



**Innovative technologies in hypertension
control
A telemonitored cuff-less blood pressure device**

Mikael Tomás Xufre

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Orientador: Prof. Doutor Miguel Castelo-Branco Craveiro de Sousa

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À Covilhã, cidade que se tornou especial e onde será sempre um prazer retornar.

Resumo

Introdução: Conhecido como fator de risco cardiovascular mais prevalente, a Hipertensão arterial (HTA) afeta cerca de 1,13 mil milhões de pessoas em todo o mundo. É apontada como causa de até 45% das mortes por doença cardiovascular e 51% das mortes por Acidente Vascular Cerebral (AVC). Sabe-se atualmente que uma das razões é o facto dos doentes com HTA terem maior risco de desenvolver Fibrilhação Auricular (FA) e consequente embolização de trombos auriculares para a circulação cerebral. Foi demonstrado que reduzir e manter a pressão arterial (PA) de doentes hipertensos em níveis considerados ideais tem um impacto significativo na redução da mortalidade e morbilidade associada. Assim, o controlo da doença hipertensiva torna-se fundamental. Além do envolvimento do doente, algumas tecnologias têm-se mostrado promissoras no sentido de melhorar esse controlo como a telemonitorização e os algoritmos de deteção de FA nos medidores de PA. Novos dispositivos têm tentado englobar a telemonitorização, a deteção de FA e uma maior facilidade de utilização como *smartwatches* ou outros medidores de pulso com ou sem braçadeira, no entanto, a maioria falha em obter certificação e validação clínica. Neste estudo é avaliado um novo medidor de PA portátil, sem braçadeira, que engloba também medição da frequência cardíaca, telemonitorização e deteção de ritmos suspeitos de FA. A medição é realizada em cerca de 10 segundos ao nível do pulso e tem a vantagem de estar já certificado e clinicamente validado pela Sociedade Europeia de Hipertensão.

Objetivo: Avaliar a opinião de doentes com HTA na utilização de um novo dispositivo portátil sem braçadeira (Freescan[®], Maisense) após 1 mês de utilização, através de questionário, e ainda avaliar o número de medições recomendadas realizadas.

Material e Métodos: Foram recrutados doentes seguidos em consulta de HTA que tivessem acesso a um *smartphone* (necessário para telemonitorização) e com interesse em participar. Foi fornecido um dispositivo Freescan[®], demonstrado o seu funcionamento e feito a calibração com um medidor de PA digital com braçadeira (Rossmax X5[®]). Para o seguimento foi pedido aos participantes que efetuassem 2 medições consecutivas de manhã antes de tomar a medicação para a HTA e 2 medições consecutivas ao fim do dia, preferencialmente antes de jantar. Após 4 semanas marcou-se um encontro para recolher o dispositivo e para responderem a um questionário, de forma a avaliar a opinião do participante sobre diferentes aspetos do Freescan[®].

Resultados: Obteve-se uma amostra final de 20 participantes. A média das idades foi de 57,15 (desvio padrão (DP) 9,88) anos. A média de dias com pelo menos 1 medição foi de 23,05 (DP 8,60), correspondendo a 82,32% dos 28 dias. A média do número de medições recomendadas realizadas foi de 61,80 (DP 36,05), correspondendo a 55,18% do total de medições recomendadas, 112. Aos questionários, 95% respondeu ser fácil aprender a utilizar o Freescan® (Resposta 4 “Concordo” ou 5 “Concordo totalmente”), 80% ser fácil realizar medições (4 ou 5), 70% confiam nos valores de PA (4 ou 5), 100% que foi fácil telemonitorizar os dados (4 ou 5), 100% acham importante o envio dos dados para o médico (4 ou 5) e 70% prefere o Freescan® aos medidores com braçadeira. Durante o estudo foram ainda sinalizados ao médico responsável 7 casos de HTA não controlada e 3 casos com pelo menos uma medição suspeita de FA.

Conclusões: No estudo prospetivo em doentes hipertensos acompanhados em consulta hospitalar de Hipertensão, a maioria dos participantes preferiu o Freescan® aos medidores com braçadeira e houve uma boa adaptação à nova tecnologia, verificando-se uma boa adesão ao número de medições recomendadas realizadas independentemente da idade e do sexo. Assim, a preferência dos participantes por este dispositivo aliado às tecnologias de telemonitorização e deteção de FA leva-nos a concluir que estes novos dispositivos poderão ter um papel importante no seguimento dos doentes com HTA, com potencial para aumentar o controlo da HTA e diminuir a mortalidade e morbilidade associadas a esta doença.

Palavras-chave

Hipertensão; Auto-Medição; Telemonitorização; Sem Braçadeira; Fibrilhação Auricular

Abstract

Introduction: Known as the most prevalent cardiovascular risk factor, hypertension, or High Blood Pressure (HBP), affects up to 1.13 billion people worldwide. It is responsible for up to 45% of deaths from cardiovascular disease and 51% of deaths from stroke. It is currently known that one of the reasons is that patients with hypertension are at greater risk of developing atrial fibrillation (AF) and consequent arterial thromboembolism to the cerebral circulation. It has been showed that reducing and maintaining blood pressure (BP) in hypertensive patients at levels considered ideal has a significant impact in reducing associated mortality and morbidity. Thus, the control of hypertension becomes essential. In addition to patient involvement, some technologies have showed potential in improving this control, such as telemonitoring and AF detection algorithms in BP monitoring devices. New devices have attempted to encompass telemonitoring, AF detection and greater ease of use such as smartwatches or other wrist meters with or without a cuff, however, most fail to obtain certification and clinical validation. In this study, a new portable cuff-less BP meter, which includes heart rate measurement, telemonitoring and detection of suspected AF rhythms is evaluated. The measurements are carried out in about 10 seconds at the wrist level and the device has the advantage of being already certified and clinically validated by the European Society of Hypertension.

