# Foot Exams in a Student-Run Clinic
## How to Change Weekly Provider Behavior When the Provider Changes Every Week

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## Abstract

**Background:** Chronic diabetes management is challenging in any clinic. A quality improvement study addressed the barriers affecting diabetic foot examination rates in a student-run clinic.
**Methods:** Between February 1, 2013 and December 31, 2015, providers received education about exam components and reminders to perform the exam. Two reminder phases were implemented: 1) inked stamps in the chart and 2) Diabetes Care Forms (a half sheet explaining the exam and streamlining documentation). All encounters for patients with diabetes (451) were retrospectively selected from an internal database for analysis of the presence or absence of chart reminders and diabetic foot examinations. Microsoft Excel was used for basic statistical analysis and chart propagation; SAS was used for chi-square testing.
**Results:** Pre-intervention encounters had an exam rate of 33% (43/107). During the stamp-based intervention between February 1, 2013 and January 31, 2014, the overall exam rate was 78% (86/110, $p<0.0001$ from baseline) and 90% with the presence of a stamp (81/90, $p<0.0005$ from pre-intervention). During the Diabetes Care Form (DCF) intervention between February 1, 2014 and December 31, 2015, the overall exam rate was 83% (158/191, $p<0.0001$ from baseline, $p>0.10$ from stamp intervention) and 97% for the charts with a DCF (143/148, $p<0.0001$ from baseline, $p<0.05$ from stamp intervention).
**Conclusions:** Academic detailing and visual reminders are effective techniques to improve the rate of diabetic foot examinations. A half sheet of paper serving as documentation and as a reminder increased the rate of foot exams in a student-run free clinic with paper charts and rotating clinical staff.

## Introduction

Diabetes mellitus is a chronic condition with multiple comorbidities affecting 29.1 million individuals in the United States.[1] Loss of pedal vasculature and sensation are complications that lead to the formation of ulcers. The skin and soft tissue surrounding diabetic foot ulcers can become infected, leading to lower extremity amputation in up to 28% of cases of foot ulcers[2] due to the poor wound healing from vascular insufficiencies and hyperglycemia-related immune deficiencies. The cost is an estimated $6 billion annually in the US.[3] To prevent amputation, patients should receive annual diabetic foot exams, a cost-effective intervention when used as an adjunct to adequate glycemic control.[2,4,5]

According to American Diabetes Association (ADA) guidelines, the exam should have four parts: skin, musculoskeletal, vascular, and neurologic. The skin of the foot, toes, and interdigital spaces should be examined for signs of skin breakdown, such as ulcers or non-healing abrasions. The foot should also be monitored for bunions, Charcot deformities, calluses, fissures, and nail deformities.[2,6] Vascular integrity should be evaluated by assessing for a history of claudication and palpating

for diminished pedal pulses.[2,6,7] Semmes-Weinsten monofilament testing in four plantar sites on the forefoot is recommended to identify peripheral neuropathy,[8-11] the presence of which carries a risk of recurrent ulcerations in diabetic patients.[6] Patients with diabetes should receive annual foot exams[3,12] and at every appointment when peripheral neuropathy, anatomic deformities, or a history of foot ulcers are present.[12]

Previous studies suggest that low diabetic foot exam rates is a problem in any clinic that provides care for patients with diabetes, not just in student-run clinics. In 2012, the frequency of diabetic patients receiving an annual foot exam was 71.2% in the United States.[13] One study quoted a clinic with rates as low as 16% in their clinic.[14] This statistic suggests the need for change in provider behavior and the formation of a more effective system.

One place to modify practitioner behavior is during training, such as medical school, where there is a benefit to instilling appropriate standard of care practices early.[15] There is significant educational value in medical students caring for common conditions such as diabetes in an outpatient setting.[16] Foot exam performance typifies the kind of opportunity that students' value. It has been shown that hands-on education through voluntary participation in the curriculum augments core competencies in the formal teaching curriculum.[17] The purpose of this study was to design interventions to ensure higher rates of adherence to standard of care for the student-run clinic at the Wake Forest School of Medicine.

## Methods

*Study Site*

Delivering Equal Access to Care (DEAC) clinic is the student-run clinic of the Wake Forest School of Medicine with rotating weekly personnel with varying levels of medical experience. DEAC offers weekly medical care, pharmacy, and laboratory services to patients in the surrounding community who meet financial screening metrics, including a threshold annual income less than 200% of the federal poverty line. A clinical outcomes team was responsible for extracting all relevant data documented in the paper charts each clinic night. Clinic prevalence of diabetes was 20.3% of encounters during the study period. In the pre-intervention phase of the study period, 33% of encounters for patients with diabetes did not include foot exams. From a small sample of fifteen volunteers, lack of knowledge and familiarity with foot exam technique was the most common reason for not performing a foot exam.

