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The Feasibility of using Electronic Health Records (EHRs) to describe demographic and clinical indicators of Migrant and Seasonal Farmworkers

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Abstract

Few extensive, national clinical databases exist on the health of migrant and seasonal farmworkers (MSFWs). Electronic health records (EHRs) are increasingly utilized by Federally Qualified Health Centers (FQHCs) and have the potential to improve clinical care and complement current surveillance and epidemiologic studies of underserved working populations, such as MSFWs. The aim of this feasibility study was to describe the demographics and baseline clinical indicators of patients at an FQHC by MSFW status. We described 2012 patient demographics, social history, medical indicators, and diagnoses by MSFW status from the de-identified EHR database of a large, multi-site Colorado Migrant Health Center (MHC). Included in the study were 41,817 patients from 2012: 553(1.3%) MSFWs; 20,665(49.4%) non-MSFWs; and 20,599 (49.3%) who had no information in the MSFW field. MSFWs were more often male, married, employed, Hispanic, and Spanish-speaking compared to non-MSFWs. The most frequent diagnoses for all patients were hypertension, overweight/obesity, lipid disorder, type 2 diabetes, or a back disorder. Although there were significant missing values, this feasibility study was able to analyze medical data in a timely manner and show that Meaningful Use requirements can improve the usability of EHR data for epidemiologic research of MSFWs and other patients at FQHCs. The results of this study were consistent with current literature available for MSFWs. By reaching this vulnerable working population, EHRs may be a key data source for occupational injury and illness surveillance and research.

BACKGROUND

U.S. Farmworkers

Farmworkers represent a substantial number of U.S. workers with estimates ranging from approximately 750,000[1] to over three million.[2] Many farmworkers are seasonal and/or migrant workers and are diverse in nationality, socioeconomic status, and country of birth. According to the National Agriculture Worker Survey (NAWS) by the U.S. Department of

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Labor, approximately 81% of farmworkers reported being Hispanic or Latino, with about 75% born in Mexico, and an estimated 53% unauthorized to work in the United States. Data from NAWS indicated that the average income of a farmworker family is between $15,000 and $17,499 and only 23% have health insurance.[3] Due to their unique laborious working situations and variety of backgrounds, farmworkers have an increased risk of adverse health outcomes and experience many barriers to healthcare access such as literacy, language, financial, or even transportation.[2,3]

An estimated 862,808 migrant and seasonal farmworkers and their family members received care at a Migrant Health Center (MHC) in 2011.[4] Clinical data acquired at MHCs may be an important source for surveillance of the health and safety risks faced by this population, beyond workers' compensation or other occupational health data sources that do not always capture the full picture of farmworker health issues.[5]

Occupation Information in Electronic Health Records

In 2011, the Institute of Medicine (IOM) released several detailed Meaningful Use recommendations, including incorporating occupation and industry information into electronic health records (EHRs). The committee determined that including occupation and industry information into health records may contribute to Meaningful Use.[6] Meaningful Use, as defined by the Centers for Medicare and Medicaid Services (CMS), stipulates that EHRs should be used in a meaningful way to improve healthcare delivery according to certain quality and quantity indicators.[7] The first two stages of Meaningful Use focus on adapting EHRs and participating in Health Information Exchange (HIE). HIE is the process of safely securing and exchanging patient health information across two or more providers in support of Meaningful Use quality measures. Meaningful Use guidance of Stage 3 focuses on improving population health "through better-informed diagnoses, more focused treatment plans, and improved and streamlined return-to-work guidance."[6,7] Occupation information will be an important demographic to facilitate the population health activities of Stage 3.

EHR acceptance provides an opportunity for many researchers across various fields in the United States to increase understanding of disease, injury, surveillance, and other public health efforts among patient populations.[8] U.S. providers and patients generally support adoption of EHRs and HIE,[9–11] including among economically disadvantaged groups.[12] Public health researchers have already begun using EHR data for surveillance[13–16] and population studies of infectious disease.[8] HIE has shown promise in improving patient care and reducing superfluous cost by connecting providers to share patient information in a secure manner.[17–19] Some researchers even found reduced work burden on small providers that use EHRs.[20] Patients are now able to access their own health information using "patient portals" through secure internet access.[21] The increase in use and acceptance contributes to the availability of clinical data for public health research in populations that were previously difficult to reach.

