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Evaluating CMSRU student clinic diabetic patients' hemoglobin A1c values, adherence to laboratory services, and potential barriers to care

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Abstract

Medical schools often have student-run clinics that give medical students the opportunity to have increased clinical exposure. Often, the clinics provide free or a reduced cost of care for patients and target underserved populations. Current research regarding medical student-run clinics is few and far between. The research that does exist usually targets investigating the effect of the clinics on medical student education, while fewer studies exist that target investigating the actual care that patients receive. In order to increase the number of studies investigating patient care at student-run clinics, this retrospective chart review sought to determine whether Cooper Medical School of Rowan University's student-run clinic adequately evaluates diabetic patients' hemoglobin A1c level through lab referrals. It also strived to determine whether patients are able to adhere to those lab referrals and whether those patients have any documented social barriers to health that are preventing them from adhering to lab services. The chart review, of 100 patients diagnosed with type II diabetes, found that students do refer patients to lab services, and that patients do go to the labs. However, patients often are lost to follow-up, and their social history is often not documented in the electronic medical record. In addition, there was no significant improvement in two consecutive hemoglobin A1c values collected from patients' charts. These results suggest that while the clinic is adequately assessing a core measure for diabetes care, it is not adequately assessing patients' social needs or working on improving patients' hemoglobin A1c levels.

Introduction

       Student-run clinics in medical schools are a common component of the medical school curriculum and their goals are often two-fold: to provide more clinical experience for medical students, and to provide healthcare access for underserved populations.

       A survey sent to all AAMC medical schools evaluated the prevalence and characteristics of student-run medical clinics. The survey was created because, at the time, no data had been collected on student clinics that best summarized the organization and services that the clinics offer. With a high response rate, the survey included questions regarding the site, hours of operation, funding sources, budget, patient demographics, and reasons for visits. It was found that the medical student-run clinics see a diverse patient population, with most patients being minority populations, and patients were most often uninsured. Most visits were for chronic medical condition management. Funding was primarily from grants, fundraising, or the government. The article concludes that these student-run free clinics provide much-needed access to healthcare for marginalized populations while still maintaining quality care and access to laboratory services, specialists, and social services[1].

       Clinical publications on medical student-run clinics are few and far between. Medical students and physicians associated with the clinics often publish articles summarizing the development of medical school clinics and describing methods implemented to better connect with underserved patient populations. Authors from JeffHope, a clinic affiliated with Jefferson Medical College, described the clinic origins and goals, consistent with many other medical student clinics. The founding mission of the clinic was to serve the homeless and uninsured population in Philadelphia and to bridge the gap before finding a primary care provider for patients. There are multiple clinics scattered through Philadelphia with residents and student volunteers. While the service is not free, clinical services are provided at a reduced cost[2]. Student clinics are common at medical schools, with about 50% of medical schools having at least

one student-run clinic[1]. Most of the clinics provide care for minority populations with chronic medical conditions, as is true for the clinic at Cooper Medical School of Rowan University (CMSRU).

The student-run clinic at CMSRU is a multidisciplinary clinic that serves uninsured patients from the city of Camden. Patients typically are referred to the clinic from Cooper Hospital, but also have heard about the clinic from word of mouth. The clinic runs Monday through Thursday for three to four hours in the late afternoon during the school year. Clinic teams are comprised of a first, second, and third-year medical student, as well as one to two pharmacy students. The pharmacy students often do a medication reconciliation alone with patients at the start of clinic, while third-year students lead educational, clinical discussions. Medical students conduct interviews and perform physical exams with patients for 20-30 minutes, and then present to attending physicians to discuss the assessment and plan for each patient. Patients can be referred to specialists or to laboratory facilities via forms that offer free services for the patients. The clinic also has social work student coordinators who assess patients' health care barriers during each visit. Students write the patient notes on the electronic medical record system (EMR) with Epic software, which can be accessed by all Cooper providers.

Based on literature reviewed in relation to student-run clinics, most of the publications address the educational benefits for students. Authors often evaluate student perceptions, empathetic skills, and educational value when pursuing research on student-clinic outcomes. One article investigated students' perceptions about caring for the underserved and found that students who volunteered at a homeless clinic had more positive attitudes towards that patient population[3]. Another study investigated the role of empathy development in student-run clinics[4]. Other journal articles focused on how student-run clinics contribute to medical student education, including one study that found that multidisciplinary student-run clinics increase awareness of other health professional roles[5]. This is certainly important to evaluate, but one critical aspect often missing from literature searches of student-run clinics are patients' health outcomes.

The primary goal of student-run clinics is to provide care for underserved patients. Nevertheless, while many articles investigate student perceptions, educational value, and clinic characteristics, health

outcomes for patients are not investigated nearly as often. Some do assess patient satisfaction outcomes to target areas of improvement in the clinic, and have identified areas including hours of operation, information privacy, and likelihood of recommendation[6]. In addition, some articles can be found that address outcomes of chronic medical conditions, including diabetes, hyperlipidemia, and hypertension. Outcomes that investigators focused on included hemoglobin A1c, LDL, triglyceride, blood pressure, and HDL values[7,8,9,10]. These studies do exist, yet only approximately 10% of articles found on student-run clinics truly investigated patients' health outcomes. This suggests there needs to be a better balance of types of student-run clinic clinical research, with a focus on outcomes to determine how well patients' chronic medical conditions are managed.

