Finding Employees with Undiagnosed Diabetes

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ABSTRACT
Purpose: Implement a confidential and low cost method to identify employees with undiagnosed diabetes. **Methods**: Blood samples from fasting plasma glucose measurements obtained by a third party vendor from the annual employee health risk assessment data were re-run at a cut-point of 117 mg/dL or greater to obtain a hemoglobin A1c (A1c) value. Individual letters were sent from the third party vendor to employees with a HbA1c value of 5.7% or greater informing them of an employee diabetes management program. **Results**: 1611 of 3044 (53%) employees participated in the annual health risk assessment; 87 employees demonstrated a fasting plasma glucose $\geq$117 mg/dL; 27 employees had a A1c of 5.7-6.3%; and 16 employees had an A1c $\geq$6.5%; 9 employees volunteered to participant in the diabetes management program. The employer spent a total of $783 to find 16 employees with undiagnosed diabetes and 27 employees with undiagnosed pre-diabetes. **Conclusion**: The process used by this employer maintained confidentiality and was considered a low cost means of finding employees with undiagnosed diabetes.

INTRODUCTION
It is estimated that approximately 25.8 million (8.3%) Americans have diabetes.[1] Of this, 18.8 million Americans have an existing diagnosis for diabetes with the remaining 7 million being undiagnosed.[1] Additionally, 79 million Americans have pre-diabetes, of which only 7% are aware of their condition.[2]

The health care costs associated with diabetes and pre-diabetes are significant. In the United States in 2007, the total health care expenditures (direct and indirect) for those with diagnosed diabetes, undiagnosed diabetes, and pre-diabetes was $174 billion, $18 billion, and $25 billion, respectively.[1] Medical expenses for those with diabetes are more than two times higher compared to those without diabetes.[1] Specifically for employers, diabetes is ranked as the third most costly physical health condition of their employees.[3]

Indirect costs are also significant for employers. Employees with diabetes have health-related absenteeism rates that are 0.8% higher than individuals without diabetes, which accounts for $2.6 billion in indirect expenditures.[4] It is estimated that for American employers, diabetes accounts for 120 million work days per year where work performance is reduced.[4] Reduced productivity due to diabetes is estimated to add an additional $20 billion in indirect costs to employers each year.[4]

The purpose of this case study is to present a procedure that one employer used to find employees with undiagnosed diabetes and present a case of one unlikely employee who was found to have undiagnosed diabetes as a result of the newly implemented procedure.

METHODS
Diabetes Mellitus Risk Reduction Program
In 2011, a medium-sized (3,000 employees), self-insured organization in the United States implemented a novel interprofessional employee health program to counter the effects of diabetes. The interprofessional Diabetes Mellitus Risk Reduction Program (DMRRP) team consists of five pharmacists, a dietitian, an exercise physiologist, a health educator, and a licensed mental health practitioner (LMHP). Consultants to the team include a physician, a wellness coordinator, and a human resources healthcare benefits specialist.

Employees are eligible and can voluntarily participate in the DMRRP if they have an existing diagnosis of diabetes or criteria that meets the definition of pre-diabetes. The program takes place at the worksite location during regular business hours, is funded by the organization, is free of charge to the employee participants, and allows employees to participate in the program for as long as they wish. The primary outcomes of the program are to demonstrate improvements in quality-of-life, healthy behaviors, cardiovascular risk, medication adherence, and absenteeism. An objective of the program is to encourage as many employees as possible with diabetes or pre-diabetes to voluntarily participate in the program. Because national data suggests that a certain portion of a given population does not know they have diabetes, a procedure was developed in an attempt to find employees with undiagnosed diabetes.

Identifying Undiagnosed Diabetes Protocol
During the annual employee benefits enrollment time period, employees are asked to participate in an annual wellness assessment that includes a health risk appraisal questionnaire and a health risk assessment. Among other data, the health risk assessment obtains a fasting plasma glucose measurement. These assessments are completed by a contracted third party vendor who specializes with administering employee wellness assessments.

