

Impact of Robotic Telemedicine in a Remote Community in Canada

Michael Jong

Discipline of Family Medicine, Memorial University
Goose Bay, Canada
mjong@hvgb.net

Abstract-Mortality and morbidity is higher for patients living in remote Canada. A telerobotic demonstration project was conducted in a remote community of 1500 in northern Labrador. A wireless, mobile robot allows the physician to be virtually present. The physician uses a laptop to move the robot unfettered and zoom and pan the camera, while freely interacting with patients and nurses. The evaluation focused on: access, quality, acceptability and costs as they related to the nurses, attending physicians, patients and the healthcare delivery in Nain. The number of telerobotics encounters was 157. The evaluation findings indicate a positive impact on the health care delivery from the perspective of patients, nurses, physicians and health care system. The findings of this evaluation indicate that remote robotic presence can have a positive impact on health care delivery in northern Canada.

Keywords-robotic, telemedicine

I. INTRODUCTION

Travel for health care in northern Canada is expensive. In Nunavut, a northern territory in Canada, the cost of transportation project for 2011-12 is 22% of the health care budget [1]. For patients living in our remote communities cost of travel for health care in northern Canada is huge, about \$1000-\$2000 for a return flight and \$100-\$200 per day for accommodation. A routine visit will require 3 days – to fly in the day before the appointment and if there is no immediate follow-up tests required to return home the following day. About one-half of the patients requires traveling companion to support the patients for during the travel and the clinical encounter. This doubles the cost for travel for health care outside the community.

In Canada, twenty one percent of its population lived in rural communities of less than 10,000 population but only 9.4% of the physicians live and work in these communities. The burden of illness is higher in rural versus urban – rural Canadians less than 45 years of age have about a 30 percent higher mortality rate than urban dwellers of the same age [2]. Morbidity and mortality is higher, the further one lives away from the city. The highest death rates are in most remote communities. The most isolated rural Canadians live three years less than their urban counterparts [3]. Life expectancy in the Canadian male Inuit is 12.6 years less than the general Canadian population, with the greatest disparity in the 20-24 years age group [4].

Telehealth is one of the tools that improve access to health services for patients living in remote communities. There have been varying degrees of success in the utility of telehealth - from regions where telehealth is not well utilized

[5] to places where video is used for leading of resuscitation remotely [6].

This project explores the effectiveness of robotic telemedicine in a remote community in northern Canada. A telerobotic demonstration project was conducted in northern Labrador between January 2010 and March 2011 to assess the impact on health care delivery in a northern remote fly-in community of 1500 residents. Off-site physicians provide support for advanced practice nurses in the delivery of urgent and emergent care by using a virtual presence robot.

Section II presents the methods used for the study. In Section III, we present the results. Conclusion and future work is presented in section IV.

II. METHODS

In this project the remote presence robot (RP7), which was named “Rosie”, connects a remote health center with a Regional Health Center. The wireless, mobile robot allows the physician to be virtually present. The physician uses a laptop to move the robot unfettered and zoom and pan the camera, while freely interacting with patients and nurses.

Training of a physician to use the robot takes about one hour. Nurses do not need training. The connection between the laptop and robot is through the internet via a full-duplex operation. The connection is monitored continuously and remote diagnostics are conducted as needed.

The evaluation focused on: access, quality, acceptability and costs as they related to the nurses, attending physicians, patients and the healthcare delivery in Nain. The evaluation was conducted, using forms that were self-administered by 3 physicians and 7 nurses, after use of the robot. The 157 patients also completed patient evaluation forms after the use of the robot. A mixed method study was conducted. Qualitative interviews were conducted with the providers at six months and again at one year (see Appendix 1).

III. RESULTS

The number of telerobotics encounters was 157. The evaluation findings indicate a positive impact on the health care delivery.

1) Patients

Patients reported improved access to physician services and improved physician services at the community level.