Objective: Evaluate the opinion of a group of patients with hypertension about a new portable and cuffless BP meter (FreeScan[®], Maisense) after using it for 1 month through a questionnaire and evaluate the number of recommended measurements performed.

Material and methods: Patients being followed up at HBP consultation who had access to a smartphone (necessary for telemonitoring) were invited to participate in the study. A Freescan[®] device was provided, it was demonstrated how it function and the calibration with a digital BP meter with arm cuff (Rossmax X5[®]) was made. For follow-up, participants were asked to take 2 consecutive measurements in the morning before taking medication for HBP and 2 consecutive measurements at the end of the day, preferably before dinner. After the 4 weeks, a meeting was arranged to collect the device and to deliver a questionnaire, in order to assess the participant's opinion on different aspects of the Freescan[®] device.

Results: We obtained a final sample of 20 participants. The mean age was 57.15 (standard deviation (SD) 9.88) years. The average number of days with at least 1

measurement was 23,05 (SD 8,80) corresponding to 82,32% of the 28 days. The average number of recommended measurements taken was 61,80 (SD 36,05) corresponding to 55,18%. In the questionnaires, 95% answered that it was easy to learn how to use the device (answer 4 “I agree” or 5 “I totally agree”), 80% that it was easy to take BP measurements (4 or 5), 70% that they trusted the BP values (4 or 5), 100% that it was easy to telemonitor the data (4 or 5), 100% gave great importance to the doctor receiving constantly the data (4 or 5) and 70% preferred the Freescan® over cuff-based BP monitors. During the study, 7 cases of non-controlled hypertension and 3 cases with at least one suspected AF measurement were reported to the responsible physician. The number of recommended measurements taken was not influenced by age or sex.

Conclusions: In this prospective study of hypertensive patients followed up in hypertension hospital consultation, most participants preferred Freescan® over cuff-based BP monitors and there was a good adaptation to the new technology as well as a good adherence to the number of measurements recommended independent of age or sex. That leads us to conclude that these new devices may have an important role in the follow-up of patients with hypertension, in order to increase control and decrease the mortality and morbidity associated with this condition.

Keywords

Hypertension; Self-Monitoring; Telemonitorization; Cuff-less; Auricular Fibrillation

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Acronyms list

| | |
|-------|---|
| ABPM | Ambulatory Blood Pressure Measurement |
| AF | Atrial Fibrillation |
| BP | Blood Pressure |
| CHCB | Centro Hospitalar Universitário Cova da Beira |
| CV | Cardiovascular |
| DALYS | Disability Adjusted Lost Years |
| ECG | Electrocardiogram |
| ESC | European Society of Cardiology |
| ESH | European Society of Hypertension |
| HBP | High Blood Pressure |
| SD | Standard Deviation |
| SMBP | Self-monitored blood Pressure |

Chapter 1

Introduction

Arterial hypertension, also known as High blood pressure (HBP), is the most prevalent cardiovascular (CV) risk factor worldwide, affecting approximately 1.13 Billion people(1). It is estimated to be responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke, resulting in more than 8 Million deaths per year and 92 Million disability adjusted lost years (DALYS)(2, 3) . Being a modifiable risk factor, make it a key factor to intervene with the aim of reducing mortality and morbidity. In Portugal, a study conducted in 2011 and 2012 showed that high Blood Pressure (BP) affect up to 42.2% of the population. Among the hypertensive patients, 76.6% were aware of the hypertension condition, 74.9% were treated and 42.5% were controlled(4). Controlling HBP to lower levels was associated with a reduction of Hypertension-mediated organ damage and CV events(5, 6), thus, it is vital to achieve high levels of controlled blood pressure. Another concern about HBP is that accumulating evidence is closely linking hypertension with an increased risk of developing atrial fibrillation (AF) which is alone associated with 20 to 30% of ischemic strokes and with a 2-fold increased risk of all-cause mortality in women and a 1.5-fold increase in men(7). The 2016 European Society of Cardiology (ESC) Guidelines for the Management of Atrial Fibrillation also state that the risk of ischemic stroke due to AF is largely mitigated by anticoagulation, revealing the importance of identify patients with AF. Thus, proper BP assessment, detection of AF and treatment of these patients are important to improve prognosis like concluded by Kallistratos et al.(8). Another promising technology that has showed to improve hypertension control by the patient is telemonitorization, that is, the transmission of the readings to the physician, typically over the internet(9).

The diagnosis of hypertension has been established using individual readings taken on different occasions in-office (5, 10). Although useful, this method has been associated to misdiagnosis in up to 32% of patients due to the white-coat hypertension - situation in where a patient presents high BP readings in-office but normal readings out-of-office, associated with emotional stress - or masked hypertension – situation where a patient present with normal BP readings in-office but high BP readings out-of-office(11). Thus, recent guidelines have placed more emphasis on other methods to complement in-office measurements, like the 24h Ambulatory Blood Pressure Measurement (ABPM) and Self-monitored blood Pressure (SMBP) at home by the patient. It was in 1940 that Ayman and

Goldshine demonstrated for the first time the existence of significant differences between the values of in-office BP taken by the doctor and BP measured at home by the patient or his relatives(12). It is now known that home or ambulatory measurements provide more accurate estimates of the patient's true mean BP(13).

