

Tele-ECG collaboration between tertiary and primary care in Singapore: Outcomes and learning over a 6-year period

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Dear Editor,

An electrocardiogram (ECG) is the mainstay of cardiac evaluation available in primary care, after which assessment in relation to clinical symptoms and signs is made by family physicians to assess the patients holistically. Subsequently, based on this clinical evaluation, patients may then be referred for tertiary review at a cardiology department or managed in primary care. In Singapore, ECG abnormalities found in asymptomatic patients may require a specialist review and thus make up a substantial number of patients referred by primary care physicians from public healthcare polyclinics to cardiology outpatient clinics. Some of these patients may be clinically managed in primary care with no further evaluation necessary, yet others may require a non-urgent or expedited review.

Right-siting of care for patients and decreasing referrals would therefore free up valuable limited resources in tertiary hospitals for patients who require more urgent reviews. This would then decrease economic burden both for the patients and public healthcare system. Tan Tock Seng Hospital (TTSH) and Khoo Teck Puat Hospital (KTPH) are acute hospitals currently affiliated with 7 primary care polyclinics within the National Healthcare Group Singapore. The close collaboration between TTSH and KTPH cardiologists and the 7 polyclinics facilitated the launch of a Tele-ECG programme with the objective to provide kerbside ECG consults, to allow quick reviews and management of patients in primary care, thus reducing the number of referrals for ECG abnormalities in asymptomatic patients to tertiary specialist centres.

The project commenced in April 2016. At the initial phase, identified TTSH cardiologists and primary care doctors from 3 polyclinics (Ang Mo Kio, Hougang and Toa Payoh) were included in this collaborative effort. This subsequently expanded to include KTPH cardiology

department and the other 4 polyclinics (Yishun, Woodlands, Geylang and Kallang), gradually from November 2018. The designated family physicians involved in this programme served as the link between the cardiologists and their teams in the polyclinics. They were given a list of ECG abnormalities that could be managed in primary care or guided in the need and urgency of referral. ECG findings that were not in the list were collated with patients' summaries from fellow colleagues and discussed with the cardiologists of both hospitals on the same day. The collected data included ECG diagnoses made by the primary care and the outcomes after consulting the cardiologists. There were 3 possible outcomes post kerbside consult: routine referral, expedited direct-access referral (within 2 weeks) to be reviewed by the cardiologists, or no further action needed.

Over the period of April 2016 to December 2022, there were a total of 1808 polyclinic tele-ECG referrals. The mean age of the patients was 58.4 years, where the majority of the patients were aged 60 to 79 years old (54%), male (57%) and of Chinese ethnicity (63%). Of these, a total of 1244 (69%) did not require tertiary care referral and could continue to be managed in primary care, thus saving an average of 15 referrals per month during this period. The breakdown of total referrals made, and average number of referrals saved per year during this period of 81 months is illustrated in Fig. 1A. Here, 564 (31%) patients required further evaluation in the cardiology specialist outpatient clinic. Of these patients, 127 (7%) required expedited review within 2 weeks by cardiologists and 437 (24%) were given routine referral appointments. Common ECG findings that primary care could identify and manage included premature atrial and ventricular complexes, non-specific T-wave inversions and left ventricular hypertrophy. More complex ECGs would be referred and discussed through the tele-ECG collaboration. Up till 31 December 2022, there