Given the availability of clinical data from clinics that serve farmworkers, this may be an efficient way to study specific injuries and illnesses related to farmworkers as compared to other patients served at these clinics. MHCs offer a unique view of farmworkers from an occupational health perspective if coupled with technical, clinical, and information support from non-profits such as the National Center for Farmworker Health[22] and the Migrant Clinicians Network.[23] MHCs allow farmworkers to access healthcare and may be vital to understanding the health issues of this vulnerable population. Clinical data available from MHC providers may contribute to the national discussion on demonstrating meaningful use by the routine inclusion of occupation and industry within certified EHRs.[6] This study used a merged, de-identified HIE database to describe the patients that visited a Colorado FQHC in 2012 by farmworker status, including demographics, medical indicators, and the most frequent medical diagnoses.[24]

METHODS

EHR Data Source and Population

The medical records data in this study were obtained from the Community Based Research Network (CBRN), a National Institute of Environmental Health Sciences (NIEHS) funded research collaborative.[24] This cross-sectional study captured a snapshot of adult patient EHR data from January 1st through December 31st 2012. Operating as nine community health clinics and a mobile unit, the MHC prioritizes service to all low-income, medically underserved, migrant and seasonal farmworker community members.[25] The database included patient demographics, vital sign measurements, diagnosis codes, and a free text variable with some occupation and/or industry information.

Data Acquisition and Use

A data use agreement was approved and signed by the three principal investigators of the CBRN project to outline specific data handling responsibilities and intended use. Data were acquired using a Virtual Private Network to securely transfer data from the clinic to the HIE manager as a pilot, through both SQL and HL7 coding.[26] The data were stored in secure warehousing units and accessed by the HIE management analysts only for database building and reporting. The HIE assigned encrypted, unique identification codes for each patient and removed identifying information.

Human Subjects Considerations

After Institutional Review Board approval from the University of Texas Health Science Center Committee for the Protection of Human Subjects and CBRN steering committee approval, a de-identified clinical dataset was transferred for analysis from the HIE management organization to the investigator using password protected, University of Texas, secure network storage. This study analyzed the EHR database as though the records were abstracted from paper health records. Patients received their usual medical care at the clinics with no active participation required by the patients. A previous IRB-approved Waiver of Authorization was established for release of records (in place of an individual informed consent).

Patient Descriptors

Encrypted records for patients aged 18 years or older were reviewed for errors and completeness and matched on unique identification codes to distinguish and remove any duplicate records. Demographic factors available from the patient record included age, marital status, sex, primary language, race, ethnicity, insurance, and status of the following —employment, migrant farmworker, and seasonal farmworker. Migrant and seasonal farmworkers were grouped together as "MSFW." Medical indicators from the patient encounter included body mass index (BMI), temperature, heart rate (pulse), and systolic and diastolic blood pressure. BMI was calculated in the medical record, provided in the dataset, and edited for out-of-range values. Additionally, a binary variable was generated to indicate patients with a BMI ≥30 kg/m^2 to reflect obesity versus other. After de-duplication, the last value of the medical indicator in 2012 was included in the study (for example, the latest encounter's BMI value and similarly for other variables). If multiple values existed for the last encounter, an average was taken. International Classification of Disease-Clinical Modification (ICD-CM) diagnosis codes available from the EHR database were also de-duplicated and counted by illness, excluding codes for preventive/non-illness procedures such as vaccination or pregnancy. From the diagnosis codes, binary variables were created to indicate patients with a 2012 diagnosis of one of the most frequently counted diagnoses for all patients including hypertension (e.g. 401.X–405.X), overweight/obesity, type 2 diabetes, lipid disorder, back disorder, anxiety, joint disorders, abdominal pain, drug abuse, and soft tissue disorders. A binary variable was generated for patients with a history of any surgical procedures. The following variables were available but excluded due to text entry and a lack of systematic coding scheme: allergies, education, income, family history, medication list, and social history (drug use, alcohol use, sexual orientation).