Auscultatory or oscillometric semiautomatic or automatic sphygmomanometers which use a cuff around the arm are the preferred method for measuring BP(5). These devices, certified and validated by proper entities, are useful in-office but they have been proven to be a barrier to systematic measurements by the patient due to discomfort in the process of measurement and to the bulky equipment needed(14). Another disadvantage associated with cuff-BP is the fact that it was found to have variable accuracy for measuring BP, which adversely influences correct BP classification(15). For that reason, numerous devices like wearables, smartphone applications and tricorders have become commercially available claiming to measure BP without a cuff and possibly overcome some of these difficulties(9, 16). Although promising, it is important to study and evaluate these new devices as many of them lack proper validation and have limited use due to motion artifacts(9).

The device we propose to test in this study is the FreeScan® from Maisense. A small pocket device that measures BP directly over the radial artery on the wrist without the need of a cuff(17), has achieved a pass grade according to both the ANSI/AAMI/ISO 2013 and ESH-IP 2010 validation protocols(18) and is listed in the website "www.stridebp.org", a joint initiative with the European Society of Hypertension (ESH), the International Society of Hypertension and the World Hypertension League, that list all validated BP monitors. FreeScan® also obtains a one-lead electrocardiogram (ECG), identifies suspected abnormal rhythms like AF and has telemonitoring ability, sending the readings over the internet to a platform accessible only by the physician. This kind of device could revolutionize HBP management because it features all these technologies that have shown potential to improve the health of HBP patients like AF rhythm detection, telemonitorization, permits home measuring and is a non-invasive device. We do not search to compare values of BP between this device and other traditional cuff-based devices because the FreeScan® Maisense was already certified and validated in prior studies(17, 18). The AF detection feature was also previously studied showing that it has high sensitivity and specificity(19).

Objectives

The aims of this study are to evaluate the opinion of a group of patients with hypertension about a new portable and cuffless device (FreeScan[®], Maisense) after using it for 1 month through a questionnaire and to evaluate the number of recommended measurements performed.

Hypothesis to test

- 1- The Freescan[®] meter is preferred over cuff-based BP meters.
- 2- The Freescan[®] meter is easy to use.
- 3- The participants comply with the number of recommended measurements.

Chapter 2

Material and Methods

Population and Sample

The participants of this study were selected from the patients being followed at the HBP consults of the Centro Hospitalar Universitário Cova da Beira (CHUCB). The ages ranged between 29 and 70 years, with a mean of 57.15 (SD 9,88), in which 55% are woman and 45% are men.

Size, selection and recruitment process of the sample

A total of 20 participants were followed for the period of 4 weeks. They were selected by invitation after they present in their follow-up consult of hypertension. The total number of patients assessed that did not met the inclusion criteria were not registered. The criteria of inclusion were the following: 1) Have a diagnosis of hypertension; 2) Have access to a smartphone (needed for telemonitorization).

If meeting all the criteria, all the process was carefully explained, and an informed consent was signed by all parts (annex 1). We showed how the FreeScan® device function, let them try a few times and we explained that we will accompany each participant for four weeks starting to count from the second day of measurements as recommended by the guidelines for ambulatory blood pressure monitoring (20). We asked to make two consecutive measurements in the morning before taking the hypertension medication and two consecutive measurements in the end of the day, preferably before dinner. Instructions were given that if any doubts would arise, they could contact us (via e-mail or phone number) and that, if the values of BP were out of control or if AF rhythms were identified, we could contact them. After this, the calibration was made with a “Rossmax® X5” BP monitor using the FreeScan® calibration menu. It consists of two interspersed measurements starting with FreeScan® and then Rossmax®. At each set of measurements, the value of BP obtained by Rossmax® was inserted in the FreeScan® device to calibrate. Finally, the mobile application was installed in the personal smartphone of the participant, a login using the name Maisense”x” (“x” being numbers from 1 to 20) was used (for data protection), the Bluetooth connection was configured and the connection to the online platforms that allows us to receive data was established.

Material

A FreeScan[®] Maisense device (figure 2.1) was provided to each participant. It is a small (95.5×37×22 mm) and light (60 g) cuff-less pocket device that estimates BP directly from the radial pulse using three embedded electrodes and one force sensor. The pulse wave identification is combined with single-lead electrocardiography, providing the device with parameters such as pulse transit time and R–R interval for calculating BP (systolic and diastolic) and pulse rate in around 10 seconds.



Figure 2.1 - FreeScan[®] blood pressure monitor, image taken from the official website of the manufacturer www.maisense.com/EN/products_freescan.html

The cuff-based BP monitor used for calibration was a Rossmax X5[®] (figure 2.2).



Figure 1.2 - Rossmax® x5 Cuff blood pressure digital monitor, image taken from the official website of the manufacturer <https://www.rossmax.com/zh/products/monitoring/blood-pressure-monitors/x5-parr-automatic-blood-pressure-monitor.html>

The online platform used to monitor the data received by the FreeScan® devices was the website <http://myfreescan.maisense.com/pcs/index.html> from Maisense (Figure 2.3). After registration we could consult all the data at any time.

