Patients' satisfaction associated with portable coagulometers for warfarin monitoring: a cross-sectional study

Nicoletta Riva[1], Christian Borg Xuereb[2], Walter Ageno[3], Michael Makris[4], Alex Gatt[1]

[1]*Department of Pathology, Faculty of Medicine and Surgery, University of Malta, Msida, Malta;*
[2]*Department of Gerontology and Dementia Studies, Faculty for Social Wellbeing, University of Malta, Msida, Malta;*
[3]*Department of Medicine and Surgery, University of Insubria, Varese, Italy;*
[4]*Sheffield Haemophilia and Thrombosis Centre, University of Sheffield, Sheffield, United Kingdom*

Background - The use of point-of-care (POC) coagulometers for monitoring patients on vitamin K antagonist (VKA) treatment makes international normalised ratio (INR) results immediately available. The aim of this study was to compare patients' satisfaction with VKA treatment in two settings characterised by distinct ways of monitoring: POC INR versus laboratory INR.

Materials and methods - We recruited adult patients on long-term warfarin treatment (July 2017-February 2018) from the Anticoagulation Clinics at five district health centres (namely Cospicua, Floriana, Mosta, Qormi, Rabat-POC INR) and at Mater Dei Hospital (Msida - Laboratory INR) in Malta. We administered two psychometric questionnaires: the Duke Anticoagulation Satisfaction Scale (DASS) (range 25-175, lower scores corresponding to higher satisfaction) and the Perception of Anticoagulation Treatment Questionnaire (PACT-Q2) (range 0-100, higher scores corresponding to higher satisfaction).

Results - We analysed 313 questionnaires (POC INR n=159, laboratory INR n=154). In the POC INR cohort, median age was 72 years and 59.1% were males; in the laboratory INR cohort, median age was 70.5 years and 46.1% were males. The POC INR cohort obtained significantly lower overall DASS score ($p<0.001$) and significantly higher PACT-Q2 scores ($p<0.001$ for the subscale "convenience"; $p=0.039$ for the subscale "anticoagulant treatment satisfaction") than the laboratory INR cohort. In multiple regression analysis, the use of POC coagulometers was significantly associated with the overall DASS score ($p=0.013$) and the PACT-Q2 convenience score ($p=0.012$).

Discussion - Patients on warfarin treatment were generally satisfied. Patients monitored with the POC INR with a dedicated time slot reported less inconvenience and burdens and better psychological impact than patients monitored with the traditional laboratory INR.

Keywords: *international normalised ratio, point-of-care systems, quality of life, surveys and questionnaires, warfarin.*

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Correspondence: Nicoletta Riva
e-mail: nico.riva@hotmail.it

INTRODUCTION

Anticoagulation, frequently a long-term treatment, can affect one's health-related quality of life (QoL). It does have positive aspects (e.g. the reassurance provided by the treatment itself or the contact with supportive healthcare professionals)[1], but there are also

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negative ones (e.g. the need for lifestyle changes or regular blood test monitoring, or concerns about possible side effects)[1-3]. Health-related QoL should always be taken into consideration when dealing with chronic treatment, since patient dissatisfaction can lead to decreased adherence[4-6], poor anticoagulation control, and worse clinical outcomes[2,7]. It is important to identify patients with low QoL or low satisfaction in order to establish targeted interventions[8]. Specific psychometric questionnaires have been developed to target satisfaction in anticoagulated patients, such as the Duke Anticoagulation Satisfaction Scale (DASS)[2] and the Perception of Anticoagulation Treatment Questionnaire (PACT-Q© [Sanofi-Aventis, Lyon, France])[3,9].

Vitamin K antagonist (VKA) treatment requires periodical monitoring of the international normalised ratio (INR), which can be performed through venepuncture and laboratory coagulometers (laboratory INR) or through finger-prick and point-of-care coagulometers (POC INR). The POC INR is usually performed by the patients themselves (self-testing), who with training can eventually interpret INR values and adjust VKA dosage (self-management). However, patients on self-testing/self-management might have to incur significant costs to buy a POC coagulometer and the respective test strips. Several studies showed that POC coagulometers improved patients' QoL, by using generic QoL scales[10,11] or simple questions[12-15], but it was still unclear whether a similar beneficial effect could be obtained with the use of POC coagulometers by healthcare professionals in the anticoagulation clinics. A similar set-up in certain health systems could offer a completely free professional service without any additional financial burden. A small study used the DASS to compare venepuncture *vs* POC-testing, but did not find any statistically significant difference between the two groups[16].