The patient demographic population is described as a whole and by MSFW status in Table 1. Since a large portion of patient records were missing MSFW status information, we categorized patients with null values for MSFW status as a third comparison group to understand whether these patients were different. Medical indicators were summarized including the ten most frequent clinical diagnoses based on ICD-9CM code counts for all patients and by MSFW status in Table 2. The chi-square test or Fisher's exact test was used to examine differences for categorical variables (e.g. sex, race, etc.) between MSFWs versus non-MSFW patients and patients with no information (No-Info) regarding MSFW status. The Bonferroni adjustment was used to adjust the resulting P-value for pairwise multiple comparisons for the three MSFW groups (MSFW vs. Non-MSFW, MSFW vs. No-Info, and Non-MSFW vs. No-Info) to make sure that the overall Type I error rate was controlled at 0.05. For continuous variables (e.g., blood pressure, BMI, etc.), the Kruskal-Wallis non-parametric test was used to assess the equality of the median across the three MSFW groups. Further, the Dunn procedure was used to conduct pairwise multiple comparisons of MSFWs, non-MSFW, and No-Info groups, and Bonferroni adjusted P-values were computed for each pairwise comparison. All statistical tests were conducted at a significance level of 0.05 (two-sided). Statistical analyses were conducted using Stata version 11.0 (StataCorp, College Station, TX).[27]

RESULTS

We identified 98,175 patient records from a Colorado FQHC in 2012 (Figure 1). Patient records were excluded from the analysis if the patient was less than 18-years-old (n=28,979) or if there was no provider visit during 2012 (n=27,379). As a result, a total of 41,817 patients were included in the study. Of these, 553 were indicated as MSFW patients; 20,665 were identified as non-MSFW patients; and 20,599 had no information in the MSFW field.

Patient Demographics

Patient demographics (age, sex, marital status, employment, preferred language, race/ethnicity, and insurance) were described and compared across MSFW status groups in Table 1. Among the 41,817 study patients, the median age was 39 years, with males comprising 38.5% of the population. Less than half of patients (41.2%) identified as married; 34.5% were designated as employed; and the majority of patients identified English as their primary language (67.0%). Most patients identified as either Hispanic (53.7%) or non-Hispanic white (40.6%). The majority of patients utilized federal or state funding as payment for medical service (81.7%) compared to self-pay (4.0%) or private insurance (14.3%).

As compared to non-MSFWs, MSFWs were significantly younger, had a higher proportion of males, and a higher percentage of patients identified as married. MSFWs were identified as employed more often than non-MSFWs, and they identified their primary language as English significantly less often. The majority of MSFWs were Hispanic (85.8%), compared to about half of non-MSFWs (49.1%). MSFWs were more likely to use self-pay rather than the federal or state funding to pay for their care compared to the non-MSFW group.

As compared to the No-Info group, MSFWs were significantly older and had a significantly higher proportion of male patients. MSFWs had a significantly higher percentage of married patients, a somewhat higher employed percentage, and a significantly lower percentage of primary English speakers. MSFWs had a significantly higher percentage of Hispanic patients, with only half (50.9%) of MSFWs utilizing federal/state funding for medical compared to 72.7% of the No-Info group using federal/state funding. The No-Info group had a high number of missing values in the marital status, employment, language, and insurance variables. Although not displayed in a table, we also compared the Non-MSFW group to the No-Info group. Compared to the Non-MSFW group, the No-Info group was significantly younger ($P<0.001$) and had significantly more Hispanic patients ($P<0.001$). Other comparisons were not significantly different.

Patient Medical Indicators

Table 2 displays the ten most frequent patient medical indicators, and the prevalence of the ten most frequent diagnoses are displayed in Table 3.

BMI and Obesity—Overall, the MSFW group had a lower mean BMI compared to the Non-MSFW group, but had a significantly higher mean BMI compared to No-Info group. The percentage of obesity was significantly higher in the MSFW and Non-MSFW groups compared to the No-Info group.