They felt they were more involved in their own care and received treatment earlier without the need to travel. Patients stated they were more willing to access healthcare when they knew they could see a physician via Rosie. Patients reported more ease and comfort with medical care especially as their family members or interpreters could also be present in the session.

Patients felt that being able to access services in their community improved communications with the nurses and physicians. Patients felt that being able to access services at home without the need for travel decreased the disruption to their family and job. "Rosie" decreased their family's financial costs for medical care when they did not have to travel. Patients were highly satisfied with their telerobotic sessions stating they were willing to use Rosie again.

2) Nurses

Among the key findings for nurses are reports of reduced stress due to increased accessibility to the physician. Physicians were readily accessed from home, office or hospital. Nurses reported this eased their stress, especially when faced with an urgent/emergent case that they felt might be outside their scope of practice and/or during inclement weather. Nurses also reported increased job satisfaction with reduced stress of managing urgent or emergent cases. Nurses said that having this technology reduced the stress of practicing nursing in a remote northern community, and that they would consider it a benefit to work in a community where such technology was available.

Nurses felt the partnership between the nurse and the physician deepened with physicians gaining a better understanding of the nurses' knowledge and skills. Nurses reported feeling more of "being part of a team" and that collaboration between the nurse and physician improved with the use of the robot. Nurses felt improved satisfaction with the quality and timeliness of services they were able to provide to the community. They also reported the nurse-physician collaboration increased the community's level of confidence in the health care delivery team. Nurses reported that in 50% of the consultations, using the robot, they learned something new.

Nurses reported that they were able to concentrate their efforts on the patient rather than needing to manage the telehealth equipment. They were accepting of the new technology and felt this was a definitely an upgrade and improvement in telehealth equipment. They expressed an interest in having additional attachments such as ultrasound, otoscope and stethoscope for future applications. Nurses also reported it would be useful to leverage the multi-disciplinary teams such as chronic care / diabetes team by using this technology, to provide the outreach services from Goose Bay to Nain.

3) Physicians

Physicians reported improved access to both the nurses and patients. They felt they were better able to assess, diagnose, treat and manage patients due to the robot. They reported that being able to move independently and manage the movement, focus or zoom of the camera enabled better

assessment on how the urgent or emergent interventions were working. Physicians and nurses reported that the functionality of camera and audio capabilities allow them to work together for improved mental health assessments. The physicians felt they were able to lead the triage team in an emergency via using the RP7 robot.

Physicians reported the improved ability to assess, diagnose, treat and manage patients without being present in the community also decreased their job stress as the attending physician practicing in a remote community. They felt by being virtually present with the nurses they also increased their own confidence in the abilities of their nursing colleagues. They reported improved collaboration and communications and improved relationships with nurses. Physicians reported that personal interactions with nurses, patients and family members improved.

Physicians reported they were better able to supervise resident physicians and nurses in performing procedures and that their coaching was much safer using the mobile robot with advanced camera and audio capabilities.

The physicians, with the robot software with their laptops, could connect to Nain from any internet access point at home, office, or hospital. This connectivity using the robot gave them less job stress and more job satisfaction, especially evident during inclement weather when either getting into the community or getting the patient out of the community was not an option. On one occasion, during inclement weather, the attending physician conducted his regularly scheduled clinics via Rosie from Goose Bay.

All the physician and nurse respondents agree that the quality of the interaction with patients is better with telerobotics compared with traditional videoconferencing.

4) Health care system

The evaluation also identified many benefits to the health care system. The improved access to physician services and improved access during inclement weather was viewed by all as a benefit. The use of the RP7 robot supported improvements in the assessment and care of patients and their families. It improved the timeliness and quality of patient care.

Both physicians and nurses (100%) strongly agree that the workflow in the clinic improved with telerobotics. The use of the robot was reported to have improved the workflow of the community health clinic. While the robot did not decrease the workload during the project, it was suggested that the use of the robot could decrease the workload of the physician during his regular scheduled visits. The ability for physicians to see patients as needed and for follow-ups allowed for less over-booked clinics during regular scheduled visits.