Type II diabetes is a common chronic medical condition that can be difficult for patients to manage and that the CMSRU clinic encounters almost daily in the patient population. One of the core measures that the Centers for Medicaid and Medicare Services has identified for evaluating diabetes outcomes is the hemoglobin A1c screening and hemoglobin A1c control. At the CMSRU clinic, patients who need this lab value checked are referred to the laboratory services, which is free of cost. At subsequent visits, students may encounter that patients have not gotten this lab drawn, further hindering adequate diabetes management. On the one hand, these patients may have significant social barriers preventing them from going to laboratory services, including, but not limited to, transportation, language, childcare, and job requirements. These social barriers can be documented in student notes, as well as a specific social history section in the EMR. On the other hand, there also may be a communication barrier in the student teaching about diabetes care management

The goal of this retrospective study, is therefore, to evaluate medical students' referrals to laboratory services for hemoglobin A1c values, patients' adherence to these referrals, improvements in hemoglobin A1c values, and social barriers patients may have. According to the Association for Healthcare Research and Quality, hemoglobin A1c screening in patients diagnosed with diabetes is a good way to evaluate an interventions' effects[11,12,13]. Adequate control of hemoglobin A1c values is associated with improved outcomes in cardiovascular events, microvascular complications, and

mortality[13]. The American Diabetes Association recommends a hemoglobin A1cgoal of less than 7% and to obtain a screening in the diabetic population at least twice yearly[12]. Barriers do exist that prevent patients from accessing screenings, including barriers in the financial, structural, and cognitive categories. These barriers prevent access to screening, presentation to care, and adequate treatment, resulting in worse health outcomes[14]. Therefore, this study aims to investigate potential social barriers to health that may hinder patients from diabetes screening, as well as to determine if the CMSRU medical students are adequately screening and managing an aspect of the patients' diabetes care.

Methods

This study is a retrospective chart review of patients in the CMSRU clinic diagnosed with type II diabetes. An Institutional Review Board (IRB) proposal was submitted and approved in November 2018. The IRB proposal involved submitting a document with several different components. The first component was a statement of the objectives, hypotheses, background, and significance of the research. The objectives included the statement that the CMSRU student clinic manages uninsured, underserved patients with chronic medical conditions. This project strived to evaluate how the CMSRU student run clinic is managing patients with type II diabetes. As part of this evaluation, the chart review aimed to collect the hemoglobin A1c core measure, derived from the diabetes core measure set from the Centers for Medicare and Medicaid services. In addition, the chart review documented whether patients were referred to lab services and whether those patients adhered to lab services and therefore were actually able to monitor their hemoglobin A1c value. The retrospective chart review also evaluated if potential socioeconomic barriers to lab adherence exist by evaluating the patients' notes and social history section.

The next component of the IRB proposal involves stating the study design and the research plan. The study design was a retrospective chart review that extended from August 1, 2015 to September 30, 2016, of 100 subjects with type II diabetes at the CMSRU student clinic. Patients were determined to have type II diabetes via the diagnosis section in the EMR system. The exclusion criteria were patients who are not CMSRU student clinic patients and who do not have type II diabetes. The included patients

were identified using the CMSRU clinic database of appointments on the EMR, which medical students are able to access, and data was gathered from the subjects' charts and laboratory values on the EMR.

Finally, the IRB proposal outlined the data analysis plan, risks and benefits, and procedures to maintain privacy. To analyze the results, percentages were calculated for each outcome. Out of 100 patients, percentages of lab referrals and patients' adherence to lab referrals were calculated. In addition, average hemoglobin A1c values were calculated, both from before and after lab referrals. Two consecutive hemoglobin A1c values were compared using a paired t-test, using Excel data analysis software, and with a significant p-value being <0.05. Social history analysis entailed the qualitative aspect of the study, which attempted to identify trends in patients' socioeconomic barriers. Risks were reduced for this chart review by keeping the data de-identified on a password-protected computer in the student-run clinic.

Results

The results of this study are both quantitative and qualitative in nature and include the referral and adherence to getting labs done, the initial hemoglobin A1C levels, a second hemoglobin A1C level, and the social history.

For patients diagnosed with diabetes, 84% were referred to the lab for hemoglobin A1C levels. 69% of patients diagnosed with diabetes adhered to the referral for laboratory services and were able to check their hemoglobin A1c level (Figure 1). 34% of all of the patients had no initial hemoglobin A1c value documented. Out of the 100 patients in the population, 33% of them had no post-referral hemoglobin A1c levels (Table 1).

Patients' initial hemoglobin A1C was an average of 7.9, well above the value required for a diagnosis of type II diabetes. The average hemoglobin A1C after referral to the lab was 7.13. Using paired t-test analysis to determine if there was a significant change between the average hemoglobin A1C values revealed that there was no significant difference between the two, with a p-value of 0.14 (Table 1).

Out of the 100 patients in the group, 63% had no social history documented in the electronic medical record. From those that had documented social history, 16% were deemed lost to follow-up, 4% had documented economic issues, and 1% had documented transportation issues (Figure 2).

Discussion

The results of this retrospective chart review suggest that the majority of patients (84%) with type II diabetes at the CMSRU clinic who need to have their hemoglobin A1c values checked are sufficiently referred to the laboratory services. In addition, the majority of those patients (69%) are able to successfully get their hemoglobin A1c values checked at the lab. There was no significant improvement in consecutive hemoglobin A1c values and the second-look values were still above 7.0. For best diabetes control, the hemoglobin A1c goal is to be less than 7.0. Qualitatively, most of patients had no social history documented in the EMR. Of those that did, 16% were lost to follow-up and never returned to clinic. Those with economic issues often had notes that stated patients could not afford medication. Another common social issue was a lack of transportation.