Blood Pressure (BP) and BP Categories—Median blood pressure was 120/78 mmHg for all patients at the last visit. The MSFW group had significantly higher median systolic BP compared to Non-MSFW and No-Info group patients. MSFW patients had significantly lower diastolic BP compared to Non-MSFW but significantly higher compared to No-Info. When BP was categorized according to normal, pre-hypertension, hypertension stage 1, and hypertension stage 2,[28] more than half of all patients were categorized as pre-hypertensive (43.4%) or hypertensive (20.1%). The percentage of normal BPs was similar between MSFW and the Non-MSFW patients, but the No-Info group had a significantly higher percentage of patients with a normal BP.

Vitals—Median heart rate was 80 beats per minute and mean patient temperature was 98.03°F. Overall, 66.1% of patients had a previous surgical history. MSFWs had significantly lower heart rate, lower percentage of past surgery, and no difference in temperature compared to Non-MSFW or No-Info patients.

Diagnoses—Each patient had a list of diagnoses associated with 2012 clinic visits. A patient may have had more than one diagnosis for a given visit, so we removed any duplicate diagnosis code entries. The most frequent diagnosis codes for all patients are displayed in Table 2b. The composition of the most frequent diagnoses in all groups was similar, but the leading diagnosis in MSFWs was overweight/obesity followed by hypertension. The prevalence of each of the ten most frequent indicators was lower in the No-Info group, except for back disorder diagnoses, which were the leading diagnosis (15.6%). Note that diagnoses were not mutually exclusive; rather, it was possible for one patient to have multiple diagnoses. Therefore, prevalence percentages across diagnoses rows cannot be added.

DISCUSSION

No national HIE currently exists in the United States. As potentially the first anchor for a national MSFW-focused HIE, this study addresses a lack of current, geographically diverse medical data available on farmworkers around the country and encourages progress in HIE. The goal of this study was to characterize MSFW population served at a Colorado clinic by demographic and medical indicators. The first clinic added to the HIE was a Colorado FQHC that serves as a MHC to nine communities in northeastern Colorado. Patient record data from 2012 were transferred from the health center to the HIE manager. Few comprehensive studies exist to characterize demographics of MSFWs nationally, and specifically in Colorado.

Summary of Results

The demographic findings from this study were similar to those found in the NAWS, including the high percentage of Hispanics among MSFWs and using self-pay to cover medical expenses.[3,29] The No-Info group had a significant number of missing records in marital status, employment, language, and insurance (greater than 99% missing). These missing values made it difficult to interpret significant differences between the No-Info group and the other patient groups. The No-Info group is suspected to have a combination of MSFW and Non-MSFW patients and was, therefore, still included in the patient description as a separate patient group.

In regard to medical indicators, a high percentage of patients were obese (39.3%), and the mean BMI was just under obese classification. Median systolic and diastolic blood pressures were close to the pre-hypertension cutoff, with only 36.6% of patients below the pre-hypertension cutoff at the last visit (120/80 mmHg). Most patients had a normal heart rate and temperature; over 66% of patients reported some form of previous surgery. The most frequent diagnoses assigned to patients in 2012 were chronic diseases with similarly high diagnosis prevalence for MSFWs, Non-MSFWs, and No-Info patients. Most differences between patient groups observed in regards to medical indicators were statistically significant, but not always clinically significant. The large sample size and use of non-parametric statistical methods may have resulted in statistical significance rather than clinical significance.

The results of this study are consistent with the sparse literature available on MSFWs.[30–33] Most of the information available regarding the health of MSFWs is specific to certain regions, such as in California,[33] Michigan,[32,34] New York,[30] or Texas.[32] Limited national information is available from the NAWS.[3,29] In the medical literature available, type 2 diabetes and hypertension were always among the top diagnoses, as shown in this study.[30,32] Most studies found similar demographics among MSFWs, especially the high percentage of Hispanic ethnicity and lower percentage of health insurance coverage. Nearly 25 years ago, type 2 diabetes and hypertension were among the most frequent diagnoses for MSFW patients at MHCs in Michigan, Indiana, and Texas.[32] However, our feasibility study examined adult patients by MSFW status for Colorado. For hypertension, the 2005–2006 NHANES[35] estimated that 29% of U.S. adults were stage 1 hypertensive or higher (above 140/90). In our study, the prevalence for all patients was (20.1%), which was lower than the NHANES, but we did not have information about medication use or controlled hypertension. Future expansion of this analysis to other FQHCs will provide the opportunity to fill a gap in data available for research and greater geographic representation. Upcoming EHR requirements regarding Meaningful Use may help bridge the gap between medicine and epidemiologic research. Rather than conducting extensive studies in patient populations, epidemiologists may be able to utilize EHR and HIE databases to establish exposure and health outcome associations while addressing Meaningful Use Stage 3 requirements, including to “improve population health”.[6] Systematically incorporating industry and occupation into EHRs can streamline public health research for vulnerable populations as outlined in Stage 3 of Meaningful Use.

