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Follow-Up of Post Myocardial Infarction Using Telemedicine: Stakeholders' Education, Results and Customer Satisfaction.

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Follow-Up of Post Myocardial Infarction Using Telemedicine: Stakeholders' Education, Results and Customer Satisfaction

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Abstract: Background. There are few studies about post myocardial infarction follow-up using telemedicine. We organized a post-discharge telemedicine service with a dedicated team. To do this, it was necessary that all stakeholders involved in the organization and use of the telemedicine service were properly educated and informed. **Methods.** We designed a theoretical-practical mini-course, to train healthcare personnel and increase skills, with excellent learning outcomes and satisfaction. Thereafter, we enrolled patients affected by acute myocardial infarction with ST elevation (STEMI), MINOCA (myocardial infarction with no obstructive coronary atherosclerosis), Takotsubo syndrome or spontaneous coronary dissection, and high-risk acute myocardial infarction without ST elevation (NSTEMI). At discharge, the cardiology technician performed counselling for the patient; using regional platforms, televisit at 1 and 4 months monitored major adverse cardiac events (MACE), heart failure, arrhythmias, unstable angina and non-cardiovascular events, therapy adherence, target therapy and customer satisfaction. **Results.** Between November 2021 and February 2023, we enrolled 110 patients: 72% affected by STEMI, 22% by NSTEMI. At the 1-month follow up, 12 patients did not reach pressure target and 23 patients did not reach LDL target. We observed three in hospital readmission, three in hospital visits for further investigation and one death. To date, a four months follow up was performed for 54 patients. No readmissions or deaths occurred. We detect a rate of 96% of customer satisfaction. **Conclusion.** A health coordination center with a dedicated team makes televisit safe as a follow-up for post myocardial infarction patients. Before, it is fundamental for healthcare professionals the acquisition of theoretical knowledge and updates and the acquisition of manual, technical and practical skills.

Keywords: education; televisit; telecounselling; post myocardial infarction; follow-up; customer satisfaction

1. Introduction

In the last few years, acute myocardial infarction (AMI) hospitalization decreased, due to the action of primary prevention, reaching a total volume of 123,327 admissions since 2019 in Italy [1]. Such patients need follow-up to check for symptoms, adherence to therapy and achievement of therapeutic targets. The increasing demand for outpatient services and the concomitant pandemic from SARS-COV2 accelerated the creation and the implementation of telemedicine services. In literature, we still find few experiences with follow-up of post myocardial infarction using telemedicine. A study by Zhang et al., published in 2021 and concerning 288 patients hospitalized for ST elevation myocardial infarction (STEMI) during the period of the COVID19 pandemic, reported

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that in such patients followed mostly in telemedicine there was an increased adherence to therapy, with better long-term prognosis (1 year follow-up) [2]. Previously, in 2019, Spaulding described a digital health intervention developed by Johns Hopkins, the Corrie Health Digital Platform (Corrie), which included the first cardiological smartphone application Apple Care Kit, combined with an Apple Watch and a blood pressure bracelet equipped with Bluetooth. Corrie's goals were self-management of cardiac drugs, self-tracking of vital signs, education about cardiovascular diseases through animated articles and videos, and coordination of care including outpatient follow-up visits. This is an example of a self-management tool in post-myocardial infarction [3]. Kamel and colleagues divided two hundred patients admitted for STEMI and primary angioplasty (PCI) in two groups: a hundred patients in the study group received a monthly telecontrol using a smartphone application for 3 months, from 1 week after discharge, and at least one clinical visit in attendance. At the end of the course, there was no significant difference between the groups in terms of major cardiovascular events and adherence to therapy in general; however, patients in the study group showed better adherence to taking certain medications, smoking cessation and cardiac rehabilitation [4]. The IMMACULATE trial also showed that among low-risk patients with revascularization after myocardial infarction, remote monitoring by healthcare professionals is feasible and safe [5]. Another study aimed to assess the effects of telenursing on patients' activities of daily living and instrumental activities of daily living following a myocardial infarction, suggesting that the use of telenursing intervention may increase these activities and may enhance patients' independence [6].