In summary, there is always room for improvement, but generally, medical students at the clinic are adequately recommending that patients with type II diabetes need to have laboratory follow-up and check their hemoglobin A1c levels. This leads to patients, more often than not, successfully going to the lab and checking these levels. However, the hemoglobin A1c values are still not adequately controlled, on average. Though it is difficult to determine why this may be the case, the social history could sometimes suggest some reasons. A large percentage of patients were lost to follow-up, which prevented further diabetes management and identification of reasons for failed hemoglobin A1c control. Economic barriers could also be a reason, as this may prevent some patients from paying for medications needed to manage their diabetes. In addition, transportation issues would prevent medication pick-up as well as regular attendance at clinic appointments.

There are several limitations to the study, in each aspect of data collection. Patient population size can certainly be increased. 100 patients were chosen arbitrarily, but there are many more patients in the

clinic diagnosed with type II diabetes. Increasing the patient size would increase the validity of the results.

Another limitation is the selection of patients based on their type II diabetes history. This was gathered from the history section in the EMR. The problem with that, is that often the EMR does not have accurate information about patients' past medical history. In order to diagnose type II diabetes, the hemoglobin A1c must be equal to or greater than 6.5%, or the fasting glucose must be 126 mg/dL or greater, or the two-hour glucose must be 200 mg/dL or greater[11,12]. During this chart review, it was assumed that type II diabetes diagnosis was determined using the appropriate criteria. This assumption may have caused some patients who were falsely diagnosed with type II diabetes to be included in the patient population. A possible way to have prevented this would be to check previous laboratory data to see if it fit a type II diabetes diagnosis. However, a patient could have been diagnosed with diabetes in a different hospital system, or patients may have told interviewers they were diagnosed with the condition in the past even if they were not actually diagnosed.

Instead of solely focusing on the hemoglobin A1c values, other diabetes core measures could have been evaluated as well. These include looking at a lipid panel and glucose levels, which other student clinics have evaluated[13,9]. This study aimed to focus on the core value of hemoglobin A1c, but other data could have been collected to better suggest whether patients' diabetes is being adequately controlled at the CMSRU clinic.

There was no set period of time between the first and the second hemoglobin A1c value comparison. The hemoglobin A1c value is an average blood sugar over a 3-month period. Since the time between the first and second hemoglobin A1c data was not documented during data collection, this period could have been less than a 3-month period. This may have falsely suggested that patients' diabetes was not adequately controlled, based on hemoglobin A1c values, while patients simply may have needed more time for a new average blood glucose level. In addition, it often takes time to control diabetes with medications, lifestyle changes, and advice from clinic visits.

For patients who were referred to laboratory services, those patients are given forms to allow them to go to the laboratory. Therefore, a patient would need this form to get the hemoglobin A1c level checked. However, when checking if patients successfully went to the lab, it was not necessarily checked that the patient was referred to the lab. Fortunately, patients who were not referred did not have laboratory data.

Another limitation in this study was the lack of data on social history. Social history at the clinic can be documented in the medical student note or social history section of the EMR. However, only 37% had social history documented. One potential reason for this could be that the social work coordinators in the clinic have their own social history documentation system. They use paper forms at each visit, which go into a paper chart created for the patient. However, medical students do not access the patient charts to input social history into the EMR, and there is little communication between the students and the social work coordinators about patients' social history. These results and limitations offer room for new clinic interventions.

Conclusion

In summary, this is a retrospective chart review that evaluated the CMSRU student-run free clinic's management of patients diagnosed with type II diabetes, while assessing for adequate social history documentation in order to determine gaps in care. To do this, 100 patients with the type II diabetes diagnosis in the EMR were selected. It was determined if they were referred to laboratory services, and if the patients went to the lab. A pre-referral and post-referral hemoglobin A1c were also documented. Finally, any social history in the patients' charts was also documented.

The results suggest that CMSRU medical students are sufficiently referring patients with type II diabetes to the lab to check their hemoglobin A1c levels, which is one of the Medicaid core measures. In addition, most patients do go to the laboratory. However, there was no significant difference between the pre and post-referral hemoglobin A1c levels, suggesting that the actual diabetes control is not sufficient.

Finally, the most important data gathered from the social history is that many patients are eventually lost to follow-up in the clinic, which prevents any further diabetes management.

There is always room for improvement, and though most patients are referred to labs and most go to labs, those percentages could increase. To improve students' referral rates to laboratory services, a list of the core measures for common chronic medical conditions could be distributed to students. Along with those core measures, instructions for managing those core measures, including how often patients need to be referred to laboratory services could be included. It becomes more complicated when trying to improve patients' adherence rates to laboratory services, since the reasons for not going are often multi-faceted. Still, several innovative interventions have been attempted in the past, including one that involved a mobile application and texting service that sent reminders to patients[15]. The issue with this is that not all patients necessarily have phone capabilities to use those services, particularly in underserved areas.

To improve patients' general management of the core hemoglobin A1c measure, that also becomes more complex. Patients may not be taking their medications, or may not be eating healthily, or may not be exercising, to name a few. This could be assessed at each visit. However, due to the busy nature of the CMSRU clinic, it sometimes is unrealistic to be able to always allow for an in-depth visit. Therefore, one potential clinic change could be to create diabetic group visits. A clinic implemented group visits to manage chronic conditions and streamline care[16]. By creating group visits, students could assess how patients currently manage diabetes and then teach the patients about how to manage diabetes with lifestyle changes.

The main issue identified through this chart review is that the social history was not documented well in the EMR. It is part of the standard of care in the clinic for each patient to complete a social history form through care coordination efforts, usually by a social work student or medical student volunteer. These forms are placed in patient charts in the back of the clinic, but often never accessed again. Since social history is asked every time the patients come into clinic, medical students usually don't ask the history unless it seems relevant. One way to incorporate the social history taking into the EMR would be

to have the social work students put that information into the EMR. A clinic does that at a clinic with primarily Spanish-speakers and it helps identify specific socioeconomic needs[17].