Thus, the aim of this study was to compare patients' satisfaction with warfarin treatment in two different settings characterised by distinct ways of monitoring: anticoagulation clinics with laboratory INR monitoring *vs* anticoagulation clinics with POC INR monitoring.

MATERIALS AND METHODS

Study population

The island of Malta was an ideal setting to conduct this study because the two ways of INR monitoring co-existed at the same time. We included adult patients on long-term warfarin treatment from two different settings. The laboratory INR cohort consisted of patients tested with the classical venepuncture and the standard laboratory INR. They were enrolled from the Anticoagulation Clinic at Mater Dei Hospital (Msida, Malta). In this setting, blood collection was performed early in the morning, samples were analysed in the Coagulation Laboratory, and warfarin dose adjustment was prescribed after the INR results become available, typically in the early afternoon. The INR was measured using the automated coagulation analyser ACL TOP 500 and the HemosIL® RecombiPlasTin 2G reagent (Instrumentation Laboratory, Milan, Italy). We excluded patients with less than 12 months experience with the laboratory INR for VKA monitoring.

The POC INR cohort consisted of patients tested with a finger-prick for capillary blood testing using POC coagulometers. In Malta, the POC devices have been in use by healthcare professionals at several health centres around the island since 2014. In this setting, patients were allocated a specific time slot for INR testing, which was immediately followed by warfarin dose adjustment by the attending physicians. Patients were enrolled from the Anticoagulation Clinics at five main health centres (i.e. Cospicua, Floriana, Mosta, Qormi, Rabat), which cater for different geographical areas of Malta. The POC coagulometer CoaguChek XS Plus (Roche Diagnostics International Ltd., Mannheim; Germany) was used to determine the INR. We excluded patients with less than 12 months experience with the POC INR for VKA monitoring. All patients monitored with the POC INR had previous experience of the laboratory INR system, since laboratory INR was usually performed at the beginning of VKA treatment. At the beginning of the POC system, the local protocol for switching from laboratory INR to POC INR required some strict criteria (target INR ≤3.0; at least 3 consecutive INR values within the therapeutic range; absence of antiphospholipid syndrome, liver disease, severe renal failure, active cancer, or dual antiplatelet therapy), but it was then left at the discretion of the attending physicians.

Study design

We performed a cross-sectional study. Consecutive adult patients attending the above-mentioned Anticoagulation Clinics on random days between July

2017 and February 2018, were invited to participate. After explaining the rationale and the design of this study, eligible patients received an information sheet and, if they agreed to take part in this study, they were asked to sign a consent form. Both English language and Maltese versions of information sheets, consent forms, and questionnaires were available.

Patients' satisfaction with the anticoagulant treatment was evaluated through the administration of two specific psychometric questionnaires at the time of enrolment: the DASS[2] and the PACT-Q2[3]. The PACT-Q1 was not administered because it measures the expectations associated with the anticoagulant treatment and should be administered before treatment initiation[3]. The choice of whether to complete the Maltese or the English versions of the questionnaires was left at the discretion of each patient. The Maltese translations of the DASS and PACT-Q2 questionnaires had been previously validated (Cronbach's alpha 0.87 for the DASS, 0.86 for the "convenience" subscale and 0.62 for the "anticoagulant treatment satisfaction" subscale of the PACT-Q2)[17,18]. Patients were offered the option of filling in the questionnaires in the waiting room of the Anticoagulation Clinics or at home, then sending it back by post with a pre-paid, self-addressed envelope; in the latter case, they received a maximum of two phone call reminders, if needed. Questionnaires were identified with a numeric code to ensure anonymity. The researchers had the list with the correspondence between the code and patients' details, which was used to contact the patients only in case of unanswered questions.

The following information was collected through a demographic form completed by the patients and a review of medical notes: baseline characteristics of the population (age, sex, nationality, languages spoken, domestic situation, level of education, employment status), details of the warfarin treatment (indication for anticoagulant treatment, starting date, prescribed duration, INR target range, INR results in the year before inclusion). Experience of unsuitable blood specimens was defined as any previous coagulation blood samples that were either haemolysed, lipaemic, insufficient, or filled in excess (from 2012 up to the day of enrolment). This study was approved by the University of Malta Research and Ethics Committee (protocol 07/2016).

Statistical analysis

Continuous variables were expressed as mean with standard deviation (SD) or median with interquartile range (IQR); categorical variables were expressed as counts and percentages. Normality was evaluated using the Wilk-Shapiro test. Continuous variables were compared using Student's *t*-test for normally distributed variables or the non-parametric Mann-Whitney U test for not-normally distributed variables; categorical variables were compared using the χ^2 test or Fisher's exact test, as appropriate.