At the same time, however, it is essential that all stakeholders involved in the organization and use of a telemedicine service are properly educated and informed. In Italy, for example, in May 2021, a survey carried out by the Osservatorio Innovazione Digitale in Sanità of the Politecnico in Milan showed that doctors using telemedicine are only 30%, digital literacy (basic digital skills and the use of digital in daily life) affect 60% of operators, but only 4% have e-Health competences, which is a satisfactory level in all areas of professional digital skills [7].

Things do not change if we analyse the so-called 'digital natives': SIGM (Segretarate Italian Young Doctors) studied the 'Millennials' or under-35s through the VALIDATE project ("VALues In Doing Assessments of health TEchnologies"). The results show that 13% directly manage big data in clinical and research practice, 13% use artificial intelligence in their area of interest and 22 and 34% respectively have a direct and indirect involvement in telemedicine [8].

From here, the necessity to educate the sanitary staff, supplying the necessary competences [9]:

1. Clinical: clinical experience must be combined with technology to make clinical decisions at a distance, to interpret non-verbal and verbal remote expressions or to carry out objective examination in a telehealth environment [10];
2. Technological: use of the necessary technology and ability to guide the patient to the use of the necessary technology, what to do when the technology does not work, handle digital patient data for clinic and research [11,12];
3. General: adherence to ethical, regulatory and procedural norms, knowledge of best practice, knowledge of limits of telehealth, organization and coordination of the team, communication (empathy and support during the session) [13,14].

2. Materials and Methods

2.1. Setting and Design of stakeholders' education

Concerning medical education, to ensure that the telemedicine service and the path for ischemic heart disease patients worked, we collaborated as editors in the drafting of a Corporate Act by the Health Directorate and General Directorate of the Local Health Department, for the specifics of the organization and implementation of the televisit procedure. In particular, we designed a theoretical-practical mini-course, to train healthcare personnel and increase skills, entitled "e-Health, telemedicine and services – televisit: theory and practice". The program included notions of a theoretical nature to know the new type of service and the relevant legislation, but above all practical,

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with telesimulations, to give the opportunity to do field exercises and make it easier to carry out the new service.

The course met two training needs: the acquisition of theoretical knowledge and updates and the acquisition of manual, technical and practical skills; it was aimed at doctors, nurses and technicians, for a maximum of 50 participants per edition. The educational objective was to start the televisit service or implement it, where already present, improving performance. The program of the training event, lasting 4 hours, included three sessions: the first dedicated to definitions, procedural and regulatory rules, the second dedicated specifically to televisit and the third to practical telesimulations. The first two sessions were held through lectures, the last through practical technical demonstrations. Specifically, the course program was structured as described in Table 1.

Table 1. Course program.

1° Session		**DEFINITIONS, REGULATORY RULES AND PROCEDURES**	
From 9.00 to 10.00	Duration 1 hour	*DETAILS*	***Teaching methodology***
from: h 9.00 to: h 9.20	20 min	e-Health	lectures
from: h 9.20 to: h 9.40	20 min	Telemedicine: Guidelines and consensus documents, Decentralized Clinical Trial	lectures
from: h 9.20 to: h 9.40	20 min	Televisit: the regional indications and the Corporate Deliberation	lectures
		BREAK	
2° Session	Duration	**TELEVISIT**	
From 10.15 to 12.15 P.M.	*2 hours*	*DETAILS*	
from: h 10.15 to: h 10.35	20 min	The first step: deciding which performance, organizing and coordinating the team	lectures
from: h 10.35 to: h 10.55	20 min	The team: doctor, nurse, technician, ...: necessary skills and roles	lectures
from: h 10.55 to: h 11.15	20 min	SISMED surgery operation implemented	lectures
from: h 11.15 to: h 11.35	20 min	SISMED surgery operation implemented	lectures
from: h 11.35 to: h 11.55	20 min	The necessary ratings for staff: what requests and to whom	lectures
from: h 11.55 to: h 12.15	20 min	Patient information and information examples (brochure)	lectures
		BREAK	
3° Session	Duration	**TELESIMULATION**	
From 12.30 to 13.40	*70 min*	*DETAILS*	
from: h 12.30 to: h 13.30	1 hour	Reproduction of some clinical simulations on televisit	practical technical demonstrations
from: h 13.30 to: h 13.40	10 min	LEARNING TEST	

The learning test was made through a questionnaire including 16 questions, indicating as threshold of acceptability beyond which it was considered passed the test 75%. A satisfaction questionnaire was distributed at the end of the course too.