There also definitely needs to be better encouragement for patient follow-up. More than half of the patients were lost to follow-up, identified by no further clinic attendance. Students could be required to call their scheduled patients a day or two before their visit to improve clinic attendance. The earlier-stated idea of text reminders could serve to improve attendance as well. However, without adequately assessing patients' barriers to clinic attendance, it's difficult to know how to improve this aspect.

Without innovation, there would be no change or progress. To ensure that the CMSRU student-run clinic improves, it is important to evaluate for areas of improvement. Since the primary goal of the clinic is to care for underserved patients without insurance, this retrospective chart review sought to see if a subset of the patient population has been adequately cared for. Though the chart review timeline was from a little over two years ago, the results can generally be extrapolated to today because there has not been anything significant that would have caused changes in how patients with diabetes are being managed. Therefore, it can be concluded that the clinical evaluation of how patients with type II diabetes is sufficient and follows guidelines, however there need to be changes to other details of managing diabetes. Several potential changes that could bridge this management gap were addressed previously. This includes further evaluation and EMR documentation of socioeconomic barriers as well as patients' knowledge about their chronic medical condition.

Figures

Subject number	Initial HbA1c	New HbA1c
1	8.1	None
2	5.9	None
3	6.8	6.9
4	7.6	6.4
5	6.8	7.4
6	7.2	7.1
7	5.8	5.3
8	13.6	12.2
9	5.4	None
10	None	4.5
11	10.9	None
12	7.3	None

13	None	6.7
14	None	5.5
15	None	11.3
16	8.2	6.7
17	None	5.7
18	12	13.3
19	7	7
20	6.1	None
21	None	5.7
21	None	5.9
23	None	6.7
24	5.5	5.4
25	5.3	5.5
26	5.7	None
27	6.1	None
28	13.5	None
29	None	None
30	None	6.7
31	5.5	5.4
32	5.3	5.5
33	8.9	7.2
34	11.5	11
35	8.8	8.5
36	5.9	None
37	None	None
38	5.9	5.3
39	5.9	None
40	5.6	5.9
41	None	7.1
42	12.4	7.4
43	8.4	12.4
44	6.4	None
45	None	5.6
46	10.9	None
47	None	5.9
48	9.5	9.7
49	13.4	None
50	9.5	8.8
51	9	10

52	None	5.6
53	6.5	
54	None	6.4
55	7.9	8
56	None	5.4
57	10.1	None
58	None	12
59	5.8	None
60	6.4	None
61	None	None
62	5.5	5.1
63	5	5.6
64	None	None
65	12.2	13.2
66	6.1	None
67	9.1	7.1
68	None	5.1
69	6	None
70	None	5.9
71	5.8	None
72	6	None
73	9	12.6
74	5.8	5.3
75	None	None
76	5.2	None
77	6.7	6.2
78	7	6.8
79	7.2	None
80	None	None
81	6	5.9
82	6	5.8
83	None	5.5
84	None	5.2
85	None	5.2
86	None	6.2
87	11.2	8.9
88	None	4.5
89	11.3	7.4
90	7	7.5

91	13.3	None	
92	14.4		6.7
93	None		10
94	None	None	
95	None		5.7
96	7.5		6.3
97	None		5.7
98	5.8		6.5
99	5.8	None	
100	None	None	
Average	7.866666667		7.134848485

Table 1: Hemoglobin A1c values pre and post-referrals to laboratory services.
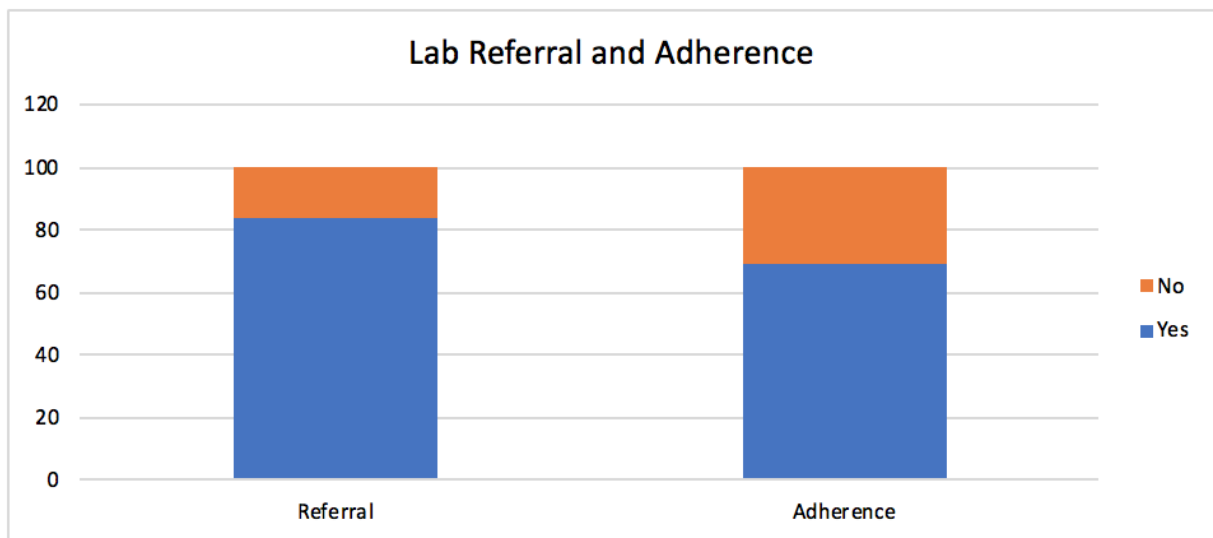Paired t-test: p-value=0.144