The DASS was expressed as total score (ranging from 25 to 175), and as the score of each subscale (limitations, hassles/burdens, psychological impact). Six items (3h, 4a, 4b, 4f, 4h, 4j) were reversed prior to analysis, according to Samsa *et al.*[2]. The PACT-Q2 score was reported separately for the two subscales. The items of the "convenience" subscale were reversed, summed, and rescaled on a scale from 0 to 100; the items of the "anticoagulant treatment satisfaction" subscale were summed and rescaled on a scale from 0 to 100[9]. The DASS and PACT-Q2 scores were compared between the two cohorts (laboratory INR *vs* POC INR). For the DASS, lower scores correspond to higher satisfaction, while for the PACT-Q2, higher scores correspond to higher satisfaction. A further comparison was performed by considering the original answers (not reverse coded) and dividing them into three categories. For the DASS, the categories were defined as follows: negative (answers: "not at all", "a little", "somewhat"), neutral (answer: "moderately"), positive (answers: "quite a bit", "a lot", "very much"). For the PACT-Q2, the categories were defined as follows: negative (answers: "not at all", "a little"), neutral (answer: "moderately"), positive (answers: "a lot", "extremely"). Patients' satisfaction was also evaluated by age categories (< 45 years, 45-54 years, 55-64 years, 65-74 years, 75-84 years, ≥ 85 years).

The TTR was calculated according to the Rosendaal method[19] from the outpatients INR values of the 12 months prior to enrolment. High TTR was defined as ≥70%, according to recently published guidelines[20].

To assess the role of POC monitoring on patients' satisfaction, multiple regression analysis was performed, considering the results of the questionnaires of both study cohorts together and adjusting for several potential confounding variables. Three models were created, using the questionnaires' scores (overall DASS score, PACT-Q2

convenience, or PACT-Q2 satisfaction) as dependent variable. The independent variables were age, male sex, living alone, level of education, paid employment, warfarin treatment duration, atrial fibrillation as clinical indication, INR in range at enrolment, high TTR, hospitalisation in the previous year, previous bleeding on warfarin (self-reported), indirect experience of warfarin side effects (self-reported), experience of unsuitable blood specimens, choice of the Maltese language of the questionnaire, use of the POC for INR monitoring.

A sensitivity analysis was performed by including only those patients in the two cohorts who fulfilled the initial criteria for switching to the POC INR monitoring (lack of severe diseases; target INR ≤3.0; stable INR, defined as at least three consecutive INR values within the therapeutic range 12 months±1 month prior to enrolment). These same criteria were followed because it is known that unstable INR or severe comorbidities can influence patients' perception and satisfaction with chronic treatments[21] and therefore could potentially create an imbalance between the two groups. Another sensitivity analysis was performed considering separately the Maltese and the English versions of the PACT-Q2, since the Maltese translation of the "anticoagulant treatment satisfaction" subscale of the PACT-Q2 showed lower reliability than the original English version[18].

Sample size calculation was based on the following hypothesis. In The Home INR Study (THINRS), patients who performed INR self-testing at home obtained a mean (SD) overall DASS score of 46.8 (16.3) points, while patients who underwent INR testing in the clinic obtained a mean (SD) overall DASS score of 49.2 (18.0) points[22]. A difference between the two cohorts of 5 points, with a pooled SD of 15 points was hypothesised. In order to achieve a power of 80% and a significance level of 0.05, the necessary sample size was 142 patients per group. Therefore, we planned to enrol at least 150 patients per group. The statistical programmes STATA/SE v.12 (StataCorp LP, College Station, TX, USA) and SPSS v. 21 (SPSS Inc., Chicago, IL, USA) were used for the analysis; $p<0.05$ was considered statistically significant.

RESULTS

Study population

The flow diagram of the study population selection, showing the number of enrolled patients, returned questionnaires, and reasons for exclusion, is shown in **Figure 1.** Overall, 159 questionnaires were analysed for the POC INR cohort and 154 questionnaires for the laboratory INR cohort.