*Interventions*

A summary of dates and interventions can be found in Table 1.

Academic Detailing: Medical providers were asked to watch a short YouTube video on the exam and were given a five-minute lecture/instruction by a designated Institute for Healthcare Improvement (IHI) or DEAC instructor on the procedure of the exam.

Visual reminders: Initially, a red stamp reading "FOOT EXAM" was placed in the physical exam section of the chart. The provider would document the pertinent findings below the stamped area. Later, a half sheet known as the Diabetes Care Form (DCF) (Appendix 1) was placed in the front of the chart and results were documented by circling appropriate findings.

Three hundred and ninety-three student volunteers participated at DEAC during the study period. As part of the study intervention, check-in volunteers prospectively identified charts for documentation of diabetes, otherwise a patient was asked at triage and check-in stations if they had diabetes. Reminders were placed in charts whenever a patient with diabetes was identified. For the medical care team, ideal diabetes management at DEAC included medical histories conducted by medical care team volunteers, in-house labs as necessary, and a four-part foot exam at every visit. Performing full foot exams at every visit was deemed most appropriate in our environment to optimize consistency and student opportunities to perform a foot exam.

The IHI Chapter of Wake Forest was responsible for working with DEAC leadership to propose and implement interventions at the conclusion of each Plan-Do-Study-Act (PDSA) cycle. The project was intended to have DEAC implement changes into clinic protocol and IHI would gradually transition to a monitoring and consulting role after the completion of a two month wash-in phase, a period which was felt to be adequate for providers to adapt. IHI originally defined a 70% goal for all encounters involving a patient with diabetes to perform a foot exam in rough concordance with national rates. IHI provided the inked stamps in the charts, educational resources, data analysis, and eventual study write-up.

*Data Collection, Inclusion Criteria, and Analysis*

Data including month and year of patient encounter, presence or absence of chart reminder, and presence or absence of foot exam performance was collected from the paper chart and entered by a DEAC volunteer into REDCap,[18] a secure electronic data capture tool.

Study inclusion criteria were defined as entries in REDCap that included all of the above sections. If the complete data set for an encounter was not originally documented in the paper chart, it was not analyzed.

Encounters between January 1, 2012 and January 31, 2013 were used for baseline analysis and between February 1, 2013 and December 31, 2015 for intervention analysis. Encounters between February 1, 2013 and March 31, 2013 are included only in the wash-in period of data analysis to account for training of DEAC and IHI leadership to train volunteers. A total of 451 patient encounters, including baseline, wash-in, and interventions, were analyzed in this study.

The de-identified data set was provided to investigators containing the aforementioned parameters. The data was exported to an Excel spreadsheet for calculations and the graphs published in this study. Approval for this research was received from the Wake Forest Institutional Review Board.

**Table 1.** Chronology of Study Interventions

| Date of PDSA | Intervention |
|---|---|
| 1/1/2012 - 1/31/2013 | Baseline data was collected on foot exam rates. |
| 2/1/2013 - 4/30/2013 | (1) A red foot exam stamp was added at either check-in or triage; each week, the medical team received 5 minutes of academic detailing on how to do the foot exam per ADA guidelines. |
| 5/1/2013 - 8/31/2013 | (2) Decreased IHI-led detailing with concomitant increase in DEAC-led detailing. Changed stamp location to triage only. |
| 9/1/2013 - 1/31/2014 | (3) DEAC only academic detailing |
| 2/1/2014 - 12/31/2015 | (4) Start of DCF usage and cessation of stamp usage. DEAC detailing was limited to familiarizing providers with DCF. |

## Results

**Table 2.** Diabetic Foot Examinations during Pre-intervention and Intervention Phases, and Overall Differences of Exams with Reminders