Figure 1: Percentage of patients referred to laboratory services (84%) and percentage of patients who adhered to going to laboratory services (69%).
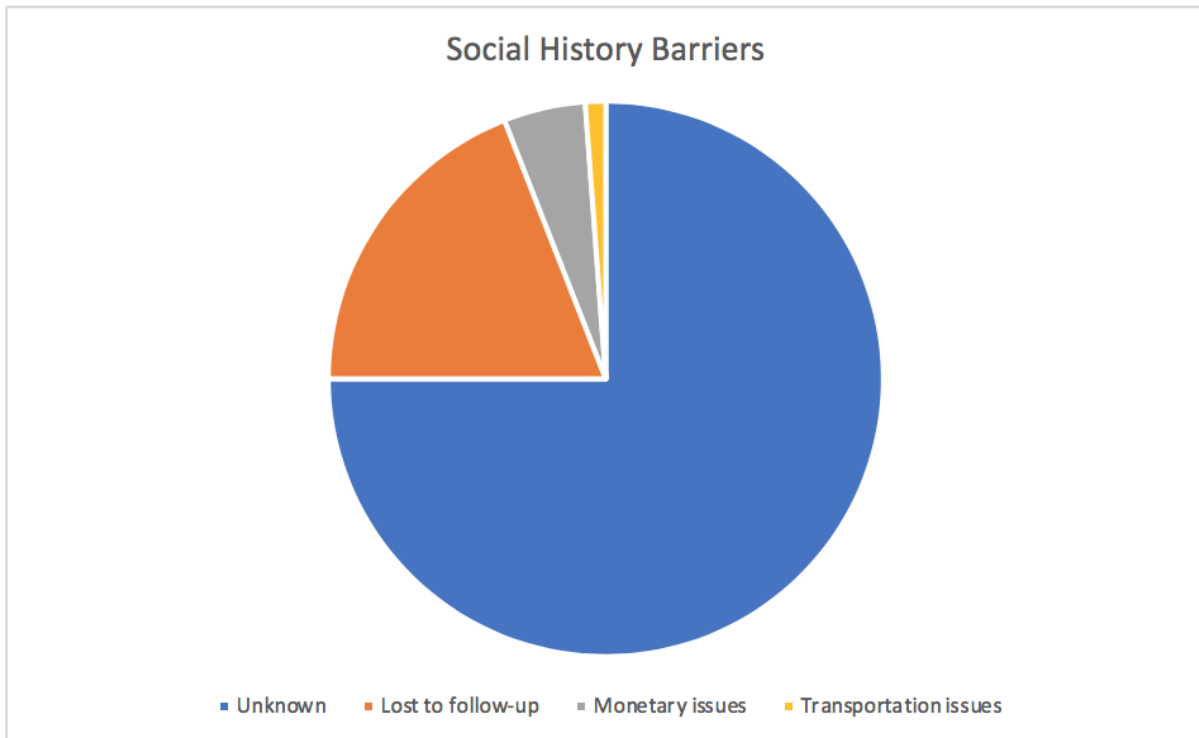
Figure 2: Most common social history barriers documented in patients' EMR chart.

Annotated bibliography (in order of citations)

1.   Simpson SA, Long JA. Medical student-run health clinics: important contributors to patient care and medical education. Journal of general internal medicine. 2007;22(3):352-356.

The authors of this journal article wanted to publish data on the medical student-run clinics throughout the U.S. and did so by distributing a survey to all AAMC allopathic medical schools in the country. The goal of the survey was to describe the prevalence of the clinics among medical schools and how the clinics operate. The survey collected data on various aspects of the clinics, including sites, hours of operation, finances, budget, patient demographics, reasons for visits, and clinic volume. The authors had a response rate of 74%, from 94 schools, and concluded that many of the student-run clinics care for disadvantaged patients. They state that the clinics are a "phenomenon" in medical school education.

Though the survey used in this article did not get the maximum number of responses, the majority of schools responded. It was helpful to really describe what most of the clinics do. The survey results are helpful for me because it gives a decent background on student clinic operations. It shows that the CMSRU student-run clinic is structured similarly to many others.

2.	Hemba KE, Plumb J. JeffHOPE: The Development and Operation of a Student-Run Clinic. Journal of primary care & community health. 2011;2(3):167-172.

This is a case study that is unique in that in analyzes the workings of the Jefferson student-run clinic. The authors describe the origins, mission, services, organizational structure, and funding, while identifying areas for improvement in the clinic. There is no data analysis, results, or conclusion, rather it's a discussion about the significant of student-run clinics in healthcare, particularly in addressing the social determinants of health of underserved populations.

The study is well written, and while it can help illuminate areas of improvement in the CMSRU clinic, it also helps me consider the social determinants of health that can be barriers to care for our patients. The social determinants of health are something to think about while I investigate patients' adherence to lab services.

3.	Sick B, Zhang L, Weber-Main AM. Changes in Health Professional Students' Attitudes Toward the Underserved: Impact of Extended Participation in an Interprofessional Student-Run Free Clinic. Journal of allied health. 2017;46(4):213-219.

This study examined the impact of student-run clinic volunteering for 2 years on attitudes toward the medically underserved population. A health professionals' attitude toward the homeless survey was administered to students from six different health professions before, one year after, and two years after volunteering at a free clinic. The survey results were compared to those who never applied to volunteer and to those who applied to volunteer but were not accepted. Students who had applied had similar scores at baseline and differed from those who never applied. All three groups showed declining attitudes in the first year. Students who volunteered had more favorable attitudes rom one year onwards. The results suggest that volunteering in a clinic is a protective factor for negative attitudes toward the underserved.