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Fifty health workers took part in our course, obtaining a positive outcome to the learning test; moreover 98% expressed a positive opinion to the satisfaction questionnaire; 2% did not reply.

2.2. Setting and Design of the study

As for our study, this is a prospective single-center observational cohort study, using real world data (RWD) and telemedicine. The procedures adopted were in accordance with institutional guidelines. We selected the following patients:

a) Patients admitted for acute myocardial infarction with ST elevation (STEMI) and undergoing primary angioplasty,

b) Patients with myocardial infarction with no obstructive coronary atherosclerosis (MINOCA) or Takotsubo syndrome or coronary dissection,

c) Patients with no ST elevation myocardial infarction (NSTEMI).

All patients must have digital skills or a caregiver with digital skills. For these patients we programmed a follow-up through televisit 1 and 4 months after hospital discharge. We designed this service since early 2020, taking into account four key aspects:

1. The clinical need of the patients of periodic follow-up for ischemic heart disease;

2. Many patients' difficulties in reaching the hospital;

3. The availability of new types of dedicated technologies and telemedicine services, according to current regulations.

In particular, for the post myocardial infarction follow-up we selected televisit, according to the definitions indicated by the National Guidelines [15], which also established a system of rules, specifying the televisit charging system as the existing remuneration for the traditional mode.

In order to obtain a good organizational effectiveness, a multidisciplinary team was created, with the introduction of not only strictly medical staff too: the team consists of two dedicated cardiologists, two nurses and two cardiology technicians, with clinical and digital skills, supported by digital healthcare applications, according to literature models [16]. We also followed indications regarding the Lazio Region Guidelines [17,18] and, from a practical point of view, the outpatient organization included a path already published in the literature [19].

Methods for recruitment:

1. The cardiology technician checks the appointment for televisit at 1 month and delivers the vademecum to the patient with the details of the appointment signed by the doctor responsible for telemedicine, and explains to the patient the methods, details and clinical advice for the achievement of therapeutic targets; at the same time a written patient consent for data treatment using telemedicine is collected. It is important to note that this counselling can be also made using telemedicine, meaning that the technician performs a telecounselling (or teleassistance) with a video call to explain the previous ones to the patient.

2. The discharging cardiologist includes the appointment in the letter.

During the televisit:

The cardiologist provides:

a) Evaluation of symptoms, self-control parameters (blood pressure, heart rate) and blood chemistry vision;

b) Lifestyle check (diet, smoking, physical activity, etc.);

c) Check of the adherence to dual antiplatelet therapy (DAPT) and prescribed therapy with evaluation of any side effect;

d) Televisit reporting, programming any instrumental surveys and subsequent programming control on televisit to 4 months;

The cardiology technician provides:

a) Entering related database;

b) Calling subsequent patients for telecounselling.

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2.3. Data Collections

We collected data using an Access database. Data on demographic and clinical characteristics were collected from the electronic medical records by cardiology technicians during the recruitment and counselling of patients. These included personal data, past medical history, cardiovascular risk factors, presentation type, angiographic data, and time spent in hospital, complications during admission and medications on discharge. Likewise, during follow-up televisits, parameters of self-control, symptoms, blood chemistry and medications were collected. Blood chemistry includes LDL cholesterol, hemoglobin (Hb) and blood glucose; parameters of self-control include systolic blood pressure and heart rate. Guideline-directed medical therapy for acute coronary syndrome (ACS) in accordance to the European Society of Cardiology (ESC) [20] and American College of Cardiology/American Heart Association (ACC/AHA) [21] guidelines was prescribed.