| Phase of Study | Charts (No.) | Diabetic Foot Exams Proportion $\pm$ SEM | $\chi^2$ | $P^a$ | $P^b$ |
|---|---|---|---|---|---|
| Pre-intervention (baseline) | 132 | 0.33$\pm$0.04 | | | |
| Wash-in | 18 | 0.50$\pm$0.12 | 1.9 | >0.10 | |
|     without reminder | 8 | 0.38$\pm$0.18 | 0.059 | >0.10 | |
|     with reminder | 10[c] | 0.60$\pm$0.16 | 2.9 | <0.10 | |
| "Foot Exam Stamp" phase | 110 | 0.78$\pm$0.01 | 49 | <0.0001 | |
|     without reminder | 20 | 0.25$\pm$0.10 | 0.55 | >0.10 | |
|     with reminder | 90[c] | 0.90$\pm$0.03 | 69.8 | <0.0001 | |
| DCF phase | 191 | 0.83$\pm$0.03 | 81 | <0.0001 | >0.10 |
|     without reminder | 43 | 0.35$\pm$0.07 | 0.035[a], 0.62[b] | >0.10 | >0.10 |
|     with reminder | 148[c] | 0.97$\pm$0.02 | 126[a], 4.4[b] | <0.0001 | <0.05 |
| Combined "Foot Exam Stamp" and DCF phases | | | | | |
|     without reminders | 63 | 0.32$\pm$0.05 | | | |
|     with reminders | 238[c] | 0.94$\pm$0.02 | 126 | <0.0001[d] | |

SEM = standard error of the mean, DCF = Diabetes Care Form, a = chi-squared test of intervention subcategory compared to baseline, b = chi-squared test of DCF intervention compared to "Foot Exam" Stamp intervention matched to reminder subcategory (i.e. without reminder matched to without reminder, etc), c = calculated rates of chart reminders are 0.56, 0.82, and 0.77 for wash-in, foot stamp and DCF interventions, respectively. Overall rate of reminder was 0.79. d = chi squared test of values with reminders compared to without reminders.

**Figure 1.** Run Graph of Foot Exam Adherence over Time
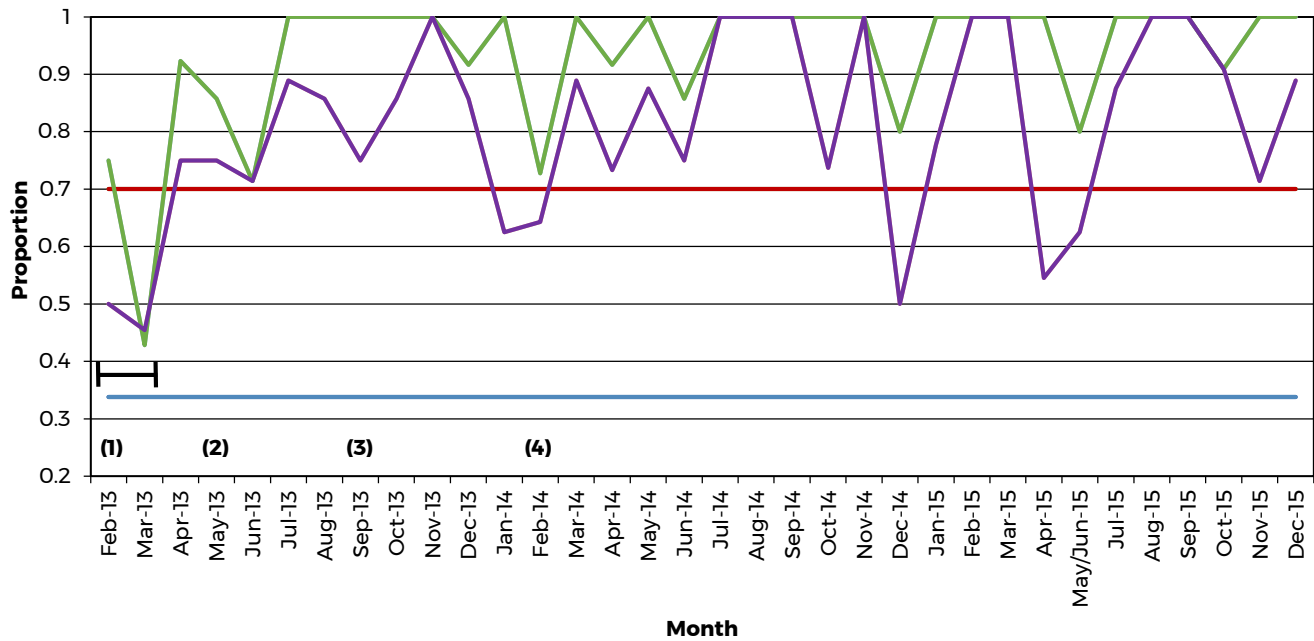


Blue line: the baseline before the intervention. Red line: the organization's goal. Green line: proportions of exams with reminders. Purple line: proportions of total exams (i.e. with reminder and without reminder, combined). Black bar: wash-in period. (1), (2), (3), (4): numerical annotations correlate with PDSA cycles and implementation noted in Table 1.

