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PREHOSPITAL IDENTIFICATION OF UNDERLYING CORONARY ARTERY DISEASE BY COMMUNITY PARAMEDICS

Martina Heinelt, Ian R. Drennan, Jinbaek Kim, Steven Lucas, Kyle Grant, Chris Spearen, Walter Tavares, Lina Al-Imari, Jane Philpott, Paul Hoogeveen, Laurie J. Morrison

ABSTRACT

There is a lack of definitive evidence that preventative, in-home medical care provided by highly trained community paramedics reduces acute health care utilization and improves the overall well-being of patients suffering from chronic diseases. The Expanding Paramedicine in the Community (EPIC) trial is a randomized controlled trial designed to investigate the use of community paramedics in chronic disease management (ClinicalTrials.gov ID: NCT02034045). This case of a patient randomized to the intervention arm of the EPIC study demonstrates how the added layer of frequent patient contact by community paramedics and real-time electronic medical record (EMR) correspondence between the paramedics, physicians and other involved practitioners prevented possible life-threatening complications. The visiting community paramedic deduced the need for an electrocardiogram, which prompted the primary care physician to order a stress test revealing abnormalities and thus a coronary artery bypass graft was performed without emergency procedures, unnecessary financial expenditure or further health degradation such as a myocardial infarction. **Key words:** Community paramedicine, chronic care model, coronary artery bypass graft, out-of-hospital care, electronic medical record

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INTRODUCTION

Patients with Diabetes Mellitus, Heart Failure, and Chronic Obstructive Pulmonary Disease, the three most common chronic diseases worldwide, cost the

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Canadian health care system billions of dollars per year.^{1–3} Already strained, the system is poorly structured to continue to support patients as these diseases increasingly afflict Canada's aging population.^{4–6} Individual hospitals, primary care providers and community-based care initiatives have been unable to integrate their stratified care into an effective disease-management strategy. Patients thus rely on 911 for disease-related exacerbations/symptomatology for lack of alternative support. Many of the resulting hospital and Emergency Department (ED) visits turn out to be unnecessary and their prevention would alleviate a substantial portion of health care resource utilization.¹

We propose the Expanding Paramedicine in the Community (EPIC) trial (ClinicalTrials.gov ID: NCT02034045), a disease-management strategy allotting existing resources in a tiered delivery system using Chronic Care Model principles.^{7,8} EPIC employs community-based paramedics working under the direction of patients' primary care physicians to provide in-home treatments in an attempt to reduce acute health care utilizations and improve overall quality of health. The methods for the EPIC trial have been previously published.⁹ The primary outcome of the EPIC trial is the number of hospital admissions, while secondary outcomes include: 911 usage, ED visits, length of hospital admissions, patient satisfaction and quality of life, mortality and an economic analysis. The community paramedics involved in the EPIC trial have undergone a specialized training program to expand their scope of practice in relation to chronic disease management and are dedicated to the EPIC trial, working outside of the car count used to provide 911 emergency coverage to the region. Paramedics are highly trained, accessible 24-7, mobile throughout the community and able to collaborate with other community-based practitioners. They are sensitive to subtle environmental cues and are able to integrate these into patient assessment and treatment plans. Strategic use of community paramedics has been shown to be associated with decreased acute hospital admissions, improved overall patient health care and minimized cost.^{10–12} The interest in community paramedic programs has gained international attention as a potential method of improving health care efficiency,^{13,14} however, a recent systematic review¹⁵ identified only a single randomized controlled trial

from the UK which evaluated the efficacy of community paramedics.¹⁶

Using a stratified, randomized controlled trial, EPIC aims to reduce acute health care resource utilization by patients diagnosed with these common chronic illnesses. Patients are enrolled in the EPIC trial based on identification by their primary care physician as at risk for multiple emergency department and hospital admissions. Patients are then contacted to discuss their willingness to participate in the trial. Patients randomized to the control group of the EPIC trial continue to receive routine care, while the patients randomized to the intervention group additionally receive scheduled home visits by the community paramedics at 3-month intervals over two years. The community paramedics work in close contact through a common electronic medical record (EMR) with family health teams and other health care practitioners to ensure a coordinated approach to patient care, including the orchestration of patient follow-up visits with the various health professionals contributing to their care plan.

Follow-up or exacerbation visits may be prompted by the patient, the paramedics or the family health team at any time. During each visit, the paramedic will educate and counsel the patient, perform a physical examination and record disease-specific medical history and examination results, which will be entered into the family health team EMR. The EMR provides a real-time interface between the paramedics and the other health care practitioners involved in patient care from the family health team. All patient encounters are stored on the EMR, which allows the community paramedics access to the patient's medical history as well as previous and upcoming medical appointments. It also allows for communication to occur between the paramedics and the various team members including the treating physician directly through email. The paramedic may also decide to treat based on disease-specific evidence and/or may telephone the primary physician in accordance with their medical directives. We present the case of a patient currently randomized to the intervention arm of the EPIC trial.