Study Limitations

As a feasibility study, we identified some limitations regarding EHR data. A substantial number of data were missing for nearly half of all patients in 2012, including information about the MSFW variable that we used for comparison. Depending on the distribution of missing values, this could reduce the validity of our results. Further research in this database revealed that missing values may be due to errors during the data transfer from the clinic to the HIE and subsequently to the researcher, rather than a lack of collection by clinic staff[36] or refusal by the patient to provide information upon request. Speculation of possible errors included inconsistency in file selection or file corruption during transfer from the HIE formatting to a dataset. Another possibility for error is in variability of data collection methods between different providers, which has been found as an issue in other hospital departments.[37] The records from this study come from a Colorado patient population, rely on the ICD-9CM coding scheme, and may not be generalizable to all MSFWs, FQHC users, general clinic patients, or the general U.S. population. When conducting research in a working population, the healthy worker effect should also be considered as a potential selection bias where workers may be healthier than non-workers.[38]

In regard to the MSFW category, information about standard clinic practice was obtained from CBRN clinic and community partners in order to understand the function and reliability of this variable. The MSFW category is currently documented in the EHR system as a billing assignment. Instead, there should be a special population designation category in addition to the billing field. This would allow the documentation of both the MSFW status and, in the event that the patient has third party coverage, the billing information. Providers at this clinic track MSFW status using a non-payor related variable that was not transferred with this database but is critical in future analyses to ensure the distinction between the two identifiers and better understand the percentage of MSFWs that are utilizing the different payor systems (personal communications Ed Hendrikson, 4/18/2013, E. Roberta Ryder, 6/13/2013). Using a non-payor related variable may reduce misclassification of MSFWs and improve understanding of MSFW medical needs.

On a national basis, FQHCs designated as a MHC receive a portion of their annual grant as PHS 330 (g) funding in order to address the cost of care for MSFW patients. The amount of this grant is calculated on the basis of a projection of the number of patients to be seen. Historically new start awards are made on an average of between $250 and $400 per MSFW user per year, seldom enough to cover the cost of care for more than two or three medical encounters, let alone provision of dental, behavioral, or ancillary services such as outreach, transportation, interpretation, or environmental services, which are essential to serving this population. Therefore, if a MSFW qualifies for third party reimbursement, such as Medicare, the Colorado Indigent Care Program (CICP), or has commercial insurance, the clinic staff might not document a patient’s MSFW status, thinking to shift the cost to that other payor in order to receive a higher reimbursement. This is probably not intentional, but merely a difference in eligibility.

The quality of data received may also benefit from improved coding or consistency in collection. For example, information in the education variable was not systematically collected and was, therefore, difficult to analyze. The field was an open text field, rather than a prescribed selection. In the insurance field, there were specific options: self-pay, federal programs (Medicaid/Medicare), state programs (CICP, Children’s State Insurance program), or private insurance. Obtaining patient level of educational attainment can easily be conducted in a systematic coding scheme modeled after any national survey. Other examples of variables obtained but inconsistently coded included income, allergies, family histories, and medication. Additionally, certain variables were collected but missing completely, such as smoking status. Smoking status is particularly important when examining hypertension.[28] Including information on demographics is part of Meaningful Use standards, and refining these variables using coding schemes and improved quality will be important at later stages of Meaningful Use. Using information such as education, smoking status, family histories, etc., the provider can improve their care delivery, and epidemiologists can improve recommendations for understanding health risk factors and future interventions. Beyond Meaningful Use, including demographics is important in epidemiologic research to understand health issues of MSFWs, since few resources currently exist.