2.4. Study Outcomes

We collected all study outcomes during the 1st month and 4th months follow-up from the discharge date. The primary safety outcome was a composite outcome of all-cause mortality, myocardial infarction, stroke and coronary revascularization (major adverse cardiovascular event – MACE), the secondary safety endpoints were heart failure, arrhythmia, unstable angina and non-cardiovascular events. Efficacy outcomes were adherence to prescription of guideline-directed medical therapy and cardiovascular risk factors control (systolic blood pressure, LDL, and blood glucose), and customer satisfaction.

2.5. Statistical Analyses

We described **c**ategorical variables as percentages and continuous variables as mean with standard deviation (SD).

3. Results

3.1. Baseline Characteristics (Table 2)

Between November 2021 and February 2023, we enrolled 110 patients (80% males, 20% females); the average age was 65±12 years. As for coronary risk factors, we registered hypertension in 71.8% of patients, diabetes in 21%, dyslipidemia in 84.5%, cigarette smoking in 49% and familiarity for ischemic heart disease in 27% of them. The admission diagnosis was STEMI in 72% of patients, while 22% was affected by NSTEMI and 6% by other pathologies taken in consideration, as MINOCA and Takotsubo syndrome or coronary dissection; among STEMI patients, myocardial site was anterior in 35%, inferior in 33%, 10% anterior-lateral and 10% inferior-posterior, other sites in the remaining cases. All performed coronary arteriography and 98% was treated with coronary angioplasty; among them in 44% of cases, the interventricular artery was treated, in 24% the right coronary artery and in 15% the circumflex artery. The length of stay in hospital was 8±3 days, all patients performed echocardiography and the left ventricular ejection fraction at discharge was in average 53.2±9%. During hospital stay, 5 patients experimented non sustained ventricular tachycardia at ECG monitoring, solved with beta blockers titration, 1 patients had acute decompensation solved with adequate therapy and one experimented transitory atrio-ventricular block, without necessity of pacing.

Table 2. Baseline characteristics of study participants.

	Total (n=110)
Demographic	
Age, years	65 (12)
Sex, female	22 (20)
Medical history	

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Hypertension	79 (71.8)
Diabetes	23 (21)
Dyslipidemia	93 (84.5)
Family history of premature ischemic heart disease	54 (49)
Smokers	30 (27)
Admission	
STEMI	79 (72)
Anterior	28 (35)
Inferior	26 (33)
Anterior-lateral	8 (10)
Inferior-posterior	8 (10)
Other sites	9 (12)
NSTEMI	24 (22)
MINOCA or Takotsubo syndrome or coronary dissection	7 (6)
Complications during admission	7 (6)
Non sustained ventricular tachycardia	5
Heart failure	1
Transitory atrio-ventricular block	1
Length of stay, days	8 (3)
LVEF on discharge, %	53.2 (9)
Coronary arteriography	110 (100)
Coronary angioplasty	108 (98)
Interventricular artery	48 (44)
Right coronary artery	26 (24)
Circumflex artery	16 (15)
Others	18 (17)

Categorical data presented as n (%). Continuous data presented as mean values (standard deviation). STEMI, acute myocardial infarction with ST elevation; MINOCA, myocardial infarction with no obstructive coronary atherosclerosis; NSTEMI, acute myocardial infarction without ST elevation; LVEF, left ventricular ejection fraction.

3.2. Safety and Efficacy End-Point at one-month follow-up televisit

The characteristics of study participants during follow-up are described in Table 3.

3.2.1. Primary safety outcome

We registered 1 sudden death 3 weeks after discharge: he was a middle aged male with all risks factors except diabetes, who underwent multivessels angioplasty for a NSTEMI and with a mild reduction of left ventricular ejection fraction.