Patients in the POC INR group had a higher prevalence of male sex and INR in range on the day of enrolment, longer warfarin treatment duration, higher TTR in the previous

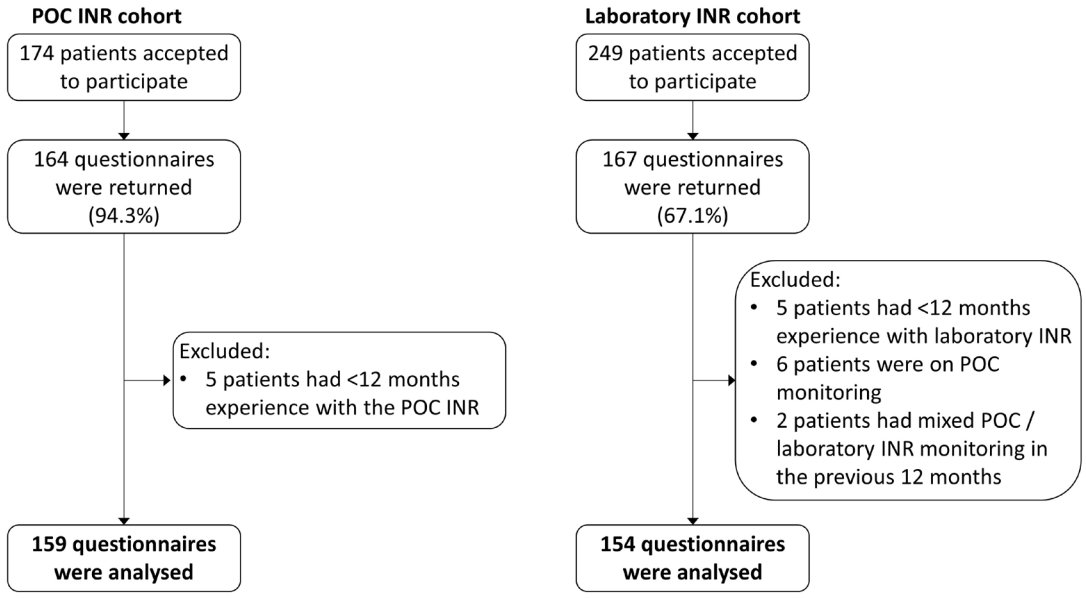

Figure 1 - Flow chart of the study population selection
INR:international normalised ratio; POC: point of care.

year, and more indirect experience of the side effects of the anticoagulant treatment. Patients in the laboratory INR group had more hospitalisations in the year prior to enrolment and higher prevalence of English among the languages spoken, even though the percentage of patients who filled the Maltese versions of the questionnaires was similar in the two settings. Differences among the two cohorts emerged also in the level of education (**Table I**).