Study Strengths

Generally speaking, health information technology has a positive impact on care,[38] but continued efforts are necessary to improve the usability and quality of EHR data. This study outlines some of the challenges of using EHR data and provides practical suggestions for improvement. Initially, it took several years to build partnerships in the community, the clinic, and with academia. As the CBRN was forming, much effort was taken to compile a medical database for research and found that the HIE provided the best foundation for the future of a national database. This study also shows how quickly data can be transferred from the clinic to the HIE, de-identified, and transferred to the researcher (less than one year). Finally, a major strength of this study was the opportunity to have a built-in comparison group by having access to non-MSFW patients attending the same clinic.

EHRs have the capacity to collect many different patient indicators, but the best quality (consistency in coding and entry) was found in those required or directly related to Meaningful Use. Stage 1, Step 5 Meaningful Use requirements include demographics and vital signs assessment during a patient visit. Core measure 5 under Stage 1 involves collecting preferred language, gender, race, ethnicity, and date of birth. Core measure 8 involves collecting vital signs, including height, weight, blood pressure, and BMI calculation for adults.[7] Variables not required by Meaningful Use at the time, such as family history, had no coding scheme and no systematic entry method. Whereas, variables that were required by Meaningful Use had the lowest percent of missing values and were the simplest to understand.

CONCLUSION

The purpose of this study was to assess the feasibility of using EHRs to conduct epidemiologic research in a specific working population, with future studies to include prospective, longitudinal research in MSFWs and other populations that utilize FQHCs. From the FQHC database, we were able to successfully describe the overall patient population and compare known MSFWs to known non-MSFWs, but we also had a significant issue with missing demographic and medical data. Our findings indicated that chronic disease is similar among this group of MSFW patients compared to other patients groups at this clinic. Also, our findings were consistent with the current literature on hypertension risk factors, including age, obesity, and sex. Future studies may include additional data collection and improved validation of data from the clinic to the researcher. Medical chart review may supplement current survey methods such as the NAWS[40] in describing MSFW health outcomes. This may be an effective way to improve epidemiologic research in populations with a weak knowledge base, specifically MSFWs. By reaching this vulnerable working population, EHR data may be vital for occupational injury and illness research in support of Stage 3 Meaningful Use.

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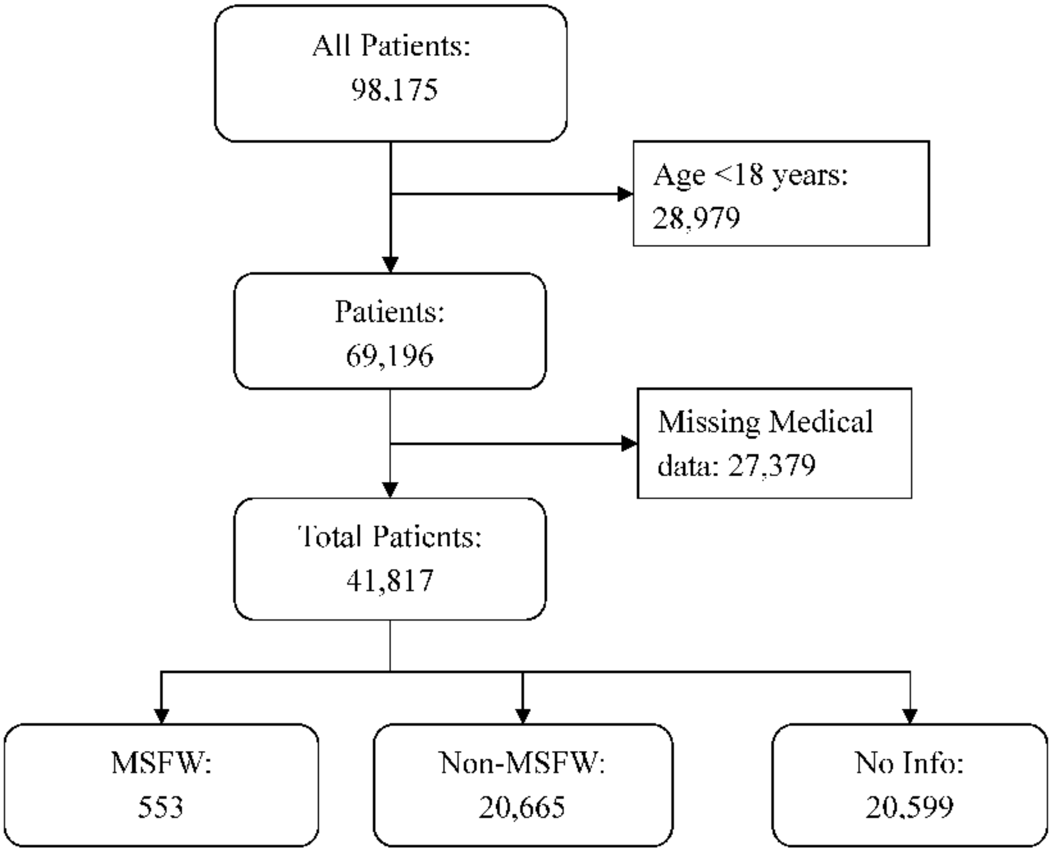