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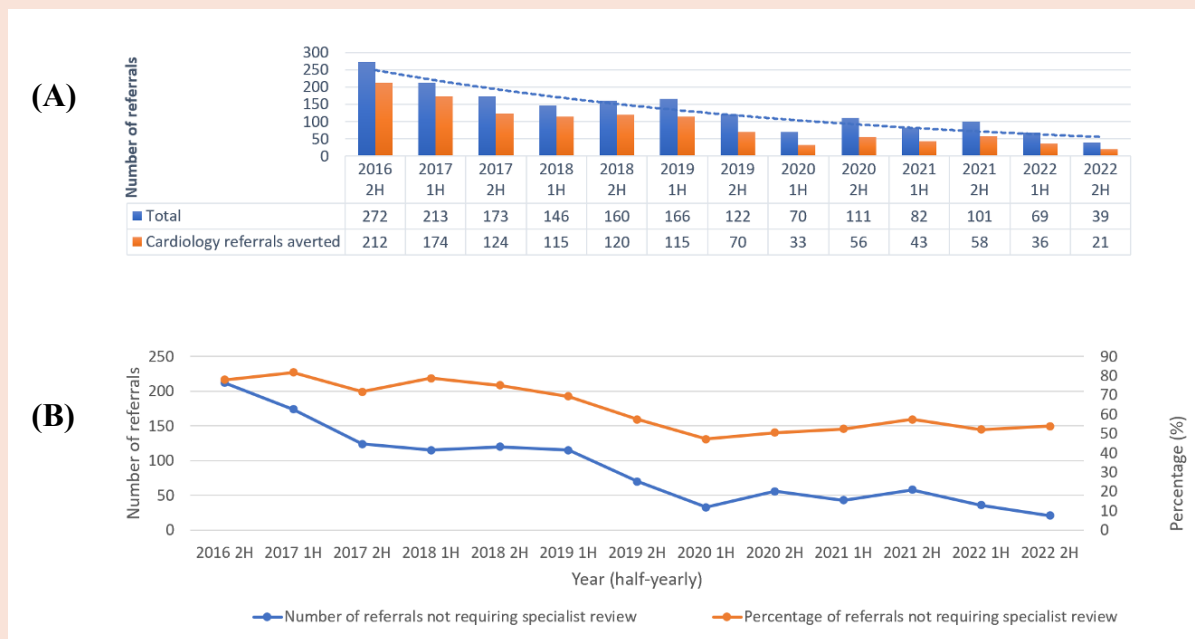
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Fig. 1. Total number of referrals made and number of referrals saved (A); decline in percentage of referrals not requiring specialist review (B).



were no known major adverse cardiac events in patients whose ECGs were managed in primary care and were deemed not to require further evaluation.

Tele-ECG support for primary care physicians has, in previous studies, conclusively demonstrated the effectiveness, safety and promptness to patients receiving appropriate therapy in the setting of acute coronary syndromes.¹⁻³ Data for tele-ECG support in the non-urgent setting remain scarce. Challenges remain in these settings when primary care physicians must decide whether the patient whose ECG is reviewed, can be safely managed in primary care, or requires a referral to tertiary care expediently or non-urgently. In cases of ECG interpretation uncertainty or that of unclear clinical significance, the primary care physicians may choose to refer these patients to tertiary care for a cardiology opinion. This economic burden can be reduced through appropriate right-siting and prompt cardiology inputs through tele-ECG, by enabling majority of such referrals to be safely managed in the community. Therefore, we embarked on this tele-ECG initiative between the primary care physicians and the cardiologists within the National Healthcare Group in Singapore.

The results of this initiative where cardiologists provide kerbside consultations and interpretation over 81 months, showed that only approximately a third of these patients require further evaluation in

specialist outpatient clinics. After accounting for the cost of implementing the tele-ECG intervention and the referrals avoided during this period, a system-level cost savings of over SGD300,000 was achieved, of which almost SGD50,000 were accrued to patients from the reduction in specialist outpatient clinic charges.

Over time, there was also a notable decline in cases requiring kerbside consult with the cardiologists as the family physicians' skills in ECG interpretation were enriched in the process as shown in Fig. 1B. There was also continuous education led by the designated family physicians to the polyclinics culminating in confidence in ECG interpretation. Only more complex ECGs were discussed via tele-ECG as the programme gradually matured. Additionally, our tele-ECG collaboration also demonstrated safety and efficacy.

Such collaborations are essential in the right-siting of patients and to ensure those who required expedited cardiologist assessment were seen in a timely manner. These efforts help to save time and cost for patients and also provide strong clinical collaborations between primary and tertiary care to ensure that resources and care are allocated appropriately.

Our tele-ECG initiative is a viable and sustainable collaboration between tertiary and primary care providers. Its successful implementation reduced referrals with more efficacious use of clinical resources in a safe and effective manner.

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Declaration

The authors declare no conflicts of interest.

Keywords: cardiology, ECG, family medicine, specialist outpatient clinics, tele-ECG

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