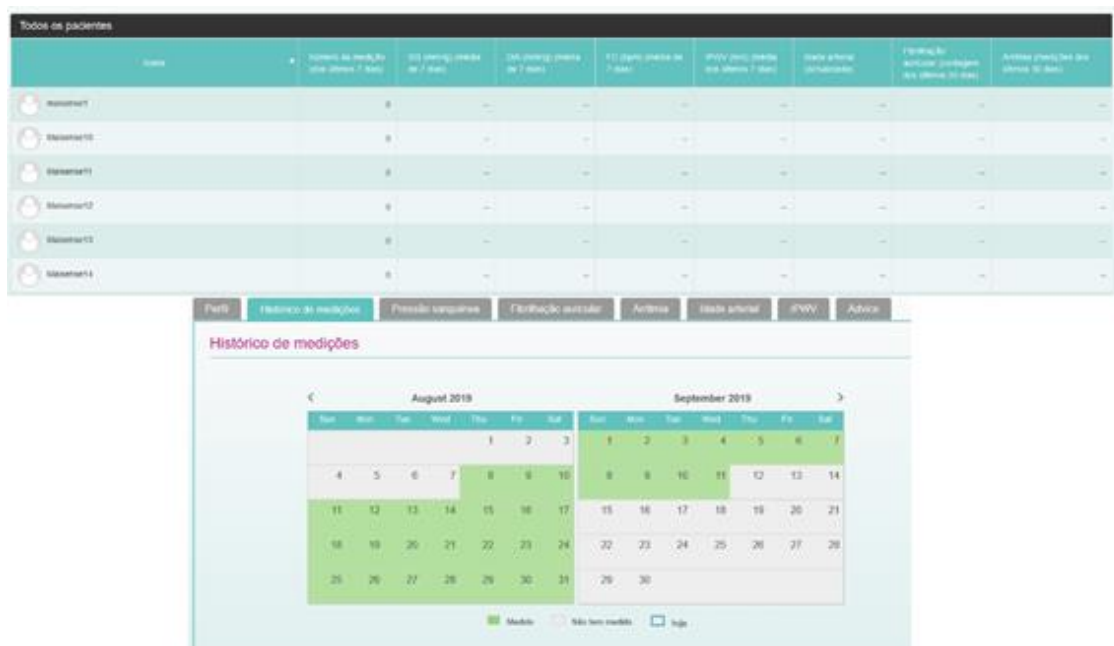


Figure 2.3 - Online platform [www.myfreescan.maisense.com/pcs](http://myfreescan.maisense.com/pcs) screenshots taken from the platform.

Follow-up

The data received were analyzed daily and after each week the mean value of BP was calculated to see if it was under control (BP < 135/85mmHg). The measurements marked as unstable were excluded in this calculation. The platform was easy to use, and the average time spent daily was around 5 minutes (the maximum simultaneous participants per month were 7). The cases out of control were signalized to the patient's doctor for assessment. Anytime a suspected FA was identified the doctor responsible was also informed. In case of any difficulty with the process of measurement the patient could contact us to seek help. We did not contact any participants during the period of assessment when no measurements were being made in order to not influence the process. After the four-week period, an appointment was arranged with the participants to recover the device and to give a questionnaire about the experience (appendix 1).

Questionnaire

The questionnaire contained 8 main questions, 6 of them in a likert-type scale (5 options to respond where 1 was "I totally disagree", 2 was "I disagree", 3 was "I don't agree nor disagree", 4 was "I agree" and 5 was "I totally agree") and 2 to choose one of two possible answers.

Statistical analysis

The statistical analysis was made with the program "IBM SPSS Statistics version 25". For all the analysis we considered a significance level of 0,05%. We use Pearson correlation test and an independent samples T-test. Only the significant output of SPSS needed for interpretation of the results are described here, all the other steps to validate the assumptions of the models, like normality, are available in appendix (appendix 2).

Chapter 3

Results

Measurements

The number of measurements realized by the 20 participants are shown in table 3.1. The mean of total measurements was 69,7 (SD 36,51), The mean of days with at least 1 measurement was 23,05 (SD 8,80), corresponding to 82,32% (SD 31,42%) of the 28 days. The mean number of recommended measurements taken was 61,8 (SD 36,05) corresponding to 55,18% (SD 39,32%) of the 112 total recommended measurements. Of all measurements, 78,89% were made correctly and 21,11% were marked as unstable (table 3.2). All BP measurements realized by the participants are available to consult in appendix (appendix 3).

Uncontrolled BP and AF

During the study we identified 7 participants with BP means constantly higher than 135/85mmHg and 3 participants with at least one measurement with suspected AF. All cases were signaled to the responsible doctors who follow the patients in consult.

Table 3.1 - Number of measurements per day.

| Partic \ Day | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | |
|--------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|
| Maisense 1 | 5 | 6 | 4 | 4 | 5 | 5 | 4 | 4 | 4 | 5 | 5 | 2 | 4 | 4 | 2 | 4 | 3 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Maisense 2 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 3 |
| Maisense 3 | 6 | 5 | 5 | 5 | 2 | 3 | 2 | 2 | 5 | 2 | 4 | 2 | 4 | 2 | 5 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 4 | 4 | 4 | 4 | |
| Maisense 4 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 2 | 4 | 3 | 3 | 3 | 3 | 3 | 2 | 0 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | 2 | |
| Maisense 5 | 3 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | |
| Maisense 6 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 0 | 2 | 5 | 0 | 2 | 4 | 2 | 0 | 0 | 2 | 0 | 1 | 0 | 2 | 1 | 1 | 0 | 0 | |
| Maisense 7 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | |
| Maisense 8 | 2 | 2 | 4 | 1 | 4 | 2 | 2 | 2 | 4 | 2 | 4 | 5 | 3 | 2 | 2 | 3 | 1 | 3 | 6 | 4 | 6 | 8 | 4 | 6 | 0 | 2 | 2 | 2 | |
| Maisense 9 | 2 | 2 | 0 | 3 | 2 | 4 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | |
| Maisense 10 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | |
| Maisense 11 | 1 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Maisense 12 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Maisense 13 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | |
| Maisense 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Maisense 15 | 5 | 4 | 5 | 5 | 5 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 5 | 4 | 5 | 5 | 4 | 4 | 3 | 4 | 4 | 2 | |
| Maisense 16 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Maisense 17 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Maisense 18 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | |
| Maisense 19 | 4 | 5 | 4 | 5 | 6 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 | 4 | |
| Maisense 20 | 4 | 4 | 4 | 5 | 7 | 1 | 1 | 0 | 3 | 2 | 1 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 5 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | |

Table 3.2 - Analysis of measurements.

| Participant | Age | #Measurements | #Instable measurements | % | Days with measurements | % | #Recomended measurements | % |
|---------------|-----------------|-----------------|------------------------|---------------|------------------------|---------------|--------------------------|---------------|
| Maisense 1 | 63 | 75 | 19 | 25,33% | 19 | 67,86% | 44 | 39,29% |
| Maisense 2 | 69 | 77 | 13 | 16,88% | 28 | 100,00% | 77 | 68,75% |
| Maisense 3 | 50 | 100 | 43 | 43,00% | 28 | 100,00% | 92 | 82,14% |
| Maisense 4 | 51 | 75 | 13 | 17,33% | 27 | 96,43% | 73 | 65,18% |
| Maisense 5 | 60 | 48 | 22 | 45,83% | 28 | 100,00% | 48 | 42,86% |
| Maisense 6 | 61 | 33 | 7 | 21,21% | 19 | 67,86% | 32 | 28,57% |
| Maisense 7 | 62 | 45 | 8 | 17,78% | 27 | 96,43% | 45 | 40,18% |
| Maisense 8 | 70 | 88 | 20 | 22,73% | 27 | 96,43% | 73 | 65,18% |
| Maisense 9 | 57 | 94 | 26 | 27,66% | 27 | 96,43% | 19 | 16,96% |
| Maisense 10 | 54 | 105 | 12 | 11,43% | 28 | 100,00% | 100 | 89,29% |
| Maisense 11 | 63 | 19 | 5 | 26,32% | 9 | 32,14% | 19 | 16,96% |
| Maisense 12 | 69 | 57 | 15 | 26,32% | 28 | 100,00% | 57 | 50,89% |
| Maisense 13 | 49 | 61 | 11 | 18,03% | 28 | 100,00% | 60 | 53,57% |
| Maisense 14 | 29 | 0 | 0 | 0,00% | 0 | 0,00% | 0 | 0,00% |
| Maisense 15 | 54 | 118 | 16 | 13,56% | 28 | 100,00% | 109 | 97,32% |
| Maisense 16 | 51 | 6 | 1 | 16,67% | 3 | 10,71% | 6 | 5,36% |
| Maisense 17 | 67 | 112 | 32 | 28,57% | 28 | 100,00% | 112 | 100,00% |
| Maisense 18 | 59 | 112 | 15 | 13,39% | 28 | 100,00% | 112 | 100,00% |
| Maisense 19 | 61 | 113 | 14 | 12,39% | 28 | 100,00% | 108 | 96,43% |
| Maisense 20 | 44 | 56 | 10 | 17,86% | 23 | 82,14% | 50 | 44,64% |
| Total | | 1394 | 302 | | 461 | | 1236 | |
| Mean | 57,15 | 69,7 | 15,1 | 21,11% | 23,05 | 82,32% | 61,8 | 55,18% |
| SD | 9,879670781 | 36,50825429 | 10,2026828 | 10,46% | 8,798773838 | 31,42% | 36,05200921 | 32,19% |
| IC 95% | (52,53 - 61,77) | (52,61 - 86,79) | (10,33 - 19,88) | | (18,93 - 27,17) | | (44,93 - 78,67) | |

Questionnaire answers

The responses to the questions are showed in graphic (Figure 3.1-3.8). If considered positive answers the choices 4 and 5 (“I agree” and “I totally agree”) and negative 1 and 2 (“I disagree” and “I totally disagree”), the results are the following for each questions:

- 1- It was easy to learn how to use the FreeScan® Maisense device: 95%** responded positively and 5% responded “I do not agree nor disagree”.
- 2- The measurements were easy to take: 80%** responded positively and 20% responded “I do not agree nor disagree”.
- 3- I trust in the values of BP obtained by the device: 70%** responded positively, 15% responded “I do not agree nor disagree” and 15% responded negatively.
- 4- The mobile application was easy to use: 100%** responded positively.
- 5- The synchronization of data via mobile application was easy to make: 100%** responded positively.
- 6- I find important that my doctor regularly receive my BP measurements: 100%** responded positively.

- 7- **Did you changed medication intake based on the values of BP measurements without consulting your doctor?:** 95% responded “NO” and 5% responded “YES”.
- 8- **Which device do you prefer?:** 70% responded Freescan® Maisense and 30% responded cuff-based digital blood pressure meter.