CASE REPORT

Patient Background Information & Baseline Data

The patient was a 53-year old male who lived with his elderly parents and had high stress levels corresponding to a fluctuating income. He would eat out regularly, had recently stopped exercising, and was struggling with recent weight gain. The patient was a non-smoker, did not consume alcohol and did not partake in recreational drug use. The patient's last estimated glomerular filtration rate was in normal range at 91 mL/min/1.73 m², glycosylated hemoglobin was

6.8% and ejection fraction was 67%. The patient's primary care physician had diagnosed the patient with type 2 diabetes mellitus, hypertension and hyperlipidemia. As a result, the patient had been co-managed by his primary care physician and an endocrinologist and had been placed on Metformin, Insulin glargine, Liraglutide, Perindopril and Nifedipine. In 2011, the patient presented with chest pain to his primary care physician and had an electrocardiogram (ECG) done, which showed an old inferior myocardial infarction. The patient also had a positive stress test at that time, however the cardiologist was negative. The patient continued to experience the same quality of chest pain thereafter and was being monitored by his health care team.

Scheduled Visit #1 – July 5, 2013

The visiting paramedic noted that the patient possessed a sound knowledge of how to properly manage his diabetes. Upon physical exam, the patient's blood pressure was found to be elevated. (Table 1) The patient exhibited full sensation in all extremities with no deficits and pink, warm, dry and intact skin. The treatment plan devised by the paramedic instructed the patient to continue monitoring blood pressure and call the physician if it increased further. An EMR message was sent to the primary care physician, who acknowledged and agreed with the paramedic's assessment and treatment plan, within 48 hours.

Scheduled Visit #2 – October 9, 2013

Upon the paramedic's arrival, the patient reported recurring, left-sided chest "discomfort" and "dull pain" short in duration and presenting mostly during physical exertion. The last episode occurred the previous week during physical activity but the patient was asymptomatic at the time of assessment. The paramedic decided to perform a 12-lead ECG (LIFEPAK 15, Physio-Control) as a precaution because of the patient's description of 'transient cardiac related symptoms,' which showed normal sinus rhythm with pathologic Q waves present in the inferior leads. (Figure 1) The treatment plan recommended by the paramedic was to continue monitoring blood pressure, continue to increase activity level and track episodes of chest discomfort. In particular the patient was asked to record the onset, duration, pain level and activity level as well as to call 911 if there was a change in symptoms. The paramedics concluded the visit by delivering the ECG to the family health team for physician review.

Table 1. Summary of physical assessment values

	Blood pressure (mmHg)	Heart rate (bpm)	Respiratory rate (rpm)	Oxygen saturation (%)	Blood glucose level (mmol/L)	Blood glucose level (mg/dL)	Weight (kg)
Scheduled visit #1	140/90	99	—	98	6.9	124.3	86.7
Scheduled visit #2	158/90	104	24	98	8.3	149.5	—
Scheduled visit #3	122/88	104	18	97	10.4	187.4	92.4
Scheduled visit #4	138/78	104	20	98	9.2	165.8	86.4

Physician Correspondence from EMR Regarding ECG Results

Family Medicine Resident to Primary Care Physician - Oct. 9, 2013

Received ECG from paramedic EPIC visit today. NSR. HR 91 bpm. Q waves in leads AVf, II, III suggesting an old inferior infarct. No other abnormalities (No ST elevation, no AV block, no LVH, no arrhythmia). This is unchanged with ECG done in Nov 2011. Workup at the time (Dec. 7, 2011) yielded a normal cardiolute perfusion test (normal perfusion, normal ejection fraction and contractility). No change in symptoms has occurred since then.

Primary Care Physician to Family Medicine Resident - Oct. 9, 2013

Great - I assume you have/will communicate your findings about past investigations to the EPIC team - does he have any symptoms suggestive of ischemia? Do you think there is a role for a repeat exercise stress test at this point?

Family Medicine Resident to Primary Care Physician - Oct. 9, 2013

He has always had non-exertional, intermittent CP [chest pain] of short duration (seconds). When reviewing with my supervisor at one of my visits, we felt

that as long as the nature of his symptoms have not changed then repeat ix [investigations] are not really indicated. I talked to him about this too and he is aware that he needs to tell me if anything changes. What do you think? He is high risk and I am not averse to repeating it. How do I communicate with the EPIC team (other than responding to the ECG)?