Some limitations to the study include the inability to randomize participants and a low survey response rate. Still, this study is a good example of how attitudes toward the underserved can dwindle in medical students, and that direct interaction with the population can promote resilience. Once again, this article helps me show that studies on student-run clinics tend to focus on how the clinics affect the students, rather than the patients.

4.	Baker SE, Brenner A. How Medical Students View the Influence of a Student-Run Free Clinic on Empathy Development: a Pilot Study. Academic psychiatry : the journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry. 2018;42(3):428-429.

The authors implemented a pilot study to investigate the effect of a student-run free clinic on empathy development via qualitative measurements. The authors used interviews, following observation of students and evaluation of the patient-centered curriculum. Students who had volunteered more than five times at a student-run clinic were recruited and interviewed, with a study population of ten. The authors found that several themes arose from interviewing students, which include the importance of volunteering, role modeling, and longer appointment times, which the students all believed helped cultivate empathy. Thus, the authors found significant value in student-run clinics, as most of the students were able to cite several ways the clinics contribute to empathy development.

The major limitation of this study was the population size. Only ten students were interviewed, which really limits the conclusions drawn from the study. Nevertheless, since the outcomes were qualitative data and there was no data analysis, this study was more anecdotal anyway. This article was helpful to me, mostly because it showed one of the more common investigations of student-run clinics, which involves looking into the impact on students, rather than patients.

5.   Tsu L, Buckley K, Early N, Jackowski R. Evaluation of multidisciplinary and pharmacy-only student-run clinics on student's perceptions of interprofessional roles. Currents in pharmacy teaching & learning. 2018;10(6):785-794.

The authors of this article wanted to determine how multidisciplinary student workshops and clinics impact students' perceptions of other healthcare professions. To do so, the authors offered multidisciplinary smoking cessation training sessions to medical students, pharmacy students, physician assistant, and clinical psychology. The students then helped provide smoking cessation services in clinics. The various students completed surveys about the roles of healthcare professionals prior to the workshops, after the workshops, and after the smoking cessation clinics. The surveys demonstrated that there was a statistically significant improvement in students' perceptions of the roles of other healthcare professionals after the multidisciplinary clinic sessions. These results suggest that multidisciplinary sessions and clinics help increase student awareness and appreciation for various healthcare professional roles.

While this study has some limitations, for the most part I believe that it was able to show what the authors sought. Multidisciplinary clinics are becoming increasingly popular and necessary, so it's important that students and other healthcare professionals are aware of others' roles. It would prevent duplication of roles or micro-managing. This article was helpful to me, mostly because it showed one of the more common investigations of student-run clinics, which involves looking into the impact on students, rather than patients.

6.   Lawrence D, Bryant TK, Nobel TB, Dolansky MA, Singh MK. A comparative evaluation of patient satisfaction outcomes in an interprofessional student-run free clinic. Journal of interprofessional care. 2015;29(5):445-450.

A common theme among student-run clinic studies is patient satisfaction, which this study investigated in Cleveland. However, this study compared patient satisfaction at a student-run clinic to a free medical clinic that is not run by students. Over a 10-month period, patient satisfaction surveys were administered to all patients in both clinics. The surveys contained 28 Likert-type items ranking satisfaction in domains that included accessibility, waiting time, facility, and provider care services. The authors found no significant differences between the surveys administered at the different sites related to the quality of provider interactions, cleanliness, or facility comfort. There were, however, greater levels of satisfaction amongst the non-student run clinic in the domains of ability to be seen, hours of operation, information privacy, and likelihood of recommendation to others. The authors concluded that the results are not unexpected, particularly the results suggesting that clinic accessibility could be improved in the student-run clinic.

This study actually fills in gaps that other studies don't that investigate patient satisfaction in student-run clinics. It compares the satisfaction to non-student-run clinics. While it is expected that student-run clinics will not operate as smoothly as other clinics, it is still a reasonable goal to identify areas of improvement to

reach the level of other clinics. While this study does not directly relate to my project, it does help me recognize the need to compare our student-run clinic to others, both locally and nationally.

7.   Gorrindo P, Peltz A, Ladner TR, et al. Medical students as health educators at a student-run free clinic: improving the clinical outcomes of diabetic patients. Academic medicine : journal of the Association of American Medical Colleges. 2014;89(4):625-631.Review article

This study retrospectively investigated the EMR of diabetic patients at a student-run free clinic associated with Vanderbilt University, between 2008 and 2011. The authors looked at patient outcomes with initial presentation and then compared outcomes 12 months later. The authors specifically analyzed the number of patient-student interactions and change in hemoglobin A1c values between those two time-points. Those outcomes were compared to benchmarks from the American Diabetes Association. The results show that there was a significant improvement in hemoglobin A1c values after about a year, which increased with the amount of patient-student interactions. The authors concluded that student clinics can provide high-quality diabetes care as well as adhere to quality metrics set by medical associations. Although the overall hemoglobin A1c value did not meet goal, the improvement suggests that with time, patients could meet goal measures as well.

This was a unique study on student-run clinics because it emphasized the importance of patient-student interactions, suggesting that communication is key in improving patient outcomes. The one issue with the statistically analysis of this, however, was that the linear regression confidence interval included, zero, making the patient-student interactions nonsignificant. The authors did explain, however, that there could still be a trend. This study helps my own research project because I want to investigate potential barriers to patients' adherence to labs, which could actually include communication issues during patient-student interactions. This would not be able to be determined from a chart review, however, so it would just be speculation.

8.   Rojas SM, Smith SD, Rojas S, Vaida F. Longitudinal hyperlipidemia outcomes at three student-run free clinic sites. Family medicine. 2015;47(4):309-314.