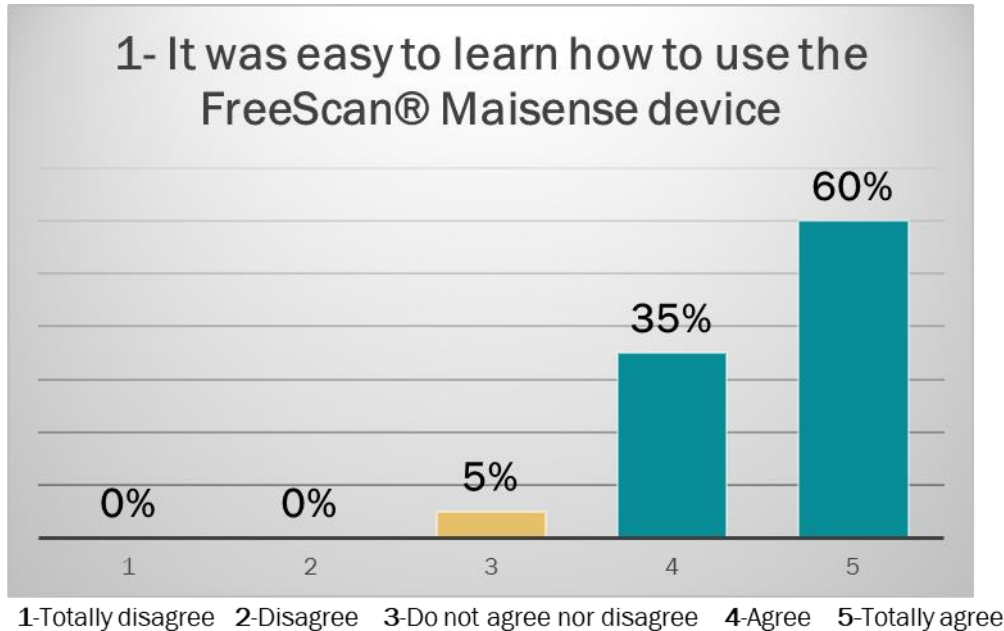


Figure 3.1 – Answers to question 1 in percentage.

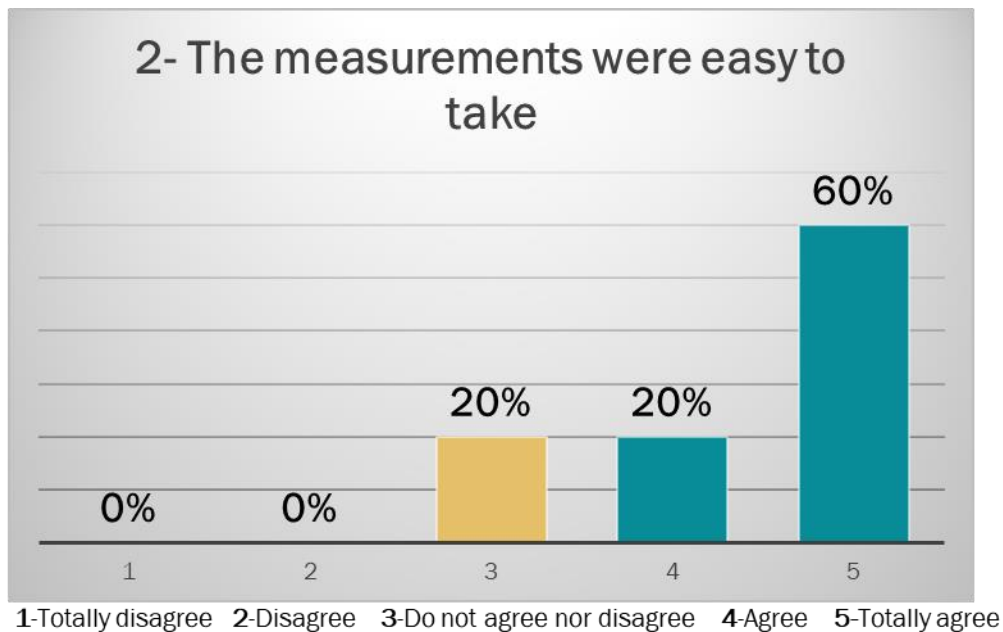


Figure 3.2 - Answers to question 2 in percentage.

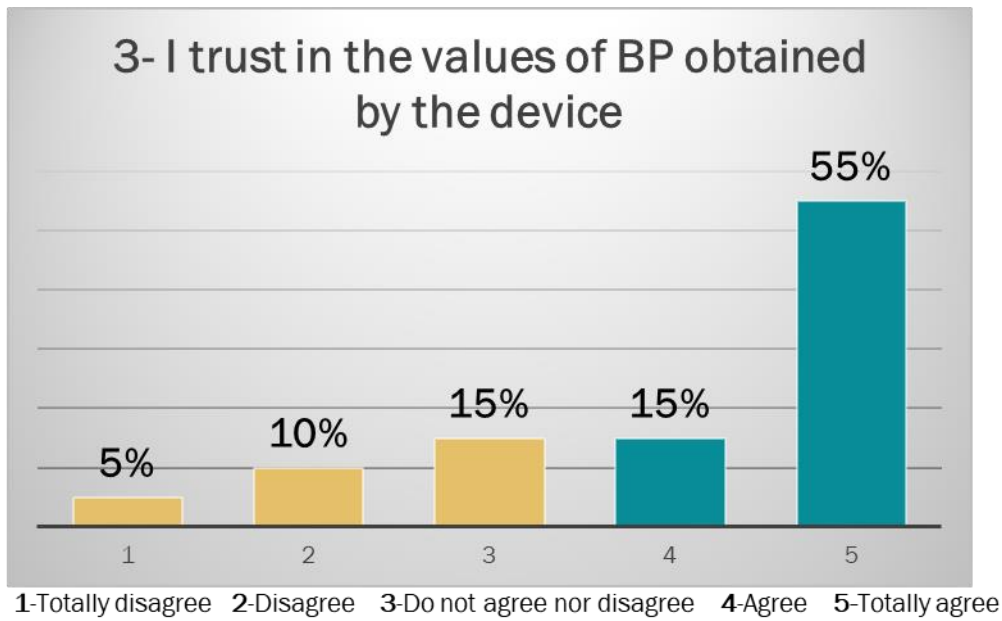


Figure 3.3 - Answers to question 3 in percentage.