3.2.2. Secondary safety endpoints

We observed 3 patients with necessity of hospital readmission. One patient had an admission for acute anemia (Hb 6 g/dl) with melena, he underwent blood transfusions and he was subjected to gastrointestinal endoscopy that demonstrated hemorrhagic gastritis, so that antiplatelet therapy was reduced and gastric protection augmented. Another patient experimented severe gastrointestinal bleeding too: she had been discharged with dual antiplatelet therapy along with anticoagulant therapy; gastrointestinal endoscopy revealed colon diverticulosis and in this case, therapy has been reduced too. Finally, one patient presented systemic allergy, probably alimentary related. Three patients required in hospital visit to perform an electrocardiogram (ECG) for referred palpitations, but the ECG revealed sinus rhythm, echocardiography for referred dyspnea, without the worsening of left ventricular ejection fraction, and blood sampling for paleness witnessed during televisit (which revealed Hb 6.9 g/dl, this is the same patient with gastrointestinal bleeding). Some cases of hypertension, hypotension, bradycardia and worsening of renal insufficiency were successfully

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treated at the distance, as far as the necessity of changing therapy or prescription and vision of instrumental examinations performed.

3.2.3. Efficacy outcomes

Adherence to prescription of guideline-directed medical therapy was confirmed, above all for dual antiplatelet therapy; 4 patients interrupted statins due to muscular pain. As for cardiovascular risk factors control, 12 patients didn't reach the pressure target, so that therapy was optimized; 23 didn't reach the LDL target, four of these suspended statins themselves, for the others therapy was optimized; 7 patients continued smoking.

3.3. Safety and Efficacy End-Point at four-months follow-up televisit.

To date, a four months follow up was performed for 54 patients only.

3.3.1. Primary safety outcome

No readmissions, no deaths and in hospital visit occurred. Hypertension, hypotension, bradycardia, or other symptoms referred were successfully treated at the distance too, as well as therapy prescription and prescription and vision of instrumental examinations performed.

3.3.2. Efficacy outcomes

Adherence to prescription of guideline-directed medical therapy was confirmed. As for cardiovascular risk factors control, 2 patients didn't reach the pressure target, 5 didn't reach the LDL target, so that therapy was optimized, 2 patients continued smoking.

Table 3. Safety and efficacy end-points during 1-month follow-up and 4-months follow-up.

	1-month FU (n=110)	**4-months FU (n=54)**
MACE	1 (0.9)	0
Heart failure	0	0
Arrhythmia	1 (0.9)	0
Unstable angina	0	0
Thoracic pain	0	1 (2)
Dyspnea	8 (7)	6 (11)
Palpitations	8 (7)	3 (5.5)
Non-cardiovascular events	3 (2.7)	0
Hospital readmission	3 (2.7)	0
In hospital visit	3 (2.7)	0
Adherence to prescriptions		
DAPT	110 (100)	54 (100)
Statin	106 (96)	54 (100)
Risk factors control		
SBP target	98 (89)	52 (96)
Average SBP (mmHg)	122 (13)	117 (8)
LDL target	87 (79)	49 (91)
Average serum LDL (mg/dl)	49 (22)	74 (56)
Stop smoking	23 (77, n=30))	23 (92, n=25)

Categorical data presented as n (%). Continuous data presented as mean values (standard deviation). FU, follow-up; MACE, major adverse cardiovascular event; DAPT, dual antiplatelet therapy; SBP, systolic blood pressure; LDL, low density lipoprotein.

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3.4. Customer Satisfaction

Finally, we detect a rating of 96% of customer satisfaction, 1% reported no preferences between televisit or in hospital visit. Few patients reported to prefer on site visit because of the lack of human contact with the doctor. The majority of patients referred to be satisfied not only with the televisit itself, with the possibility to talk with the doctor and to exchange data without moving from home, but also with the technicians' counselling and contact at a distance to improve self-management of their diseases.

4. Discussion

This study examines real-world data in using telemedicine on standard follow-up care and evaluations of outcomes among post myocardial infarction patients after hospital discharge. The health professionals who participated in this project followed a preliminary training course to acquire skills and to be able to adequately perform the telemedicine services.

We can underline some important findings. Achieving medication target doses and guideline-directed medical therapy, as far as the risk factors control during follow-up is important to reduce the risk of MACE. Telemedicine uses technological innovations and devices capable of giving support and care at a distance. Therefore, it is possible to detect and correct poor adherence to pharmacological and non-pharmacological therapy, and then stimulate early therapeutic interventions or appropriate behavioral changes. Particularly, televisit makes it possible to exchange real-time clinical data, medical reports, images, audio-video, relating to the patient; the doctor can share the findings, he can proceed with the prescription of further investigations or therapies, send the report of the televisit and enter the patient's data in the collection database. Telenursing by health professionals (nurses and technicians) helps in this management too: they can perform patient and caregiver education on adherence, medications, and lifestyle behaviors, suggestions about a heart-healthy diet and exercise, and finally also the counselling itself on how the televisit is going to play out and how the patient will get the report.

