

Comparing the effectiveness, safety and cost of teleconsultation versus face-to-face model of pharmacist-led anticoagulation clinic: A single institution experience

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Dear Editor,

Teleconsultation-based (TELE) anticoagulation clinic (ACC) is an alternative modality, but its use in Singapore's clinical setting has not been well studied. In Tan Tock Seng Hospital (TTSH), the TELE ACC service was established to enrol patients who (1) perform self-testing using a loaned point-of-care (POC) international normalised ratio (INR) coagulometer or (2) visit the nearest polyclinic for INR blood test on days instructed by an ACC pharmacist; the patients will be followed up with via telephone consult or video conference on the same day. This enables patient convenience and reduces patient wait time compared with face-to-face (F2F) consultation.

A retrospective study was done to compare the effectiveness, safety and cost of TELE ACC versus F2F ACC model in TTSH. Records of ACC patients seen via TELE and F2F visits were retrieved from 2014 to 2021. Patients on warfarin for any indication seen by ACC, 21 years old and above, and those on the same model of teleconsultation (TELE/F2F) for at least 5 months were included. Exclusion criteria include patients on direct-acting oral anticoagulants, pregnant or breastfeeding patients, and patients who were switched from either of the 2 models of consultation within the study period of 5 months unless it was part of the workflow.

Data such as number of episodes of non-compliance, dietary/herbal/supplement intake changes, lifestyle changes (physical activity, smoking and alcohol), unwell periods and changes in interacting medications were collected as they are confounders to the time in therapeutic range (TTR). For patients with atrial fibrillation, CHA₂DS₂-VASc and HAS-BLED scores were collected.

Thirty patients were recruited for each of the F2F and TELE groups. Table 1 shows the baseline demographics of the patients. The TELE group comprised 19 patients (63%) who did perform self-testing, and 11 patients (37%) who visited the nearest clinic for blood taking. There was no statistically significant difference between both groups for age, sex, ethnicity, indication for

warfarin, target INR range, comorbidities, as well as CHA₂DS₂-VASc and HAS-BLED scores for those with atrial fibrillation.

Clinical outcomes. The TTRs for both F2F and TELE service were not significantly different from each other at 64.4% and 58.3%, respectively ($P=0.35$) using the Rosendaal method, and 57.4% and 53.2%, respectively ($P=0.53$) using the traditional method (Table 1).

The results from our study were similar to another Singapore study with only atrial fibrillation patients where the TELE group had a mean TTR of 64.6% compared with 65.7% for the F2F group over 6 months using Rosendaal method.¹

Safety outcomes. There is no significant difference in the safety outcomes between the TELE and F2F ACC services in terms of the warfarin-related emergency department visits and hospitalisation, and thromboembolic events (Table 1).

To compare safety outcomes across different studies, the complication rate per patient-year was calculated. For our study, the TELE ACC and F2F ACC services had complication rates (patients with warfarin-related complications/total number of patients) of 40% ($n=12$) and 63% ($n=19$). The complication rate per patient-year was 3.2% and 5% for the TELE ACC and F2F ACC services, respectively. This is comparable to reported event rates of 2.8–7.6% per patient-year in other anticoagulation centers.²⁻⁴

Comparison of direct patient cost for TELE ACC and F2F ACC services. The mean direct patient cost for the TELE service over a period of 5 months was \$198.70 ± \$71.80. This cost is significantly higher compared with the F2F service, which was \$130.80 ± \$46.90 ($P<0.01$) (Table 1).

The higher cost of TELE service was attributed to the significantly higher number of ACC consultations done per patient for the TELE service (9.8 ± 3.3) compared with the F2F service (6.7 ± 2.4) ($P<0.01$). In addition, the average number of test strips used was greater for the TELE service, with an average

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Table 1. Comparison of face-to-face (F2F) and teleconsultation (TELE) groups.

Variable	F2F (n=30)	TELE (n=30)	P value
Baseline demographics			
Age, mean (SD), years	76 (11.4)	74 (17.1)	0.65
Male, no. (%)	14 (46.7)	10 (33.3)	0.48
Ethnicity, no. (%)			
Chinese	21 (70.0)	21 (70.0)	0.47
Malay	4 (13.3)	6 (20.0)	
Indian	1 (3.3)	2 (6.7)	
Others	4 (13.3)	1 (3.3)	
Indication for warfarin,^a no. (%)			
Atrial fibrillation	18 (60.0)	21 (70.0)	0.46
Stroke/transient ischaemic attack	8 (26.7)	11 (36.6)	0.41
Deep vein thrombosis	7 (23.3)	6 (20.0)	0.75
Pulmonary embolism	4 (13.3)	5 (16.7)	0.72
Mitral valve replacement	5 (16.6)	3 (10.0)	0.45
Left ventricular clot	0 (0)	3 (10.0)	-
Valvular heart disease	5 (16.6)	3 (10.0)	0.45
Aortic valve replacement	1 (3.3)	2 (6.7)	0.55
Antiphospholipid syndrome	0 (0.0)	1 (3.3)	-
Others	3 (10.0)	5 (16.7)	0.45
Target INR range, no. (%)			
2.0–3.0	22 (73.3)	21 (70.0)	0.19
2.0–2.5	3 (10.0)	4 (13.3)	
2.5–3.5	2 (6.7)	0 (0)	
2.5–3.0	1 (3.3)	3 (10.0)	
Others	2 (6.7)	2 (6.7)	
Consultation type, no. (%)			
Face-to-face	30 (100)	-	-
Phone	-	18 (60.0)	-
Video	-	12 (40.0)	-
Location of blood test, no. (%)			
INR coagulometer (perform self-testing)	-	19 (63.3)	-
Polyclinic/nursing home/general practitioner	-	8 (26.6)	-
Tan Tock Seng Hospital	30 (100)	3 (10.0)	<0.01
Comorbidities,^b no. (%)			
Hypertension	22 (73.3)	20 (66.6)	0.57
Congestive cardiac failure	4 (13.3)	10 (33.3)	0.07
Diabetes	11 (36.7)	13 (43.3)	0.60