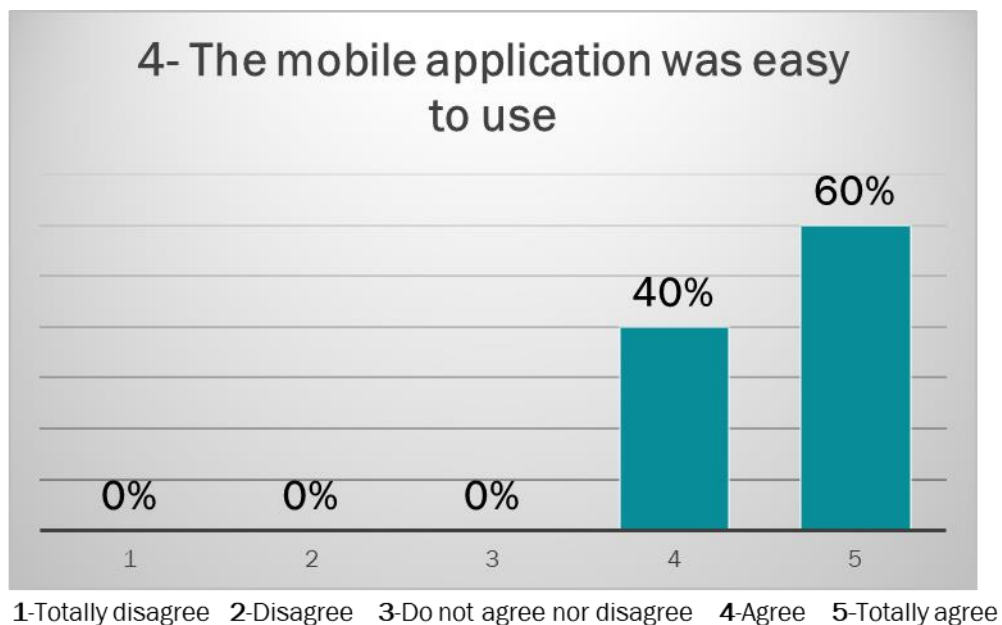
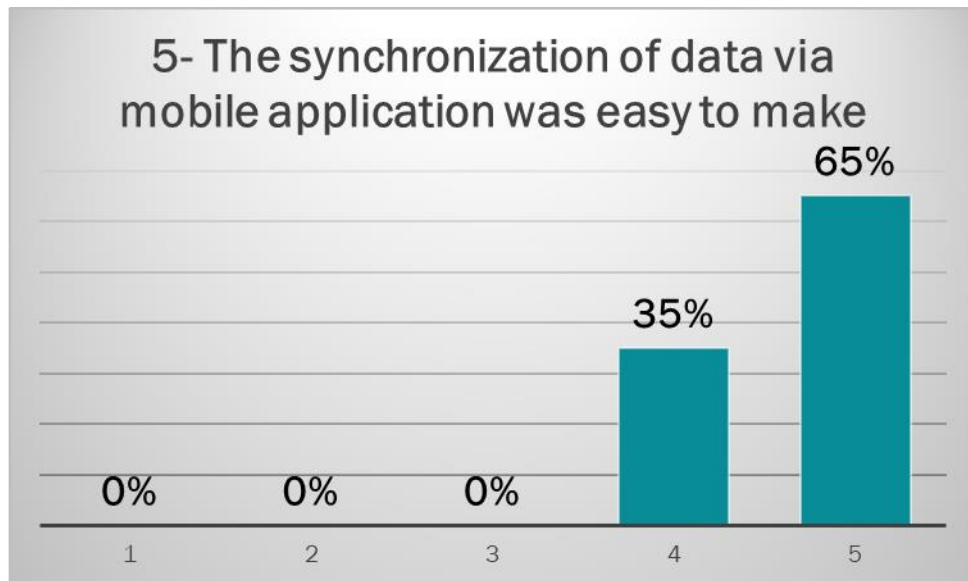
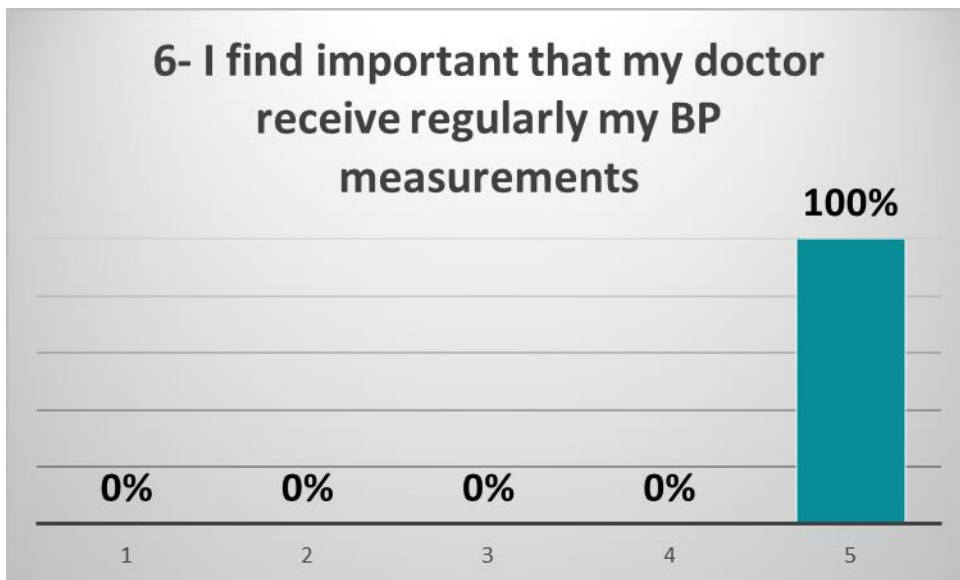