The method to finding employees with undiagnosed diabetes simply called for the laboratory to identify employee blood samples that demonstrated a fasting plasma glucose of 117 mg/dL or greater. For each employee whose fasting plasma glucose was 117 mg/dL or greater, a small portion of their blood sample was set aside and processed a second time to obtain a hemoglobin A1c (A1c) value. Employees whose blood samples revealed an A1c of 5.7% or greater were then sent a letter via U.S. mail from the third party wellness vendor explaining the results and providing information about the employers diabetes management program (DMRRP). The report sent to the employer from the third party vendor listed the number of A1c values tested and the results, but did not reveal the employees' names. This process ensured confidentiality of health information for the employees. The employees could then choose to voluntarily participate in the DMRRP.

RESULTS
The results from implementing this procedure after the first year revealed the following: 1,611 of 3,044 (53%) employees participated in the annual wellness assessments; 87 of 1,611 (5.4%) employees demonstrated a fasting plasma glucose of 117 mg/dL or greater which generated 87 A1c tests completed by the laboratory; 27 employees without a previous diagnosis of diabetes were discovered to have a A1c of 5.7% to 6.4%; and 16 employees without a previous diagnosis of diabetes were discovered to have a A1c of 6.5% or greater.

The cost to run an additional A1c measurement was $9.00 per test and therefore, the organization spent a total of $783.00 (87 x $9) to implement this new procedure. As a result, the employer was able to find 16 previously undiagnosed employees with diabetes. This resulted in the employer spending $48.94 ($783/16) per employee with undiagnosed diabetes. As a result of the mailing, 9 employees (3 diabetics; 9 pre-diabetics) who received a letter volunteered to participate in the diabetes management program.

CASE PRESENTATION
AM is a 57 year-old white female with a 5-year history of hypertension and a 22-month history of hypercholesterolemia that was enrolled in an employee health cardiovascular risk reduction program (CVRRP) for the previous 2 years. The CVRRP began in 2008 for employees with hypertension and/or high cholesterol. The CVRRP consisted of monthly one-on-one appointments with a pharmacist and focused on optimizing medication therapy management, healthy lifestyle behaviors, education, and coordination of care for chronic conditions.

The treatment plan for AM included medication therapy and lifestyle modifications. Her medications included triamterene/hydrochlorothiazide 37.5/2.5 mg daily, lisinopril 40 mg daily, metoprolol tartrate 25 mg daily, simvastatin 20 mg daily, fish oil 2 grams twice daily, and a multivitamin daily. Her lifestyle medicine plan during the 2-years in the CVRRP showed

consistency in achieving at least 300 minutes of weekly moderate intensity physical activity, a consistent eating plan of high fiber and low fat foods with 8 to 10 combined daily servings of fruits and vegetables, sleeping 6 to 7 hours per night, moderate to high work stress, and no alcohol or tobacco use.

Laboratory data during the 2-years in the CVRRP showed home blood pressure monitor readings that ranged from 95-110/60-70 mmHg, office blood pressure readings ranging from 98-116/62-78 mmHg, and a BMI ranging from 26.5 to 28.7 kg/m^2. Blood cholesterol and triglyceride readings were elevated when first starting the program which lead to the initiation of simvastatin and fish oil. After 2-years in the CVRRP, the lipid panel showed total cholesterol at 166 mg/dL, LDL at 80 mg/dL, HDL at 48 mg/dL, Non-HDL at 118 mg/dL, and triglycerides at 190 mg/dL. Fasting glucose levels gathered during the 2-year time frame of participation in the CVRRP were 107, 114, 112, 120, 105, 100, and 118 mg/dL. The most current reading of 118 mg/dl was obtained at the 2-year mark of program participation.

At the time of the 2-year mark for AM's participation in the CVRRP, the employer implemented this new procedure for the annual employee health risk assessment plan (described above). AM demonstrated a fasting plasma glucose of 118 mg/dl which prompted the laboratory to run an additional A1c test on the blood sample. AM's A1c value revealed 6.8%. To confirm this initial value, AM had an additional A1c test performed which resulted in a value of 6.7%. As a result of this new finding, AM was transferred from the CVRRP to the DMRRP for treatment and follow-up.