Table I - *Baseline characteristics of the study population*

	POC INR cohort (n=159)	Laboratory INR cohort (n=154)	P
Age (years), median (IQR)	72 (65-78)	70.5 (63-76)	0.066
Sex, n (%)			
• Males	94 (59.1%)	71 (46.1%)	0.021
• Females	65 (40.9%)	83 (53.9%)	
Nationality, n (%)			
• British	12 (7.6%)	10 (6.5%)	0.79
• Maltese	141 (88.7%)	136 (88.3%)	
• Other	6 (3.8%)	8 (5.2%)	
Languages spoken*, n (%)			
• English	105 (66.0%)	118 (76.6%)	0.039
• Maltese	146 (91.8%)	139 (90.3%)	0.63
• Other	38 (23.9%)	35 (22.7%)	0.81
Domestic situation, n (%)			
• Living alone	23 (14.5%)	37 (24.0%)	0.087
• Living with family members	131 (82.4%)	114 (74.0%)	
• Other	5 (3.1%)	3 (2.0%)	
Level of education, n (%)			
• Primary school	76 (47.8%)	57 (37.0%)	0.038
• Secondary school	51 (32.1%)	59 (38.3%)	
• College or vocational school	12 (7.6%)	25 (16.2%)	
• Graduate or professional school	4 (2.5%)	5 (3.3%)	
• University degree	15 (9.4%)	7 (4.6%)	
• Other	1 (0.6%)	1 (0.7%)	
Employment status, n (%)			
• Full-time paid employment	10 (6.3%)	22 (14.3%)	0.10
• Part-time paid employment	3 (1.9%)	8 (5.2%)	
• Homemaker/housewife	29 (18.2%)	24 (15.6%)	
• Retired/pension	110 (69.2%)	93 (60.4%)	
• Unemployed	1 (0.6%)	1 (0.7%)	
• Not working due to present health status	2 (1.3%)	4 (2.6%)	
• Other	4 (2.5%)	2 (1.3%)	
Warfarin treatment duration, n (%)			<0.001
• 1 year	1 (0.6%)	12 (7.8%)	
• >1 year to ≤2years	8 (5.0%)	23 (14.9%)	
• >2 years to ≤3years	13 (8.2%)	23 (14.9%)	
• >3 years to ≤4years	20 (12.6%)	32 (20.8%)	
• >4 years to ≤5 years	15 (9.4%)	14 (9.1%)	
• >5 years	102 (64.2%)	50 (32.5%)	
POC duration, n (%)			
• 1 year	3 (1.9%)	not applicable	
• >1 year to ≤2years	40 (25.2%)		
• >2 years to ≤3years	93 (58.5%)		
• >3 years to ≤4years	23 (14.5%)		
Clinical indication for warfarin*, n (%)			
• Atrial fibrillation	111 (69.8%)	93 (60.4%)	0.080
• Venous thromboembolism	22 (13.8%)	28 (18.2%)	0.29
• Heart valve replacement	28 (17.6%)	32 (20.8%)	0.48
• Other	9 (5.7%)	6 (3.9%)	0.60
INR target range, n (%)			0.060
• 2.0 to 3.0	144 (90.6%)	140 (90.9%)	
• 2.5 to 3.5	8 (5.0%)	13 (8.4%)	
• Other	7 (4.4%)	1 (0.7%)	
INR at enrolment, n (%)			0.005
• In range	103 (64.8%)	84 (54.6%)	
• Below range	24 (15.1%)	47 (30.5%)	
• Above range	32 (20.1%)	23 (14.9%)	
TTR in the last 12 months (%)**, median (IQR)	74.3 (62.7-87.5)	71.4 (60.2-81.8)	0.040
High TTR (≥70%) in the last 12 months**, n (%)	94 (59.5%)	83 (55.7%)	0.50
Hospitalisation in the last 12 months, n (%)			<0.001
• Yes	60 (37.7%)	96 (62.3%)	
• No	98 (61.6%)	53 (34.4%)	
• Unknown	1 (0.6%)	5 (3.3%)	
Warfarin prescribed duration (self-reported), n (%)			0.35
• Limited period of time	2 (1.3%)	1 (0.7%)	
• Lifelong	143 (89.9%)	131 (85.1%)	
• I don't know yet	14 (8.8%)	22 (14.3%)	
Previous bleeding on warfarin (self-reported), n (%) "Have you ever had any bruise or bleeding while you were taking warfarin?"			0.42
• Yes	50 (31.5%)	55 (35.7%)	
• No	109 (68.6%)	99 (64.3%)	
Indirect experience of warfarin side effects (self-reported), n (%) "Do you know someone who has had side effects from blood-thinning medications?"			0.021
• Yes	17 (10.7%)	6 (3.9%)	
• No	142 (89.3%)	148 (96.1%)	
Experience of unsuitable blood specimens, n (%)			0.42
• Yes	60 (37.7%)	65 (42.2%)	
• No	99 (62.3%)	89 (57.8%)	
Language of the questionnaires, n (%)			0.96
• English	76 (47.8%)	74 (48.1%)	
• Maltese	83 (52.2%)	80 (52.0%)	

*More than one option was possible. **Data available in 158 patients in the POC INR cohort and 149 patients in the laboratory INR cohort.
INR: international normalised ratio; IQR: interquartile range; POC: point of care; TTR: time within the therapeutic range.

Patients' satisfaction in the two study cohorts

Patients in the POC INR cohort were more satisfied than patients in the laboratory INR cohort (**Table II**), as shown by a statistically significant lower score in the overall DASS and in the subscales "hassles/burdens" and "psychological impact" (p<0.001 for all comparisons). They also had statistically significant higher scores in the PACT-Q2 "convenience" (p<0.001) and "anticoagulant treatment satisfaction" (p=0.039) subscales.

Detailed results of each item of the DASS and the PACT-Q2 are reported in *Online Supplementary Content*, **Tables SI** and **SII**. Furthermore, significant differences between the two cohorts when considering categorical answers (negative/neutral/positive) are shown in *Online Supplementary Content*, **Figures S1-S4**.

When satisfaction was analysed by age categories, we observed a trend towards higher satisfaction with increasing age (**Figure 2**). Furthermore, there was a significant difference between the two study cohorts for the overall DASS in the age categories 65-74 years (p=0.003), 75-84 years (p=0.008), and ≥ 85 years (p=0.014), and for the PACT-Q2 "convenience" subscale in the age categories 65-74 years (p=0.013) and 75-84 years (p=0.024).

Contribution of POC INR monitoring to patients' satisfaction

Three different multiple regression models were created to confirm whether the POC INR monitoring significantly contributed to patients' satisfaction (**Table III**). After adjusting for potential confounding variables, the use of POC coagulometers remained significantly associated with the overall DASS score (p=0.013) and the PACT-Q2 "convenience" score (p=0.012), thus confirming the beneficial effect of the POC in reducing the hassles and burdens associated with warfarin treatment.