## Discussion

Our data suggest that a combination of academic detailing and visual reminders were vital to enhancing the care of patients with diabetes in our setting (Table 2). The interventions successfully increased the foot exam rate above IHI's goal of 70% for encounters with patients with diabetes (Figure 1). Excluding the wash-in phase, the rates of exams when reminders were placed in the chart never fell below 70% and the total number stayed above 70% with only three runs falling below our goal. The reminder assisted student providers in completing foot exams for patients with diabetes at all encounters, not just encounters devoted to diabetes management. In the DCF phase of the study, examination rates climbed to nearly 100% which suggests that the simple process of having the reminder and detailing on the same sheet led to better adherence. Additionally, we have shown that there was a marked difference when reminders were placed in the chart over the course of the entire intervention, even after IHI ceased to participate in academic detailing. This suggests that provider behavior change was not merely related to the Hawthorne effect, where subject behavior

changes as an effect of being observed. The consistency and simplicity of the DCF is crucial to addressing deficiencies in foot exam knowledge and familiarity with performing foot exams, especially in a clinic environment with learners and significant personnel turnover.

Limitations to our study include variability in the quality of foot exam performance, especially prior to DCF use, which could not be practically assessed. This limitation was one contributor for the introduction of the DCF which led to standardized and improved documentation of exam findings; we felt improved documentation was a reasonable surrogate for improved exam quality, however this was an educated assumption and was not explicitly proven. Another limitation was that this study included a small population at a single center which limits generalization for the patient outcomes. Further, paper based charting was used for documentation in the clinic, which limits the application of our study and results in student-run clinics using electronic health records, although the DCF could be programed as an open dialogue box that auto-populates in the charts of patients with diabetes. Our study was centered on changing provider behavior. Given the relative heteroge-

neity of providers, we feel a multi-center study using our DCF would have a reasonable cost and be appropriate for use in similar environments or even adaptable to an Electronic Health Record.

One note regarding the limitations of incorporating the DCF: the clinic staff had concerns that adding an extra step for exams was time added to each encounter. We independently studied this, but found that too many other variables influenced time (e.g. number of attending physicians present, unrelated chief complaint, need for interpreters, etc.). The difference was not significant, suggesting that the foot exam did not appreciably add to the encounter time given all other factors.

The short-term goal of the project is to increase the rate of foot exams. The total rate of completed exams and reminders had only minor, statistically insignificant changes between the foot stamp and DCF phases. The rate of exams when a reminder was in the chart remained remarkably high (0.90, 0.96). Our rate of reminders trended around 0.80 during the study period, and further PDSA cycles focused on improvement in the rates of charts receiving the DCF could potentially increase exam rates to 100%.

Future considerations for research include monitoring rates of diabetes complications in these patients. Since the conclusion of the study, additional prompts for hemoglobin A1c and microalbuminuria were added to the DCF. Other areas of research would include trending changes in patients' ulcer formation. Given the relatively short timeframe, this study did not look for changes in pedal neurologic status or lower extremity microvascular ischemia. Additional long term goals would be to train ancillary staff to teach patients self-examination techniques to monitor for infections.

While showing that a simple reminder is helpful for one condition, there is a relative scarcity of data regarding quality improvement in student-run clinics. This lack of data frequently makes it difficult to propose policy changes or initiate projects that would disrupt the flow in student-run clinics. The success of the DCF suggests that similar methodology could be adapted to other standards of care.

### Acknowledgements

### Disclosures

The authors have no conflicts of interest to disclose.

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***Appendix 1.*** Diabetes Care Form (actual size 27.49x21.69-cm)

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**Diabetes Care Form**

Current ulcer or history of a foot ulcer? Y__ N__

***Measure, draw in, and label*** the patient's skin condition, using the key and the foot diagram below

**C**=Callus  **U**=Ulcer          **PU**=Pre-ulcer          **F**=Fissure          **M**=Maceration          **R** = Redness

                   **S**=Swelling          **W**=Warmth          **D**=Dryness

**Pedal Pulses**: *Fill in the blanks with a "P" or an "A" to indicate present or absent*

          Posterior tibial      Left____    Right____                              Dorsalis pedis      Left____      Right____

          **Ankle jerk reflexes**              present?              Left____   Right____

**Sensory Foot Exam** *Label sensory level with a "+" in the five circled areas of the foot if the patient can feel the 5.07 (10-gram) nylon monofilament and "-" if the patient cannot feel the filament*



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