Table 1. Comparison of face-to-face (F2F) and teleconsultation (TELE) group. (Cont'd)

Variable	F2F (n=30)	TELE (n=30)	P value
Baseline demographics			
Vascular disease ^c	12 (40.0)	15 (50.0)	0.44
Renal disease	0 (0)	5 (13.3)	-
Liver disease	1 (3.3)	1 (3.3)	1
Stroke history	11 (36.7)	14 (46.6)	0.43
Bleeding history	10 (33.3)	13 (43.3)	0.43
Medication use predisposing to bleeding,^d no. (%)	5 (16.7)	2 (6.6)	0.23
CHA₂DS₂-VASc score, mean (SD)^e	4.5 (1.5)	5.6 (2.2)	0.08
HAS-BLED score, mean (SD)^e	2.3 (1.1)	3.0 (1.3)	0.10
First visit encounters, no. (%)	8 (26.6)	0 (0)	-
Total number of days for INR monitoring, mean (SD)	177.8 (24.9)	167 (19.8)	0.09
Dietary/herbal/supplement intake changes, no. (%)	16 (53.3)	14 (46.7)	0.61
Changes in interacting medications, mean, no. (%)	4 (13.3)	3 (10.0)	0.69
Lifestyle changes, no. (%)	1 (3.3)	6 (20.0)	0.04
Non-compliance to warfarin, no. (%)	11 (36.6)	5 (16.7)	0.09
Clinical outcomes between TELE and F2F services, mean (SD)			
TTR by traditional method	57.4 (25.7)	53.2 (25.5)	0.53
TTR by Rosendaal method	64.4 (25.5)	58.3 (24.4)	0.35
Percentage of INR above TTR	6.97 (13.2)	9.8 (11.5)	0.25
Percentage of INR below TTR	28.7 (24.9)	31.9 (25.0)	0.70
Safety outcomes between TELE and F2F services, no. (%)			
Patient with INR >5.0 within 5 months	1 (3.3)	1 (3.3)	1.0
Warfarin-related emergency department visits	0	0	-
Warfarin-related hospitalisation	2 (6.6)	4 (13.3)	0.74
Thromboembolic events	0	1 (3.3)	0.31
Major bleeding	2 (6.6)	1 (3.3)	0.55
Clinically relevant non-major bleeding	1 (3.3)	1 (3.3)	1.0
Other bleeding	7 (23.3)	12 (40)	0.27
Cost comparison between TELE and F2F services,^f mean (SD)			
Number of INR test done (PT/POCT-INR)	7 (2.4)	13 (5.5)	<0.01
Number of outpatient visits	6.7 (2.4)	1.2 (1.0)	<0.01
Number of teleconsultations	0	8.9 (3.1)	<0.01
Cost of service per patient, USD	130.8 (46.9)	198.7 (71.8)	<0.01

INR: international normalised ratio; PT/POCT: prothrombin time test/point-of-care testing; SD: standard deviation; TTR: time in therapeutic range

^a Patients may have more than 1 indication.

^b Patients may have more than 1 comorbidity.

^c Prior myocardial infarction, peripheral vascular disease and ischaemic heart disease.

^d Anti-platelets or non-steroidal anti-inflammatory agents.

^e For patients with atrial fibrillation.

^f Costs were reported in US dollars based on the pegged exchange rate USD 0.72/SGD 1.

of 13 INR test strips. This was due to the 3-monthly quality control check of the home POC-INR coagulometer with the hospital POC-INR coagulometer to ensure that INR readings do not deviate significantly from each other. Additionally, some TELE patients may use more than 1 INR test strips due to failed attempts at self-testing, thus incurring a higher cost compared with F2F visits where testing was performed by a professional medical technologist.

For our study, a direct patient cost from a patient's perspective was considered to evaluate cost from a patient's point of view. Even from a patient's perspective, some costing study included different cost components, such as the cost of the coagulometer that will incur higher patient cost.⁵ For our study, the home POC INR coagulometer was loaned to the patient until the INR stabilises so that it was more cost-saving for patients. Other studies also considered indirect patient costs, such as transportation fees, time of registration and waiting time as well as time off work into account.⁶ Most cost studies do not consider practical aspects of patient's cost from the wastage of using more than 1 POCT INR test strips due to failure of attempting INR self-testing, which our study considered.

Overall, teleconsultation modality for pharmacist-led ACC service was shown to be as effective and safe as F2F ACC service in this study. The TELE ACC service requires strict compliance to local personal data protection guidelines. This includes using secured video consultation platform and conducting them in a private setting. Recording of video consultation was not permitted.

The limitation of this study is the short follow-up period of 5 months and the small sample size. Future studies can be conducted over a longer period with larger sample size, incorporate indirect patient cost, and consider travel cost and time saved, which would be a more holistic cost study from a patient's perspective. To our knowledge, this study was also the first in Singapore to examine cost of teleconsultation service compared with

usual anticoagulation management. Future cost studies can also be done from healthcare payers' and societal perspective, and consider costs such as for time taken by the healthcare provider for teleconsultation and technological infrastructure.

Disclosure

No conflict of interest.

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