Many trials have just shown the improvement of patient education, medication adherence, and lower mortality, reduction of hospital admissions, the improvement of quality of life and the reduction of healthcare costs with the use of telemedicine [22,23]. At the same time, we know that patients require closer monitoring post myocardial infarction [5]. Moreover, the European Society of Cardiology recommends the development of specific training programs for patients, caregivers and professionals to acknowledge capabilities and limitations of telemedicine [24].

Another important factor emerging from this work is that telemedicine requires teamwork. For a telemedicine service, it is fundamental to have active collaboration between the different professional figures of the multidisciplinary team (cardiologist, nurse and technician of cardiovascular physiopathology), which must necessarily collaborate and contribute to the success of the patient's care path. To do this, however, it is necessary that all operators are adequately educated from the theoretical and practical point of view; they have to know the advantages of these performances, but also the limits, and they can be therefore able to overcome them and to promptly resolve them. They must be trained to inform the patient adequately, to overcome any mistrust or difficulties with technology and new procedures.

As suggested by an interesting work of the Mayo Clinic [25], it is necessary to avoid the unsafe "doctor-does-it-all" model: staff should provide this support whether the visit is in person or virtual. It is necessary to plan the activities of the center and to plan a personalized path for each patient. Patients must be supported in gaining familiarity with the technology, there must be precise rules on 'who does what', and, to simplify work, setting up and starting before physician involvement: there must be a telemedicine health operative center.

Finally, we found few works in literature about customer satisfaction using telemedicine, for example regarding services using telemonitoring and teleconsulting [26], or about satisfaction questionnaire to measure health care professionals' satisfaction [27], or specific questionnaire to assess the quality of the service and the patient satisfaction [28] or about using telehealth platforms managed by nurses [29]. To our knowledge, there are no data about televisit and telecounselling in

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post myocardial infarction patients; this study examined the users' satisfaction, reporting the majority of patients being satisfied not only with televisit itself, but also with the technicians' counselling and contact at a distance to improve self-management of their diseases.

5. Conclusions

These RWD show that post myocardial infarction patients follow-up with telemedicine is feasible, using both televisits that allows the possibility to talk with the doctor and to exchange data without moving from home, and teleassistance or telecounselling, the nurses' and technicians' distanced contact to improve self-management of patients' diseases and to help them in performing all telemedicine activities.

Televisits are safe in the follow up of these patients; we treated many cases successfully from distance, as far as the necessity of changing therapy or prescription and vision of instrumental examinations performed. It helps in promoting adherence to prescription of guideline-directed medical therapy and in reaching target in cardiovascular risk factors.

The approval rate was high, with few patients preferring in office visit, but we observed the possibility in easily converting televisits into face to face evaluations or re-hospitalization, if necessary, to manage some adverse event.

These services were possible through the structuring of a health coordination center with a dedicated team, which also supported patients with counselling in the new path. But it was possible also thanks to the educational path carried out for health professionals, because it certainly made them more competent in the field of telemedicine and more prepared to build new paths according to the need of the patient, in patient involvement and in team collaboration.

6. Limitations

There are some limitations in our study. As mentioned, this is a prospective single-center observational cohort study, using RWD and telemedicine, and it reflects the current follow-up method used by the cardiology unit; this is why we have not a control group using traditional follow-up. Moreover, to date we have still a small sample size of enrolled patients. Finally, looking at our patients' population, we note very few complications during admission, so that it doesn't seem a high risk population, making remote follow up probably easier and safer. As far as education is concerned, the course was unique for doctors, nurses and technicians, not differentiating the single skills, but we believe that this helped to understand each other's work and to encourage teamwork collaboration.

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Conflicts of Interest: The authors declare no conflict of interest.

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