Sensitivity analyses

The first sensitivity analysis, including only patients fulfilling the initial criteria for switching to POC INR monitoring, was carried out on 196 patients (114 for the POC INR cohort and 82 for the laboratory INR cohort). This analysis confirmed the results of the main analysis, except for the "anticoagulant treatment satisfaction" subscale of the PACT-Q2, which was not significantly different between the two study cohorts (*Online Supplementary Content*, **Table SIII**).

The second sensitivity analysis, considering separately the Maltese and the English versions of the PACT-Q2, confirmed better "convenience" score for the POC INR cohort. However, there was no significant difference in the "anticoagulant treatment satisfaction" subscale when analysing only the English version (*Online Supplementary Content*, **Table SIII**).

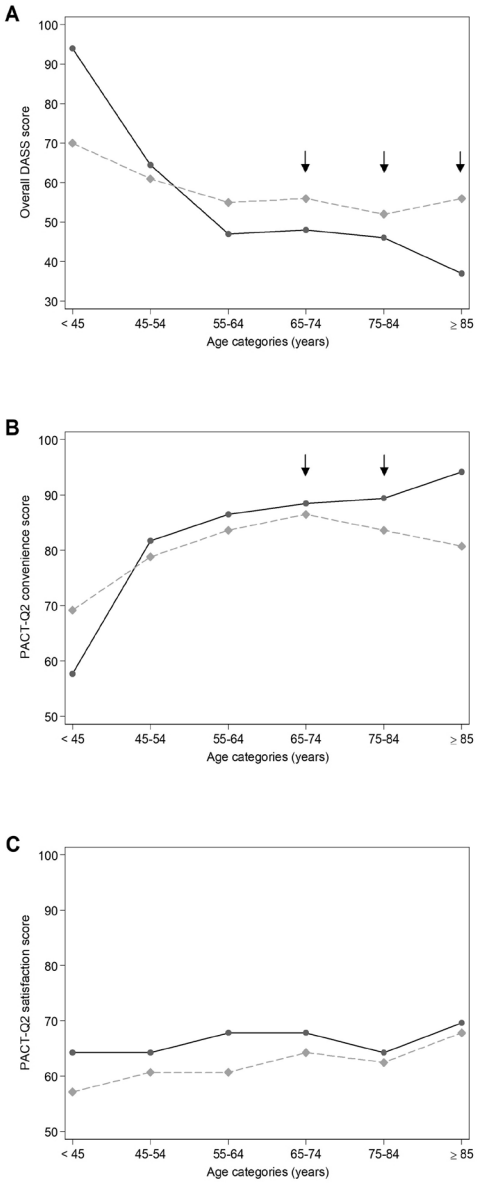

Figure 2 - Patients' satisfaction in the two study cohorts by age categories

The continuous dark line represents the point-of-care International Normalised Ratio (POC INR) cohort; the light dashed line represents the laboratory INR group. The arrows indicate statistically significant differences between the two study cohorts (p<0.05). DASS: Duke anticoagulation satisfaction scale; PACT-Q2: perception of anticoagulation treatment questionnaire (part 2).

Table II - *Results of the DASS and PACT-Q2 questionnaires in the two study cohorts*

	POC INR cohort (n=159)		Laboratory INR cohort (n=154)		Mann-Whitney U test: p
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
DASS results					
• Sections 1 and 2: limitations	16.4 (8.0)	13 (11-19)	17.7 (9.6)	14 (11-21)	0.47
• Section 3: hassles/burdens	13.6 (6.7)	11 (9-16)	17.9 (7.9)	16 (12-23)	<0.001
• Section 4: psychological impact	20.7 (6.7)	20 (16-24)	23.8 (6.7)	24 (19-28)	<0.001
• Overall DASS	50.8 (17.1)	47 (39-60)	59.4 (18.0)	56 (47-66)	<0.001
PACT-Q2 results					
• Sections B and C: convenience	85.9 (13.8)	88.5 (80.8-96.2)	79.8 (16.2)	82.7 (73.1-90.4)	<0.001
• Section D: anticoagulant treatment satisfaction	67.6 (11.8)	64.3 (60.7-75.0)	65.2 (14.5)	64.3 (57.1-75.0)	0.039

For the DASS, lower scores correspond to higher satisfaction, while for the PACT-Q2, higher scores correspond to higher satisfaction.
DASS: Duke anticoagulation satisfaction scale; INR: international normalised ratio; IQR: interquartile range; PACT-Q2: perception of anticoagulation treatment questionnaire (part 2); POC: point of care; SD: standard deviation.

