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Cost-Savings Analysis of Telemedicine Use for Ophthalmic Screening in a Rural Appalachian Health Clinic

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Abstract

Life in mountainous, rural areas poses unique obstacles for ophthalmic care--notably, a lack of access to ophthalmologists and cost of care. Using telemedicine as a screening tool addresses both issues for diabetic retinopathy (DR) screening, as fundus photography has been determined to be sensitive and specific when screening for DR.[1,2] The American Diabetes Association places a Grade E recommendation on fundus photography as a screening tool.[3] We analyze the financial impact of ophthalmic telemedicine in a mountainous, rural health clinic in West Virginia over a seven year period from 2003-2009. At-risk patients are screened with a fundus camera during routine clinic visits, and the image is interpreted off-site by an ophthalmologist. Patients are either advised to follow up yearly or receive an immediate opthalmic referral. Considering the number of patients screened, travel costs, work missed, overhead, and billing considerations yields a savings of $153.43 per patient visit.

Introduction

The town of Gary is located in McDowell County along the banks of the Tug Fork River in southern West Virginia. Gary is a former coal mining company town, established by U.S. Steel, which has seen its economy suffer drastically with the ceasing of the company's activities in the area in 1986. Although rich in natural beauty, Gary is an economically depressed area, with few opportunities for employment. Just 18.2% of Gary's working age citizens find work for one week or more annually compared to the rest of the state.[4] The 2010 U.S. Census data peg Gary's population at 937,[5] with 27.8% of the population living below the poverty line.[6]

The overhead involved to establish an ophthalmologic practice, the small population base of Gary, and the high rates of joblessness create an unfavorable situation for the citizens of Gary to receive local ophthalmic care. Therefore, it is imperative to find a solution to reduce cost while mitigating the difficulties encountered in transportation to the nearest ophthalmologist.

Telemedicine screenings offer a solution to the paired issues of cost and remoteness by using technology to bridge distances between patient and ophthalmologist at a reduced cost.

The telemedicine screenings are conducted on site at the Tug River Medical Center (TRMC) in Gary by a nurse who handles general clinic duties as well as the telemedicine screenings. She offers screening to select patients based upon individual patient characteristics. Fundus photos and intraocular pressures measured with a Tono-pen are taken of diabetics, those with family history of glaucoma, and/or visual complaints in which the nurse suspects a retinal problem. Patients whose screening results require an ophthalmology visit are referred to an ophthalmologist in the Bluefield, WV area, which is one hour away by car.

Methods

We conducted a cost savings analysis from the perspective of a telemedicine screening system which is composed of parts which do not exist in a vacuum. That is, some components of the system are co-opted from pre-existing uses and therefore these aspects of the system have fixed costs which would exist with or without the screening system. Thus, we do not consider these fixed costs in the analysis. However, some components of the system have been created specifically for the screening system and their costs and benefits are included in the analysis. When considering the costs and benefits to the telemedicine screening system in place, our model exists within the framework

Objectives

Our primary study objective was to determine the cost effectiveness of telemedicine screening in a remote, mountainous rural area in southern West Virginia. We then sought to quantify the savings or cost to the medical system. We sought to consider the number of patients screened, travel costs, work missed, and billing considerations. We hope the results of this paper will serve to strengthen the healthcare infrastructure of West Virginia.

of healthcare-related spending when considering net financial detriment or benefit to society.

The costs we did consider included the cost to pay the ophthalmologist for interpreting the screening image, the purchase price of the fundus camera, and the costs associated with a positive screening result which required a referral to an ophthalmologist. When a referral was generated, we included the cost generated by the additional screening step rather than a direct referral. These costs were additional costs on top of the regular operation of the components of the screening system.

Our savings estimations are based on the fact that all patients who were screened had an indication for ophthalmic screening which would have otherwise required a trip to an ophthalmologist. The savings to the screening system were projected considering travel costs, costs generated from missed work, and the Medicare rate for a standard binocular screening exam.