Community Paramedics to Family Medicine Resident - Oct. 10, 2013

We [the EPIC paramedics] work 7 days a week 7:00-19:00, you can contact us either through the EMR (we check messages daily) or on our cell. Feel free to contact us anytime.
EPIC Paramedics

Primary Care Physician to Family Medicine Resident - Oct. 10, 2013

Hi - looks like they [the EPIC paramedics] answered your question about contacting them - the EPIC phone number is in the personal section of each EPIC patient if you need to reach them urgently - otherwise - you can send a message to them in the Practice Solutions Suite (PSS) EMR. In terms of the patient - I'd err on the side of another reassessment with GXT [stress test] in a young patient who is high risk - you could order that now and you would have the result back by the time of your Nov. 5 visit with him.

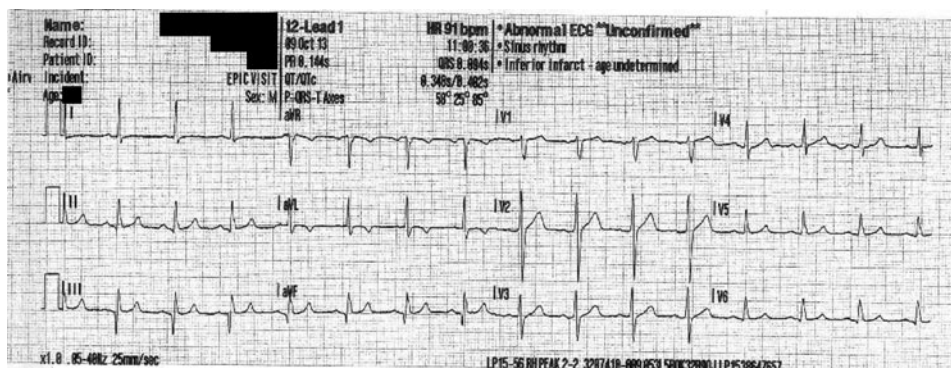


Figure 1. A 12-lead ECG during second scheduled visit.

Family Medicine Resident to Primary Care Physician - Oct. 15, 2013

Thanks, this is the ECG that the paramedics brought to me. Do you agree with my interpretation? (Seen as first note listed in the review dated Oct 9th)

Primary Care Physician to Family Medicine Resident - Oct. 15, 2013

Yes - I agree it is unchanged but there are signs of old ischemia so I still think a reassessment is not a bad idea - either by stress test or a revisit to his cardiologist for their opinion.

Note in EMR from Cardiologist - Oct. 18, 2013

- Interpretation: No exercise induced chest discomfort. Good exercise tolerance. Abnormal ECG response to exercise.

Cardiolite images demonstrate significant inferior posterior ischemia.

- The calculated ejection fraction at rest appears to be slightly reduced [41%]. Echocardiographic correlation. Abnormal study.

Family Medicine Resident to Primary Care Physician - Nov. 4, 2013

Wow. This is so interesting. We knew that he has an occult inferior MI [myocardial infarction] from 2011 and at the time that the cardiolite was normal. His symptoms never changed... Neither I nor [my supervisor] thought of repeating the testing until the paramedic from the EPIC trial personally brought the ECG in, and got us to give this a second thought. Thank you for your guidance in this situation. I really think the paramedics played an instrumental part in this man's health.

Primary Care Physician to Family Medicine Resident - Nov. 5, 2013

Yes - it's a good lesson that sometimes we need to err on the side of caution - the paramedics did a great job and I'm glad we decided to proceed with investigations.

Note from Surgeon - Nov. 29, 2013

Cardiac catheterization revealed severe three-vessel coronary artery disease and a grade 2 left ventricle. The RCA [right coronary artery] was subtotally occluded; however, it had very small ongoing right and PDA [posterior descending artery] and PL [posterior-lateral branch] with poor collateral filling and poor distal runoff. The patient was brought to the Operating Room on November 29, 2013 for coronary artery bypass grafting.

Scheduled Visit #3 – January 12, 2014

The visiting paramedic noted that the patient appeared to be in good spirits, spoke highly of his recent cardiac investigation and resulting coronary artery bypass graft and was scheduled to begin cardiac rehabilitation. The patient reported becoming suddenly tired after 3-4 hours during the day but had been constantly improving. The patient had clear lung sounds in all fields, possessed normal S1, S2 heart sounds with no obvious S3 and S4 sounds. The paramedic noted that the surgical incision seemed to be healing well with no inflammation, heat or pain. The treatment plan updated by the paramedics encouraged the patient to be mindful of portion size and meal content during the patient's post-operative reduced insulin regime. The updated treatment plan was uploaded to the EMR for review by the primary care physician and was acknowledged within 48 hours.