Table III - *Results of the multiple regression analyses*

	Overall DASS score: beta coefficient (p)	PACT-Q2 convenience score: beta coefficient (p)	PACT-Q2 satisfaction score: beta coefficient (p)
Age	−0.130 (0.055)	0.164 (0.019)	0.081 (0.24)
Male sex	−0.128 (0.033)	0.119 (0.052)	0.041 (0.51)
Living alone	0.005 (0.93)	0.005 (0.93)	−0.023 (0.69)
Level of education	−0.072 (0.28)	0.089 (0.19)	0.224 (0.001)
Paid employment (full-time or part-time)	0.071 (0.28)	−0.102 (0.13)	−0.099 (0.14)
Warfarin treatment duration	−0.051 (0.39)	−0.062 (0.31)	0.061 (0.32)
AF as clinical indication for warfarin	0.018 (0.77)	−0.085 (0.18)	−0.038 (0.55)
INR in range at enrolment	0.025 (0.65)	0.016 (0.78)	−0.089 (0.13)
High TTR (≥ 70%) in the previous year	0.032 (0.58)	−0.001 (0.99)	0.012 (0.84)
Hospitalisation in the previous year	0.065 (0.26)	−0.060 (0.31)	0.065 (0.27)
Previous bleeding on warfarin (self-reported)	0.186 (0.002)	−0.127 (0.033)	−0.239 (<0.001)
Indirect experience of warfarin side effects (self-reported)	0.003 (0.96)	−0.006 (0.92)	0.056 (0.33)
Experience of unsuitable blood specimens	0.119 (0.031)	−0.034 (0.55)	−0.046 (0.41)
Maltese language of the questionnaire	0.028 (0.63)	−0.009 (0.88)	0.004 (0.95)
Use of the POC for INR monitoring	−0.156 (0.013)	0.161 (0.012)	0.060 (0.35)

AF: atrial fibrillation; DASS: Duke anticoagulation satisfaction scale, INR: international normalisedratio; PACT-Q2: perception of anticoagulation teatment questionnaire (part 2); POC: point of care; TTR: time within therapeutic range.

DISCUSSION

This study compared patients' satisfaction with warfarin treatment in two settings characterised by different ways of INR monitoring: the conventional laboratory INR versus the use of POC coagulometers by healthcare professionals in anticoagulation clinics. We found that the POC INR cohort was more satisfied than the laboratory INR cohort, and the analysis by age categories highlighted that this difference was more evident in older people (>65 years). Taken together, our results suggested that

POC monitoring had a greater impact on improving the convenience of the anticoagulant treatment, while the anticoagulant treatment satisfaction might have been influenced also by other variables.

POC coagulometers are portable devices which provide an accurate and effective alternative to conventional laboratory INR monitoring. Several studies reported good accuracy of POC devices when compared to the laboratory INR or global coagulation assays[23-26]. Two recent meta-analyses reported also a reduction of the thromboembolic complications associated with POC monitoring[27, 28]. Despite the fact that POC consumables are more expensive than routine clinic-based INR testing, there might be a more favourable cost-effectiveness ratio when considering the cost of labour and the indirect costs (such as VKA-related adverse events)[11, 29, 30]. Furthermore, the patients really appreciated being able to self-test at home. The THINRS study randomised 2,922 patients to clinic-testing or POC self-testing, and reported higher satisfaction in the latter, with a difference of -2.4 points in the overall DASS score at 2-year follow up (p=0.002)[22]. Another randomised trial showed that patients in the self-management group, compared to patients in the standard INR management group, had an increase in the "general treatment satisfaction" and a decrease in the "daily hassles" and in the "psychological distress" domains of the Oral Anticoagulation Knowledge test[31]. Furthermore, a recent study reported that, among 92 patients who switched to POC self-testing at home, 85 (92%) were "much" or "completely" satisfied by the use of POC coagulometers, while only 36 (39%) were "much" or "completely" satisfied by INR monitoring at the thrombosis centre[15]. While the use of POC devices for self-testing can reduce the hassles associated with long travel and waiting time, there are contexts in which the POC coagulometers are used by healthcare professionals in anticoagulation clinics[29]. However, it was still unclear whether the same degree of satisfaction was associated with the use of POC devices in these contexts. A small study compared 30 VKA patients monitored with the standard laboratory INR (venepuncture group) with 46 patients assigned to POC INR monitoring (POC-testing group) performed in the setting of an anticoagulation clinic, the latter consisting mainly of patients with physical disabilities, difficult venous access, a heavy work schedule or who live a long way from the clinic[6]. The DASS was translated into Greek and culturally adapted, resulting in 27 questions with 6 possible answers. No statistically significant difference was found either in the overall DASS score (venepuncture 71.05 *vs.* POC-testing 72.37, p=0.738) or in the DASS subscales or the single DASS items[16]. However, the number of patients that could be evaluated for the overall DASS score was influenced by the high number of questionnaires with at least one missing item (33%).