Figure 1.
Electronic patient record inclusion diagram (Colorado Health Center, 2012)

TABLE 1

Demographics of All Patients and Patients by MSFW Status (Colorado Health Center, 2012)

	All Patients	MSFW	Non-MSFW	No Info	P-Value^a
Number of patients	41,817	553	20,665	20,599	
Age, years					
median (IQR)	39 (28,52)	39 (29,51)	44 (31,55)*	36 (26,48)*	<0.001
Total patients (N)	41,817	553	20,665	20,599	
Sex					
Males, n (%)	15,930 (38.5)	280 (50.6)	7,713 (37.3)*	7,937 (39.3)*	<0.001
Total patients (N)	41,421	553	20,665	20,203	
Marital Status					
Married, n (%)	8,598 (41.2)	306 (56.6)	8,242 (40.8)*	50 (42.0)*	<0.001
Total patients (N)	20,847	541	20,187	119	
Employment					
Employed, n (%)	6,659 (34.5)	174 (46.4)	6,451 (34.2)*	34 (39.1)	<0.001
Total patients (N)	19,302	375	18,840	87	
Language					
English, n (%)	14,231 (67.0)	124 (22.5)	14,063(68.3)*	44 (57.1)*	<0.001
Total patients (N)	21,233	552	20,604	77	
Race/Ethnicity, n (%)					
All Hispanic	21,172 (53.7)	452 (85.8)	9,704 (49.1)*	11,016 (57.6)*	
Non-Hisp.-White	16,020 (40.6)	70 (13.3)	8,984 (45.4)	6,966 (36.4)	<0.001
Non-Hisp.- other	2,260 (5.73)	5 (0.95)	1,095 (5.5)	1,160 (6.1)	
Total patients (N)	39,452	527	19,783	19,142	
Insurance, n (%)					
Self-Pay	734 (4.0)	175 (42.6)	556 (3.1)*	3 (3.0)*	
Federal/State	15,027 (81.7)	209 (50.9)	14,746 (82.5)	72 (72.7)	<0.001
Private Insurance	2,626 (14.3)	27 (6.6)	2,575 (14.4)	24 (24.2)	
Total Patients (N)	18,387	411	17,877	99	

[a] =Overall difference using χ^2 test (categorical variables) or Kruskal-Wallis test (continuous variable, age)

[*] =Significant difference compared to the MSFW group using Dunn Procedure (Kruskal-Wallis), Fisher's Exact test, or χ^2 test with the Bonferroni correction for multiple comparisons.