The authors performed a retrospective study of clinic visits at UCSD student-run clinics from January 1, 2006 to November 15, 2010. The authors compared the baseline and most recent LDL values in patients with new diagnoses of hyperlipidemia, as well as at least one follow-up LDL value, 6-18 months after baseline value. The study goal was to determine if the clinic had successful hyperlipidemia outcomes, according to guidelines. The authors found that there was a significant decrease in LDL from baseline in the majority of the patients. There were no significant differences when the authors stratified for language, gender, diabetes diagnosis, homelessness, or clinic site. Hispanics had better LDL control that Caucasian patients. The decrease was seen in 58.3% of patients, while the LDL control documented in the U.S. was 33.2% overall. This suggests that the clinic is doing well controlling the LDL values. The observation that Hispanics had better LDL control suggests that the clinic is able to address the cultural needs of a large Hispanic population in San Diego.

This study successfully looked at a core outcome for hyperlipidemia management, which not many student clinics have done for chronic diseases. The main limitation, however, is the small subject number, 96, which limits the generalizability to the greater U.S. population. This study helps me see that I also should not generalize my study population to the general U.S. population.

9.	Smith SD, Marrone L, Gomez A, Johnson ML, Edland SD, Beck E. Clinical outcomes of diabetic patients at a student-run free clinic project. Family medicine. 2014;46(3):198-203.

The authors of this study implemented a retrospective chart review of patients with diabetes at a student-run free clinic at UCSD from December 1, 2008 to December 1, 2009. They focused on measuring the percentage who received recommended screening tests, the percent at goal values, and compared the values to published outcomes from insured, uninsured, local, state, and national populations. The objective was to determine if the clinic was meeting the standards of care, at various healthcare levels. Pertinent measure related to diabetes that the study looked at included HbA1c, LDL, triglycerides, HDL, microalbumin/creatinine ratio, blood pressure, and ophthalmology screening within the last year prior to their last clinic visit. The authors found that the clinic met or surpassed standards for diabetes outcomes in most of the categories. They concluded that underserved populations can successfully manage chronic medical conditions, despite barriers to care.

This study shares some similarities to my own study, though the authors investigated several more core measures than I have. While I focus on HgbA1c, this study focused on many more diabetic outcomes. The statistical analysis for this study, while simple, demonstrates the results perfectly, by comparing measures and determining P-values using paired t tests and Fisher's exact tests. This helps guide my own study and potential statistical analyses I will conduct.

10.	Wahle B, Meyer K, Faller M, Kochhar K, Sevilla J. Assessment of Hypertension Management and Outcomes at an Indianapolis Student-Run Free Clinic. Journal of health care for the poor and underserved. 2017;28(2):694-706.

This is a retrospective medical record review of hypertensive patients at a student-run free clinic associated with Indiana University. The authors reviewed medical records from a 15-month period and compared the hypertension control rate to the National Health and Nutrition Examination Survey data. They found that there was a significant increase in blood pressure control over the 15month period. There was no significant difference with the national average. The authors concluded that the clinic is managing blood pressure control well.

The study defined blood pressure control as <140/90, but never actually showed any of the blood pressure values. I think it would have been helpful to be able to see those values. I also disagree with the authors' statement that the demographic characteristics are unfavorable, as this suggests a judgmental tone on behalf of the authors. In addition, the authors only included that patients attend a certain number of clinic visits, which excludes patients with significant barriers to clinic care. This means that the authors actually excluded a portion of their patient population in the study. This study assumed a lot during this study, and I believe that in studies, the authors cannot make assumptions, as this will often skew the results.

11.	Summary of Revisions: Standards of Medical Care in Diabetes-2018. Diabetes care. 2018;41(Suppl 1):S4-s6.

This summary of revisions to diabetes care was written by the American Diabetes Association. The goal of the revisions is to update standards of care for diabetes and provide physicians with the adequate recommendations. The revisions clarify how to diagnose diabetes, how to assess for comorbidities, and what the glycemic targets are, to name a few.

These revisions were helpful for my retrospective chart review because I was able to see what the updates were for diabetes care and control. This helps me determine if the CMSRU clinic is adequately controlling our patients' diabetes.

12.   6. Glycemic Targets: Standards of Medical Care in Diabetes-2018. Diabetes care. 2018;41(Suppl 1):S55-s64.

This article summarizes the targets for adequate diabetes care and was published by the American Diabetes Association. For hemoglobin A1C testing it recommends that physicians perform the A1C test at least two times a year in patients who are meeting treatment goals and who have stable glycemic control. It recommends performing A1C testing quarterly in those whose therapy changed or who aren't meeting glycemic goals. The goal for A1C in adults with diabetes is <7%. Less stringent A1C goals are appropriate for patients with a history of hypoglycemia, limited life expectancy, advanced microvascular or macrovascular complications, comorbidities, or long-standing diabetes.

I reviewed this article because it was important to have an established A1C goal for clinic patients with diabetes. Since my chart review involves evaluating the hemoglobin A1C values, I need to have an updated goal to compare the patients' labs against.

13.   O'Connor PJ, Bodkin NL, Fradkin J, et al. Diabetes performance measures: current status and future directions. *Diabetes care.* 2011;34(7):1651-1659.

This article, published by the American Diabetes Association, describes the benefits of uses core measures to provide feedback for diabetes care. The authors describe evidence that diabetes complications can be reduced by controlling hemoglobin A1C, blood pressure, and LDL cholesterol. Controlling these risk factors is related to improved clinical outcomes, and the authors suggest that patients are receiving better quality care and are benefitting. In addition, there are fewer adverse outcomes in populations with better control of core measures.