Scheduled Visit #4 – April 13, 2014

The visiting paramedic noted that the patient was now walking 3 miles 5 times per week on the treadmill. The patient complained of chest pain similar to previous episodes during the exercise but of very short duration and low frequency. In fact, the patient added that no pain had been experienced during the previous two weeks and that episodes of sudden tiredness were becoming more and more infrequent. The patient's surgical scar continued to heal well and the paramedic confirmed clear lung and heart sounds. The paramedics sent a message via the EMR to the primary care physician who acknowledged within 48 hours.

DISCUSSION

This case demonstrates how an extra layer in patient health care comprising of community paramedics may have the potential not just to decrease ED visits and alleviate financial burdens on the health care system, but also to be instrumental in the wellbeing of individuals with chronic disease. In this case, it was the combination of home-visits, where the paramedic's clinical expertise led to the acquisition of an ECG, and physician collaboration through the EMR, whose experience and cautious instincts led her to order the exercise stress test, which resulted in the vital surgery. Similar to findings by Wagner in 2000 related to the role of patient care teams in the management of chronic disease, this case exemplifies the potential contribution to the primary care of patients with a chronic illness when the roles of team members including paramedics are clearly defined and explicitly delegated and if team members are trained for their roles.¹⁷

It is possible that the same outcome would have been reached upon presentation of future symptoms. However, delayed diagnosis of the severe coronary artery disease could have progressed to a myocardial infarction leading to the development of heart failure, a poor quality of life and an increased probability of premature death. The key to early identification was the high frequency patient contact, which is one of the main Chronic Care Model principles upon which EPIC is based; since it promotes treatment adjustment and thus results in a highly effective disease management strategy.^{18,19} In addition, each scheduled visit lasted 1 to 1.5 hrs which provided sufficient time for the community paramedic to assess and educate the patient.

Communication and collaborative decision-making related to patient assessment are often identified as challenges related to implementation of community paramedic programs.²⁰ The EMR access provided to the community paramedics in the EPIC trial was important in providing timely communication between all practitioners and allowed for the rapid diagnosis and treatment of the patient through bidirectional communication. Although the family medicine resident did note that given the lack of new abnormalities or symptoms, there was not an obvious need to perform a stress test; however, the correspondence promoted caution and proactivity that ultimately may have avoided a serious emergency. In addition, the community paramedic aptly recognized the 'transient exertional induced cardiac related symptoms' as reason to run a precautionary ECG thus proving that his demonstrated sensitivity to subtle environmental data was also crucial in the outcome of this patient.

Some potential challenges to the implementation of community paramedic programs include cost, time dedicated to additional training for paramedics to expand their scope of practice, and resistance by health care practitioners to the inherent change in health care delivery.²¹ The lack of research examining the impact of community paramedicine makes it difficult to predict whether the programs would become cost-effective over the long-term, however current research suggests that integration of community paramedics is effective in reducing health care costs.^{22,23} The additional education required by the paramedics means they would be unavailable to provide 911 services for the duration of the supplementary training resulting in an upfront cost for the community paramedic program. Lastly, as community paramedic programs employ novel methods of health care delivery utilizing paramedics in a non-traditional role of primary health care there is the potential for resistance to change, whether from existing health care providers, internally from paramedics, or from the patients.²¹ As there is a paucity of research evaluating the potential barriers to community paramedicine these outcomes will be addressed as a part of the ongoing EPIC trial.¹⁵

This case demonstrates how existing elements in the health care system may be leveraged into more proficient, team-based partnerships that support patients, help them better self-manage their overall health and ultimately empower them to play a greater role in their health care thereby leading to longer and healthier lives.²⁴ The EPIC trial will hopefully provide evidence necessary to guide future policy and program creation at multiple levels of health care. The model used for the EPIC intervention, community paramedics working under the delegation of primary care physicians, simply builds upon existing EMS and family health team infrastructure, which enables this intervention to be easily scaled up for application in other health populations, regions and care models.⁹ Other potential populations that could benefit from such a program are chronically ill patients, psychiatric patients and patients with limited access to health care such as those in rural areas.²³⁻²⁵

CONCLUSION

The EPIC case highlights the role of early detection of potential emergencies in advance and proactive preventative and therapeutic interventions in managing the care of the patient with chronic diseases. It also highlights the role of the paramedic in monitoring the overall health of the patient including managing prescription pain medication, increasing their spirits and improving quality of life through improved diet and increased activity. This case exemplifies the important benefits that can be achieved by EPIC's innovative addition of regular, convenient and personalized treatments and bidirectional communication with the health care team to standard care for patients with chronic diseases. If the EPIC trial demonstrates that community paramedicine is effective in improving pre-specified patient health outcomes, expanding this type of prehospital care could efficiently use community paramedics to integrate Canada's chronic care health care system into one that is more economical, effective and patient-centred.

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