TABLE 2

Description of medical indicators (Colorado Health Center, 2012)

	All Patients	MSFW	Non-MSFW	No Info	P-value[a]
Number of patients	41,817	553	20,665	20,599	
Obesity					
BMI>=30, n (%)	14,832 (39.3)	227 (42.5)	8,525 (43.9)	6,080 (34.3)*	<0.001
Total Patients (N)	37,702	534	19,433	17,735	
BMI, kg/m^2					
mean (SD)	29.3 (7.0)	29.7 (5.8)	30.1 (7.3)	28.5 (6.6)*	<0.001
Total Patients (N)	37,702	534	19,433	17,735	
Systolic BP, mmHg					
median (IQR)	120 (110, 130)	122 (112,132)	120 (110,128)*	120 (110,132)*	<0.001
Total Patients (N)	41,554	551	20,605	20,398	
Diastolic BP, mmHg					
median (IQR)	78(70,82)	78(70,84)	79 (70,84)*	77(70,82)*	<0.001
Total Patients (N)	41,554	551	20,605	20,398	
BP Categories, n (%)					
Normal	15,213 (36.6)	180 (32.7)	6,667 (32.4)	8,366 (41.0)*	
Pre-hypertension	18,017 (43.4)	257 (46.6)	9,058 (44.0)	8,702 (42.7)	
Hypertension Stage 1	6,220 (15.0)	81 (14.7)	3,519 (17.1)	2,620 (12.8)	<0.001
Hypertension stage 2	2,105 (5.1)	33 (6.0)	1,361 (6.6)	710 (3.5)	
Total Patients (N)	41,554	551	20,605	20,398	
Heart Rate, beats/min					
median (IQR)	80 (72,84)	77 (70, 84)	80 (72, 86)*	78 (72, 84)*	<0.001
Total Patients (N)	40,143	549	20,333	19,261	
Temperature, °F					
mean (SD)	98.03 (0.6)	98.07 (0.6)	98.01 (0.6)	98.06 (0.6)	<0.001
Total Patients (N)	37,381	526	18,683	18,172	
Past Surgery					
Yes, n (%)	27,657 (66.1)	311 (56.2)	15,126 (73.2)*	12,220 (59.3)*	<0.001

	All Patients	MSFW	Non-MSFW	No Info	P-value[a]
Total Patients (N)	41,817	553	20,665	20,599	

[*] =(Pairwise)Significant difference compared to MSFWs based on Fisher’s Exact test, χ^2 test, ANOVA or Dunn Procedure (Kruskal-Wallis)

[a] =Overall difference using χ^2 test (categorical) or Kruskal-Wallis test (continuous)

TABLE 3

Top 10 Most Common Diagnoses Among Patients with Available Diagnosis Codes, Excluding Diagnostic or Preventive Codes (Colorado Health Center, 2012)

	All Patients	MSFW	Non-MSFW	No Info	P-value[a]
Number of patients	41,817	553	20,665	20,599	
Prevalence of Top Diagnoses[b], n (%)					
Hypertension	8,087 (19.3)	122 (22.1)	5,860 (28.4)*	2105 (10.2)*	<0.001
Overweight/Obese	6,047 (14.5)	190 (34.4)	4,543 (22.0)*	1,314 (6.4)*	<0.001
Lipid Disorder	5,604 (13.4)	77 (13.9)	4,069 (19.7)*	1,458 (7.1)*	<0.001
Type 2 Diabetes	4,954 (11.9)	73 (13.2)	3,416 (15.5)	1,465 (7.1)*	<0.001
Back disorder	4,861 (11.6)	68 (12.3)	1,576 (7.5)	3,217 (15.6)*	<0.001
Anxiety	4,434 (10.6)	44 (8.0)	3,203 (15.5)*	1,187 (5.8)	<0.001
Joint Disorder	3,735 (8.9)	44 (8.0)	2,482 (12.0)*	1,209 (5.9)	<0.001
Abdominal Pain	3,591 (8.6)	41 (7.41)	2,145 (10.4)*	1,405 (6.8)	<0.001
Drug Abuse	3,519 (8.42)	47 (8.5)	2,741 (13.3)*	731 (3.6)*	<0.001
Soft Tissue Disorder	3,158 (7.55)	39 (7.05)	2,080 (10.1)*	1,039 (5.0)	<0.001

* -Significant difference compared to MSFWs based on Fisher's Exact test

[a] -Overall difference using χ^2 test

[b] -Each patient may have had more than one diagnoses, but multiple diagnoses of the same health outcome were removed. The top 10 diagnoses were based on all patients rather than each individual group