The improved access increased job satisfaction and decreased job stress for nurses and physicians practicing in the remote community. The ease of transition to this new technology and acceptability of the robot was also seen as a positive impact on the health care system for nurses, patients including small children, and physicians. The community members readily accepted the robot as a means of accessing

the primary physician services and they reported an improved confidence in the healthcare delivery team.

Of the forty-seven (47) patients for which complete data is available, twenty-eight (28) patients did not require transportation to Goose Bay. Of the nineteen (19) patients who required travel, nine (9) of the patients were able to travel to Goose Bay on the scheduled hospital flights. More than half of the patients avoided medical transportation. The increased ability to use scheduled flights as opposed to medical evacuation (medevac) also lead to decreased the costs for medical transportation.

The findings indicated the use of “Rosie” the robot facilitated:

- Improved access to physicians;
- Improved management of urgent and emergent care;
- Improved mental health assessments;
- Improved personal interactions between nurse, patient/family and physician;
- Improved collaboration amongst health care team;
- Improved job satisfaction and decrease job stress amongst physicians and nurses; and
- Decreased costs of medical transportation.

IV. CONCLUSION AND FUTURE WORK

The findings of this evaluation indicate that remote robotic presence can have a positive impact on health care delivery in northern Canada. It provides residents living in the northern remote community, improved access to medical services. It enhances the ability of the physicians to collaborate with nurses in the remote community. Telerobotics is associated with a reduction in the cost of medical transportation.

Following the recommendation from the nurses, we have developed a research proposal to evaluate the effectiveness of telerobotic versus usual care for chronic disease management. Because of the positive impact of “Rosie,” the local government has decided to fund the continuation of robot telemedicine. “Rosie” is now a permanent member of the staff.

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APPENDIX 1

QUALITATIVE INTERVIEWS FOR PHYSICIANS AND NURSES

1. The robot allows the clinician to participate differently in a virtual consult than with the use of traditional telehealth. On a scale of 1-5 how would you rate the following, with 1 being not important and 5 being important:
 - Ability to move independently in rounds, clinics and emergent sessions
 - Ability to zoom to read charts, monitors, assess patients
 - Ability to utilize ultrasound in diagnosis.
 - Ability to interact virtually with the remote site in a more “natural” way.
2. The ability to access the robot from a laptop wherever they may be, at home, at the office or while traveling may have an impact your workload/workflow. On a scale of 1-5 how would you rate the following, with 1 being not important and 5 being very important:
 - Ability to manage my workload i.e. Less disruptive to my practice, office hours.
 - Ability to allow the physician to see a patient in a timelier manner.
 - Ability to reduce physician patient load during visits to community.
 - Ability for physicians to keep track of patients from home or office.
 - Ability to facilitate better collaboration among team members. Please explain.
3. How would you rate the quality of information received for decision making during the telerobotic encounter from that received using traditional telehealth? Please rate on a scale of 1-5 with 1 not as effective as traditional telehealth and 5 being much more effective than traditional telehealth. Why?
4. How easy was it for you to master the use of the robot? Please rate on a scale of 1-5 with 1 very difficult and 5 very easy
5. Did you see a difference in community acceptance of telerobotics as compared to their acceptance of traditional telehealth? If so, how did it manifest?
6. Did you see a difference in your acceptance of this mode of healthcare delivery compared to traditional telehealth? If so, how did it manifest.

7. Would having a resource like 'Rosie' be a factor in choosing a new position or remaining in Nain? Please explain.
8. What new applications could you foresee using 'Rosie' for in the future?
9. Has 'Rosie' had any impact on the quality of your work life or how you do business?
 - Reduce stress?
 - Protect professional status in instances where you may be required to work out of scope due to a medical emergency?
10. How would you fix or change the processes or equipment to improve your experience?