When accounting for travel, we considered that the fundus camera photo was taken when the patient was already in the clinic for a general health appointment and thus we did not need to factor in the cost of the clinic visit or clinic overhead as it was a fixed expense. We considered the savings gained from not having to make an additional appointment to see the nearest ophthalmologist in Bluefield, WV--34 miles and a one-hour drive away. We multiplied the number of patients by the WV State Travel Management Office mileage rate. Then, we multiplied the result by the minimum wage ($7.25 per hour) based on time taken off from work to make the two hour round trip from the TRMC at Gary, WV to Bluefield, WV and a two hour ophthalmologist visit. Travel and missed work for patients who had an indication for ophthalmic screening, yet were spared the expenses as a result of the telemedicine screening, yielded a savings of $28,067.36 over the study period.

Next, we considered the Medicare billing rate for a binocular screening exam, code 99204 of $154.53 and then subtracted the cost of $10 to pay an off-site ophthalmologist to read the fundus photograph, which yields of savings of $144.53 per patient without a subsequent referral. However, patients who subsequently needed a referral were counted as a cost to the screening system as an additional $10 per patient screened.

On the expense side, we factored in the cost for a comparable camera to the Topcon TRC-NW6S Non-Mydriatic Retinal Camera used at the TRMC. Here, we used the figure of $21,990, as a new Zeiss Visucam was recently purchased by University Eye Surgeons at Marshall University on open market bidding for this price.

In our analysis, we did not consider items which are already in place therefore were fixed costs with or without the screening system. The screening ophthalmologist's office computer was not considered as a cost to the screening system. Although necessary to view the fundus images, the computer is not considered an added cost to the system since maintaining the computer would still be required to comply with the job requirements of the ophthalmologist's regular office functioning. Additionally, although a busy ophthalmic practice may find retaining an on-site photographer beneficial due to the quantity of patients who need to be photographed, we did not factor in cost of training a photographer. A general health clinic, such as the Tug River Medical Center, may find that cross-training of staff members for fundus photography is sufficient as minimal training is needed in order to obtain quality fundus photographs.[7] As shown by the number of patients who were screened over a seven year period, the volume of patients who required fundus photography was small enough to allow for cross-coverage.

Table 1. Sum of the total USD saved in travel plus the total USD saved due to missed work plus the savings derived from lower billing to the patient. 659 total patients screened.

7 year gross savings	$95,129.28
Fundus camera	$21,990.00
Addtional Costs	$1,950.00
Total 7 yr savings	$71,189.28
Average savings per patient	$153.43

Results

Six hundred fifty-nine total patients were screened. Three hundred seventy-one patients had their fundus photos interpreted as normal, no referral needed. Two hundred eighty-eight patients had an abnormality reported on their fundus photos, but 93 patients did not require a referral, thus sparing a trip to the nearest ophthalmologist. In total, 464 patients were screened but did not require a trip to the ophthalmologist.

Based on the number of patients, the seven year period saw a savings of $153.43 per patient and a total seven year savings of $71,189.28 as shown in Table 1. Factoring in a billing cost per patient of $10 versus the 99.204 Medicare billing rate of $154.53 for the patients who did not require a referral, the savings in billing costs alone was $34,978.57. As indicated in Table 2, years in which

Table 2.

Telemedicine Savings Project			
Year	***n* Patients***	**USD Saved in Travel†**	**USD Saved in Work Missed‡**
2003	36	$1,133.64	$1,044.00
2004	143	$4,503.07	$4,147.00
2005	91	$2,865.59	$2,639.00
2006	70	$2,204.30	$2,030.00
2007	50	$1,574.50	$1,450.00
2008	22	$692.78	$638.00
2009	52	$1,637.48	$1,508.00
	Total Patients	Total USD Saved in Travel	Total USD Saved in Missed Work
	464	$14,611.36	$13,456.00

** n Patients = eyes read as "normal" plus "abnormals" with no referral needed*

*† (Round Trip Distance from TRMC, Gary to Bluefield Ophthalmologists) * (WV State Travel Management Office official mileage reimbursement) * (number of patients in the year) That is, USD Saved in Travel = (67 miles) * ($0.47) * (n patients)*

*‡ USD Saved in Missed Work = (2 hr round trip driving time + 2 hr office visit) * $7.25/hr WV minimum wage * (n patients per year)*

more patients required screening yielded a larger amount of savings.

