or African American	80 (16.3%)	6.8%
Hispanic/Latinx	7 (1.4%)	2.2%
Other	6 (1.2%)	2.3%
American Indian and Alaska Native	2 (0.4%)	0.3%
Asian	0 (0.0%)	0.6%

[a]n excludes missing information not provided by participants.
[b]County values obtained from U.S. Census Bureau (21).

Table 5 shows the percentage of abnormal blood pressure, blood glucose, and blood cholesterol readings we collected, using two threshold values defining "abnormal" for each element.

Table 5: CVD Screening Results

	Abnormal Blood Pressure n = 547[a]	
	Systolic > 140 OR Diastolic > 90	Systolic > 150 OR Diastolic > 100
Abnormal with Previous Diagnosis	117 (20%)	66 (12%)
Abnormal with NO Previous Diagnosis	134 (23%)	64 (11%)
	Abnormal Blood Glucose n = 469[a]	
	Blood Glucose > 110 mg/dL	Blood Glucose > 125 mg/dL
Abnormal with Previous Diagnosis	76 (13%)	64 (11%)
Abnormal with NO Previous Diagnosis	85 (15%)	49 (9%)
	Abnormal Total Cholesterol n = 471[a]	
	Total Cholesterol > 160 mg/dL	Total Cholesterol > 180 mg/dL
Abnormal with Previous Diagnosis	64 (11%)	48 (8%)
Abnormal with NO Previous Diagnosis	211 (37%)	144 (25%)

[a]Excludes missing information when participants declined this portion of the screening.

Table 6 displays the prevalence of diagnosed hypertension, diabetes, and hyperlipidemia in the county, as compared to the percent of abnormal readings for blood pressure, blood glucose, and total cholesterol we found in our screenings.

Table 6: Prevalence of CVD Risk Factors in County

	%Prevalence in county[a]	% in sample with abnormal readings, lower cutoff limit.	% in sample with abnormal readings, higher cutoff limit.
Hypertension	33%	43%	22%
Diabetes	20%	28%	20%
Hyperlipidemia	38%	48%	33%

[a]County data retrieved from Centers of Disease Control and Prevention, BRFSS Prevalence and Trends Data[22]

Before and after the regional campus programs that included the screenings, we surveyed the students involved concerning their confidence in their ability to design and implement a community project (see Table 7). Participants reported a large increase in confidence. (p = 0.001). Sixty-two percent (42/68) of our students were female and 84% (56/68) were from small towns, which we defined as a population fewer than 30 000 and non-metro Rural Urban Continuum Code.[23]

Table 7: Student Opinions

	strongly disagree	somewhat agree		strongly agree[a]			
	1	2	3	4	5	Total	P[b]
Pre-test	1 (1.4%)	9 (13.0%	22 (31.9%)	23 (33.3%)	14 (20.3%	69[c] (100.0%)	
Post-test	0 (0.0%)	0 (0.0%)	11 (15.5%)	30 (42.3%)	30 (42.3%)	71 (100/0%)	<0.001
Student Comments							
"It was amazing to see how willing some people were to participate. Even those who had not seen a doctor in many years were eager to see their results."							
"What surprised me most was that our participants were so willing to share their lives with us, as well as participate in our screenings. One lady at the food bank shared with me very intimate details of her life, including struggles with her family, which I think became therapeutic for her in and of itself."							

[a]I am comfortable planning and implementing a community health project or I have a good understanding of what it takes to design an effective community activity.

[b]Mann-Whitney U = 1503.0, n_1 = 69 n_2 = 71, P < 0.001 two-tailed.

[c]Two students did not complete their pre-test

Discussion

Overall, we accomplished our goal of demonstrating that a group of students based at a regional medical school campus could plan and implement a successful CVD screening program. We learned that students' confidence in their ability to design and implement a community health project was increased dramatically. It is our hope that the training in a community health project was successful in preparing our students to implement other projects in the future in the communities they will serve as physicians.

Our sample yielded a percentage of participants whose abnormal readings were like those of the entire county, suggesting that they are representative of the larger population. These initial results provide a good basis for designing the implementation phase of our project.

Limitations:
Although the primary data focus of the study was to estimate overall CVD risk, without an HDL value we were not able to calculate a numerical risk using calculators based on national evidence. Test strips that measured total blood cholesterol cost approximately $1, while the test strips used to measure HDL along with total cholesterol cost approximately $8. Our funding for this study was not sufficient to use the more expensive strips, so only total serum cholesterol could be measured. Future screenings could benefit from increased funding to measure HDL levels.

Additionally, a formal diagnosis of hypertension requires 3 separate high blood pressure readings on three different occasions. Because we only measured blood pressure several times at one sitting, no definitive diagnosis of hypertension could be made. Participants with elevated blood pressure readings were directed to a definitive source of care so that a diagnosis of hypertension could be made if appropriate. Our blood glucose readings should be considered random measures, as we were unable to know precisely when the patient last ate.

Although we attempted to choose representative screening venues, we went only where we were invited, directed by our advisory council's community contacts. Our initial results may be subject to selection bias. Our original plan was to gather regular data over several years. However, the COVID-19 pandemic forced us to suspend operations at our screening locations, limiting our results to a 2-year period. We expect to return to regular screenings soon and will track how many participants subsequently become established with our free clinic.

The Future
Due to loss of funding and logistical obstacles, the renowned Franklin County CVD prevention program reduced its leadership, staff, and programs beginning in 2001. From 2006 to 2015, the county saw a gradual increase in smoking and mortality rates. By 2015, Franklin County's mortality rate had risen to be no better than the expected mortality rate of Maine based on income.[24] This shows that a CVD screening program built over almost 25 years may lose its benefits within 10 years if continuity is broken. With sustained funding and support from the community, we hope we can avoid this problem as we continue to plan the implementation phase of our effort.

Conclusions

Our results show that regional campus medical students directed by a representative county advisory council and supervised by a regional dean can successfully implement a community CVD screening

effort. The students also expressed a dramatic increase in their confidence in designing and implementing such a project. Lessons learned are shown in Table 8, which we offer for consideration by those at other regional campuses.

Table 8: Suggested Strategies for a Successful Community Project

- Identify a clinical/administrative leader with enough influence to act as project champion.
- Establish a representative advisory council with frequent free lunch meetings.
- Identify a need or risk factor in the community.
- Include enthusiastic lay volunteers to facilitate screenings.
- Go where and when you are invited to conduct screenings.
- Have the ability to schedule referral for definitive care "on the spot".
- Identify where the at-risk populations will be waiting for another reason.
- Be efficient with the time that participants give you; about 5 to 6 minutes.
- Listen to feedback from the Advisory Council, students, and those screened.
- Be willing to make adjustments as challenges arise.

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