In our study, patients' satisfaction was compared using two psychometric questionnaires and an adequately powered sample size. We found that the cohort monitored with the POC INR had higher overall satisfaction, but also lower hassles/burdens (on the specific DASS subscale) and higher convenience (on the specific PACT-Q2 subscale). Although the population characteristics were not completely balanced between the two study cohorts, the sensitivity analyses confirmed the results of the primary analysis. Furthermore, the multiple regression models confirmed the important contribution of POC INR monitoring to patients' satisfaction and the convenience associated with the anticoagulant treatment. Other factors positively associated with patients' satisfaction were male sex and increasing age, while previous bleeding and previous experience of unsuitable blood specimens were negatively associated. Negative perception of the QoL has already been reported in the literature in young patients[32], of female sex[33], and with previous bleeding events[34].

Our results highlighted the fact that satisfaction was higher with age across both study cohorts. The literature[35,36] shows that older people are generally more satisfied with their healthcare than younger patients. In addition, a population survey conducted in the United Kingdom[36] found that the level of communication with the doctor and the discussion of the information given to the patients were predictive of satisfaction. These findings could explain why older people were more satisfied with the POC monitoring system than the hospital service, since in the former case, health care professionals have a dedicated time slot to provide relevant information to the patients.

The main strengths of this study are the use of psychometric questionnaires that were rigorously translated and validated[17,18] and the completeness of the

data, without any missing answers. In addition, patients were enrolled from different locations on the island of Malta; therefore, our sample is likely to represent the overall anticoagulated Maltese population.

However, this study also has some limitations that need to be acknowledged. First, we compared VKA-related satisfaction in two settings with different ways of monitoring (laboratory INR with delayed results vs. POC INR with dedicated time slots and immediate results). Thus, our favourable results should not be attributed only to the use of POC devices, but to the whole monitoring system associated with POC monitoring, including attending the local health centre, collection of capillary blood, and immediate warfarin dose adjustment. Second, there was a different response rate in the two cohorts: 94.3% of questionnaires returned in the POC INR group *vs* 67.1% in the laboratory INR group. The overall high response rate in our study could be due to the fact that we used face-to-face recruitment[37]. However, in order to reach the required sample size for the laboratory INR cohort, a larger number of patients was approached and recruited, which can be explained by the busy and crowded context of the Anticoagulation Clinic at Mater Dei Hospital. Whether the non-response rate could have influenced our results is a matter of debate, since it has been reported that non-respondents are less likely to be satisfied[38], and we found that the laboratory INR cohort was less satisfied than the POC INR cohort. Third, baseline characteristics (e.g. sex, level of education, hospitalisation, anticoagulation control) in the two study cohorts were not completely balanced. Since the assignment of patients to the different types of INR monitoring was not randomised but left at the discretion of the attending physicians, there might have been a selection bias resulting in more clinically stable patients being assigned to the laboratory INR cohort. Nonetheless, the important contribution of POC monitoring to patients' satisfaction was confirmed in the multiple regression analysis after adjustment for potential confounding variables. However, additional variables which could have influenced patients' satisfaction, such as journey time to the clinic or waiting time once there, were not available. Finally, the cross-sectional design did not allow patients' satisfaction over time to be evaluated.

CONCLUSIONS

The results of our study showed that the use of POC coagulometers by healthcare professionals in anticoagulation clinics, together with a dedicated time slot and immediate warfarin dose adjustment, was associated with better QoL for anticoagulated patients. These findings support a more widespread use of POC coagulometers. In fact, the availability of instant INR results can not only allow the immediate management of patients with extremely out-of-range values or patients needing an interventional procedure, but is also associated with higher patients' satisfaction.

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AUTHORSHIP CONTRIBUTION

NR is responsible for the study concept, methodology, investigation, formal analysis, data management, and writing the original draft of the manuscript. CBX is responsible for the study concept, methodology, investigation, and writing the original draft of the manuscript. WA is responsible for study supervision, and writing, reviewing and editing the final version of the manuscript. MM is responsible for study supervision, and writing, reviewing and editing the final version of the manuscript. AG is responsible for conceptualisation, methodology, supervision, and writing, reviewing and editing the final version of the manuscript.

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