Discussion

With the cost of healthcare to society becoming an ever larger discussion, policy makers will be searching for ways to maintain the quality of healthcare while reducing its cost. Telemedicine promises to fill an important niche to bridge the gap between maintaining a highly-trained physician workforce and connecting that workforce to patient populations in remote areas of the country and world. As refinements are made to the technology involved with telemedicine, it will undoubtedly grow into a role as a future development becoming important to ophthalmology, as well as other specialties.

As with any study which attempts to create a model of a system, we had to create reasonable starting points and rules for simplification that are not exactly consistent with the complexities of real-world system. We did not factor into our analysis the cost of some unknown factors such as missing a diagnosis and resulting sequelae such as increased morbidity and perhaps cost. The major hindrance to investigating the false negative rate and false positive rate and resulting clinical outcome was the lack of documentation from the ophthalmologists who received a referral from the primary care clinic. The lack of communication between the ophthalmologists and the primary care clinic also means we could not factor in the number of patients who may have been false positives and therefore resulted in unneeded ophthalmic referrals and subsequently increased cost.

Although we could not accurately measure the cost from false negatives, we did consider the impact of false positives upon the screening system. When running our analysis with the scenario that every referral was a false positive, our analysis still yielded a seven year net savings of $29,260.48, or $44.40 per patient screened, including both referred patients and non-referred patients. In the 100% false positive scenario, we accounted for the same factors as previously outlined, but we counted referrals as costs to the screening system. That is, travel, missed work, the standard Medicare billing rate for a binocular screening exam, and the cost of the telemedicine screening were additional costs to the system.

Although not knowing the exact sensitivity and specificity of the telemedicine screening creates some limitations in our analysis, previous studies have found the use of fundus photography as a screening device to be highly sensitive and specific. Scanlon et al 2003 found a sensitivity of 86% and a specificity of 77% when examining a population of 3611.[1] Ruamviboonsuk et al 2005 examined the sensitivity and specificity of a fundus camera-based screening in rural Thailand and reported a sensitivity of 80% and a specificity of 96% for detecting DR with a sample size of 130.[2] In light of these studies, we believe our financial conclusions are appropriate estimates.

Additionally, our analysis of the screening system did not consider the impact of poor patient compliance with screening recommendations. We considered an ideal system in which every patient who is referred then takes time from work to travel and follow up with the physician. Perhaps balancing this discrepancy in our analysis in which we included every referral generated by a telemedicine screening as a cost due to 100 percent follow up rates as well.

More studies will need to be done to continuously refine telemedicine's role in ophthalmology. Other specialties may also find the use of fundus photography beneficial for patient care. The use of fundus screening by primary care physicians and endocrinologists has been studied and the results indicate positive outcomes.[8,9] However, the gold standard for eye care remains a dilated fundus exam by an eye care provider. In light of this, the authors are planning a study of the sensitivity and specificity of the telemedicine project. This study will use patients who agree to have telemedicine screening performed and calibrated against the gold standard slit lamp exam.

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CME Post-Test

22. The type of area in which this analysis examined the use of ophthalmic telemedicine is a small town of under 1,000 people in southern West Virginia with a high poverty rate and high jobless rate which is not served by a local ophthalmologist.
- **a. True**
- **b. False**

23. Why might integrating fundus photography be a fairly simple process for a remote general health clinic with no nearby ophthalmologist?
- **a. Training to mastery of fundus photography requires relatively few patients and low hours. After 10 patients and an hour of practice time trainees showed equivalency with a 20 year veteran fundus photographer.**
- **b. Staff can cross train and operate the fundus camera in conjunction with general clinic duties.**
- **c. The clinic can use a regular digital camera without actually purchasing a fundus camera**
- **d. a & b are correct**
- **e. a, b, & c are correct**

24. What were the financial benefits to a system which uses telemedicine screenings for a general health clinic?
- **a. no financial benefit was noted--the main benefit was increased patient compliance**
- **b. $55 per patient visit**
- **c. $153 per patient visit**
- **d. $200 per patient visit**
- **e. no benefit of any kind was noted**