I was able to use this evidence to support why I was focusing on a diabetes core measure to determine if an aspect of clinic patients' diabetes is being adequately controlled. By determining if the hemoglobin A1C value is within the necessary limits for diabetes management, I can surmise that our clinic members are doing their part to help patients manage their chronic medical condition.

14.   Carrillo JE, Carrillo VA, Perez HR, Salas-Lopez D, Natale-Pereira A, Byron AT. Defining and targeting health care access barriers. Journal of health care for the poor and underserved. 2011;22(2):562-575.

This paper, published in the Journal of Health Care for the Poor and Underserved, describes model that classifies, analyzes, and reports health care access barriers. The model, called the Health Care Access Barriers Model (HCAB), is sued in community health interventions by targeting determinants of health status, including the three categories of financial barriers, cognitive barriers, and structural barriers. These are associated with late presentation, decreased prevention, and decreased care, which leads to poor health outcomes and health disparities. The model provides a way to approach root-cause analysis of disparities and target barriers for improvement.

This paper was helpful in reinforcing the idea that social determinants of health all contribute to worse or better health outcomes. One of the goals of my retrospective chart review is to identify what social barriers exist that may prevent patients from going to laboratory services.

15.   Arao RK, O'Connor MY, Barrett T, et al. Strengthening value-based medication management in a free clinic for the uninsured: Quality interventions aimed at reducing costs and enhancing adherence. BMJ open quality. 2017;6(2):e000069.

The authors of this study identified a cost-related problem at a student-run clinic associated with Icahn School of Medicine at Mount Sinai. This problem was a pharmacy-related cost that comprises the majority of expenses at the clinic. They found that there were two issues: lack of conscious prescribing as well as low adherence to medications. The clinic decided to implement interventions to attempt to reduce the pharmacy costs. The clinic created a mobile app-based decision aid for providers and the use of education, translation, and automated text-message reminders for patients. The results showed that there was a reduction in the annual pharmacy expenses, related both to provider prescribing and to patients' medication adherence. The authors concluded that helping to change both provider and patient behaviors helps with expenses, which could be extrapolated to the national healthcare expenditure.

The study used percentages to determine the improvement but did not demonstrate any kind of statistical analysis. While there was certainly an improvement and reduction in expenses, it would have been even more meaningful if there was statistical significance. Medication adherence and lab services adherence are very similar and could stem from similar patient barriers. The changes this clinic implemented give me ideas on changes that the clinic could implement if I determine that lab adherence is a significant issue.

16.   Kahkoska AR, Brazeau NF, Lynch KA, et al. Implementation and Evaluation of Shared Medical Appointments for Type 2 Diabetes at a Free, Student-Run Clinic in Alamance County, North Carolina. Journal of medical education and training. 2018;2(1).

Authors at a free clinic in North Carolina implemented a shared medical appointments model for patients with type 2 diabetes. The appointments included 4-12 patients with students, pharmacy residents, and an endocrinologist. The researchers looked at HbA1c values before and after the visits, 12 months prior and 12 months after. They found that six out of eight patients showed decreased HbA1c values after the shared medical visits.

This study's main limitation is the sample size. The researchers only had outcomes for eight patients, providing a very small sample size. In addition, the authors did not report whether their results were statistically significant or not. Nevertheless, reading this article was helpful because it offers a potential strategy for improving diabetes management at the CMSRU clinic with shared patient appointments. Many of the visits are simple check-ups and could be a great opportunity to educate several patients at one time, while making more room in the clinic for other visits.

17.   Davids AH, Sommese KJ, Roach MV, et al. Clinica Comunitaria Esperanza: Strategy for Health Promotion and Engagement With Hispanic Communities. Health promotion practice. 2018:1524839918784942.

Authors from Eastern Virginia Medical School assessed the healthcare barriers for patients prior to creating a student-run free clinic that serves uninsured Hispanic patients. The students worked to relieve those barriers through creation of the clinic. The goal was to implement strategies to

support the community and improve health outcomes for the targeted population. The health needs assessment suggested that some barriers to healthcare access included language, lack of knowledge, and lack of a community health center. Strategies done prior to creating the clinic included community outreach, health fairs, and monthly lunch sessions with community members. The clinic addresses language barriers by having Spanish-speakers present during patient encounters. The authors found that creating the clinic was a success in that it identifies specific needs for the Hispanic population and expands medical students' cultural competency knowledge.

I selected this article because I thought the health needs assessment given to the patients was similar to the one that the CMSRU social coordinators give to patients. The article was a general description of the process in creating a clinic, but it was helpful to see how other clinics assess healthcare barriers. We assess needs at every visit, however, the social work documentation is not in the EMR. Unless medical students ask patients about social needs as well, it is less likely for this to be documented in the chart.

18.   Trumbo SP, Schuering KM, Kallos JA, et al. The Effect of a Student-Run Free Clinic on Hospital Utilization. Journal of health care for the poor and underserved. 2018;29(2):701-710.

This is a pre-post observational study, involving the Shade Tree Clinic affiliated with the Vanderbilt University Medical Center. The investigators wanted to determine if patients at the student-run free clinic had decreased hospital and emergency room visits after being seen at the clinic. They compared hospitalizations and ER visits in 2 years before joining the clinic and 2 years following joining. Primary outcomes were the number of ER visits and hospitalizations. The analysis did not show significant differences in utilization among the total study population. However, patients did have fewer hospitalizations following joining the clinic.

This study is interesting, because instead of looking at a clinic's effect and benefits for the student volunteers, it analyzes how effective the clinic is at preventing complications, which includes hospital visits. Patients who are not connected with a primary care physician are typically more likely to visit the hospital. I can relate this to my study, because the patients who have higher complications from diabetes are more likely to go to the hospital. If clinics try to better control patients' chronic medical conditions, this could lead to fewer hospital visits.