DISCUSSION

In 2010, the American Diabetes Association (ADA) recommended the use of A1c testing as a method to identify and diagnose diabetes and pre-diabetes.[5] The ADA recommends using the A1c values 5.7% to 6.4% as diagnostic criteria for pre-diabetes and 6.5% and greater as diagnostic for diabetes.[5] Fasting plasma glucose and A1c have been shown to have a mathematical relationship where the A1c value can be converted to an estimated average glucose (eAG) and vice versa.[6,7] This relationship was used as the theoretical basis for establishing the fasting plasma glucose cut-point by converting employee fasting plasma glucose readings to estimate the A1c. Using this logic, an A1c value of 5.7% can be converted to an eAG of 117 mg/dl, and thus the reason for choosing 117 mg/dl as a starting point to re-run employee blood samples for A1c values. It should be noted that fasting glucose is not directly equal to eAG. However, if an individual has a fasting glucose of 117mg/dL or greater, their eAG is likely higher than 117mg/dL. The odds of identifying an employee with previously undiagnosed pre-diabetes or overt diabetes are higher than if we selected a lower fasting plasma glucose cut-off.

Additionally, it was decided to use a A1c cutoff of 5.7% based on published data showing that individuals who have a A1c of 5.7% to 6.4% have a 41.3% probability of developing diabetes within the next 7.5 years and a 13.3% probability of developing CVD within 10 years.[8] It should further be noted that a study published after this current procedure was put into place demonstrating the cost effectiveness of diabetes prevention efforts at various A1c cutoff points.[9] The study examined each 0.1% increment between 5.5% and 6.4%. The authors concluded from their cost/outcomes analysis that implementing a diabetes prevention program for individuals with a A1c of 5.7% or greater is the most cost effective compared with any other 0.1% increment between 5.5% and 6.4%.[9] This matches the methodology of the procedure that the employer used described above.

As a result of this new procedure, AM was discovered to be an employee with undiagnosed diabetes. Even though she was being managed appropriately with medications and exceeded what most individuals achieve with regards to healthy lifestyle behaviors, she fell into the nearly 50% probability of developing diabetes group described above.[6] She had an A1c between 5.7% and 6.4%, a BMI >25 kg/m^2, and the diagnosis of hypertension or hyperlipidemia (both in this case).[6] AM was at an additional risk for type 2 diabetes due to a family history of the condition with her mother. AM had no indication of type 2 diabetes from the multiple fasting glucose readings obtained over the two year time period as all readings were less than the 126 mg/dL diagnostic threshold for diabetes. She would have continued to be classified as having pre-diabetes without the newly implemented procedure. The lesson learned with AM is that even though a patient may be doing everything correct with regards to decreasing diabetes risk with medications and lifestyle behaviors, health care providers need to remain vigilant when looking for signs of diabetes. Fortunately for AM, she most likely has not had diabetes for an extended period of time and, therefore our enhanced prevention efforts can bring her A1c back below 6.5%.

Previous studies have shown that employers who invest in diabetes prevention programs for their employees can reduce their organization's health care costs. Direct health care savings have been related to improved blood pressure control which decreases risk for cardiovascular disease, improved foot and eye related co-morbidities, decreased hospitalizations, and healthier mothers and babies.[4] Additionally, studies have shown that employees with diabetes who manage their blood sugar level more effectively as a result of an employer sponsored diabetes management program have improved absenteeism and productivity rates to coincide with lower direct health care expenditures.[10-12]

The method presented here is not without limitations. Choosing the 117 mg/dL value as the cut-point was arbitrary based on the logic presented above realizing that this is a fasting glucose measurement and that A1c is converted to an estimated average glucose value. This method may not identify all employees with undiagnosed diabetes and will continue to be monitored and modified as necessary. Not all employees of the organization completed a health risk appraisal and, therefore not all employees were subject to this screening method. The organization continues to evaluate and implement new strategies that can increase the number of employees who complete the survey. Not all employees who were identified as having pre-diabetes or diabetes enrolled in the DMRRP. New incentives to encourage participation in the program are currently being considered. Although the overall cost to find employees with undiagnosed diabetes presented here was relatively low compared to estimated direct and indirect expenditures resulting from diabetes, the programs cost effectiveness has yet to be assessed.

CONCLUSION
Diabetes is a costly chronic condition for patients and their employers. Implementing a diabetes management program may decrease the direct and indirect costs that are related to the condition. The method used by this employer to reveal undiagnosed employees with diabetes was both low cost and confidential. The method for using a fasting plasma glucose cut point of 117 mg/dL and above was shown to be successful at finding employees with undiagnosed diabetes.

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KEY TERMS
Diabetes Management, Employee Health, Risk Reduction Program