CORRESPONDENCE

Cardiovascular Telemedicine Program in Rural Australia

TO THE EDITOR: Rural and indigenous populations are disproportionately affected by cardiovascular disease,[1,2] with a higher prevalence of cardiovascular risk factors than urban populations, as well as harsher environmental conditions, reduced access to services, and greater difficulty in attracting and retaining health professionals.[3,4] Patients therefore wait longer and travel larger distances to access diagnostic services, or they forgo treatment.

We compared waiting and reporting times and patient travel distances for exercise stress testing and 24-hour Holter monitoring over 12-month periods before (retrospective analysis) and after (prospective analysis) implementation of a telemedicine program (Tele-Cardiac Investigations) in two rural and remote regions in Australia with a referral population of 44,400 and a geographic area of 696,650 km^2.

The telemedicine program enabled cardiology specialists at a metropolitan location (Royal Brisbane and Women's Hospital [RBWH]) to work with local staff to conduct exercise stress tests and Holter monitoring remotely at 11 facilities (see the Supplementary Appendix, available at NEJM.org). For exercise stress testing, a live video feed of the electrocardiographic monitor at the rural facility allowed the telemedicine team to view patient data in real time. Local staff performed the exercise stress test with guidance from the telemedicine team, or, alternatively, the exercise stress test system was remotely controlled by the telemedicine team. The test results were immediately reported by the telemedicine team with the use of remote access software. For Holter monitoring, rural staff applied the device with guidance from the telemedicine team. The telemedicine team then remotely accessed the initialization software to program and start the recording. After the recording was complete, the telemedicine team remotely transferred the data to analysis software at RBWH for reporting.

Implementation of the telemedicine program was associated with a 42% increase in the number of tests performed over 12 months (516 in the 12 months before implementation vs. 734 in the 12 months after), with an even greater proportional increase in the number of patients from indigenous populations undergoing testing (63 before implementation vs. 127 after implementation) (Table 1). There were substantial reductions in waiting times to have tests conducted (17.71 fewer days [44.6% reduction]) and to have results reported (35.82 fewer days [99.2% reduction]), resulting in a significant reduction in the total time from referral to reporting (56.66 fewer days [71.1% reduction]; P<0.001). Round-trip travel was reduced by 502 km per patient, on average, for patients requiring Holter monitoring, with telemedicine allowing 91.3% of patients to receive testing without having to travel away from their local health facilities.

Table 1. Effect of Implementation of Telemedicine for Cardiac Testing.*

Variable	Before Implementation†	After Implementation‡
No. of tests performed	516	734
Age of persons tested — yr	54.14±15.11	54.73±16.16
Female sex — no. (%)	263 (51.0)	383 (52.2)
Indigenous ethnic group: Aboriginal or Torres Strait Islander or both — no. (%)	63 (12.2)	127 (17.3)
Total time from referral to report returned to referring doctor — days§	79.70±70.48	23.04±25.55
No. of sites conducting testing	2	11
Waiting time to have test performed — days		
All patients	39.70±43.98	21.99±25.52
Indigenous ethnic group: Aboriginal or Torres Strait Islander or both	42.59±43.96	20.88±18.62
Nonindigenous ethnic group	35.96±38.26	22.22±26.75
Female sex	34.75±40.19	22.90±29.32
Male sex	38.77±37.72	20.99±20.60
Waiting time to have test results reported — days		
All patients	36.11±42.96	0.29±0.97
Indigenous ethnic group: Aboriginal or Torres Strait Island or both	37.87±34.64	0.31±1.07
Nonindigenous ethnic group	35.61±43.95	0.28±0.95
Female sex	36.55±45.28	0.31±0.86
Male sex	34.77±40.09	0.27±1.08

* Plus–minus values are means ±SD. Data shown are from all testing sites. Ethnic group was reported by the patient.
† In region 1, the preimplementation period for Holter monitoring and exercise stress testing was the 12-month period from January 1 through December 31, 2016. In region 2, the preimplementation period for Holter monitoring was the 12-month period from January 1 through December 31, 2016, and the preimplementation period for exercise stress testing was the 12-month period from January 1 through December 31, 2013. The Royal Brisbane and Women's Hospital (RBWH) began providing exercise stress testing in region 2 in 2014. Providers in this region would scan patients' exercise stress test results and email them to RBWH, where they were printed, reported, signed, scanned, and returned by email. We recognized that substantial support was required for this region, which led to the development of the telemedicine program. Therefore, the preimplementation period for exercise stress testing in region 2 was 2013 (rather than 2016), when the region was providing its own stress testing service with no remote-access support.
‡ The postimplementation period for Holter monitoring and exercise stress testing in region 1 and region 2 was the 12-month period from January 1 through December 31, 2018.
§ P<0.001 for the reduction from the period before implementation to after implementation in the total time from referral to return of report to referring doctor.

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Disclosure forms provided by the authors are available with the full text of this letter at NEJM.org.

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