Figure 3.4 - Answers to question 4 in percentage.



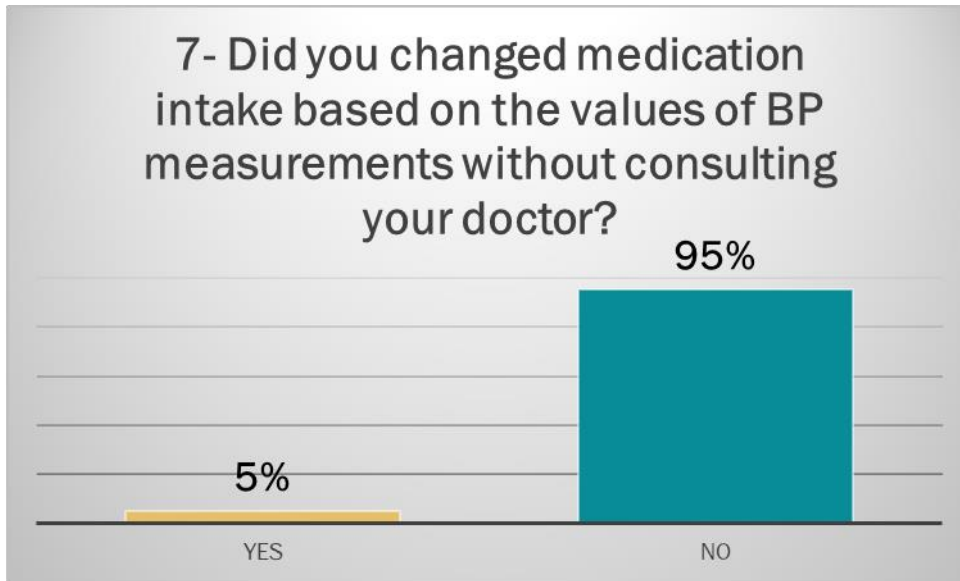
1-Totally disagree 2-Disagree 3-Do not agree nor disagree 4-Agree 5-Totally agree

Figure 3.5 - Answers to question 5 in percentage.



1-Totally disagree 2-Disagree 3-Do not agree nor disagree 4-Agree 5-Totally agree

Figure 3.6 - Answers to question 6 in percentage.



1-Totally disagree 2-Disagree 3-Do not agree nor disagree 4-Agree 5-Totally agree

Figure 3.7 - Answers to question 7 in percentage.

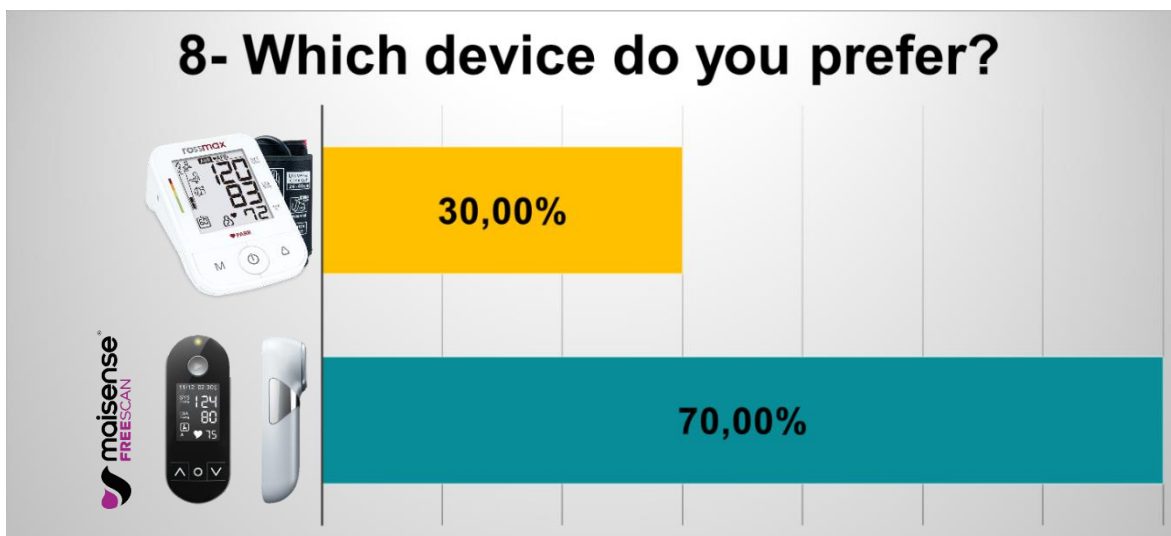


Figure 3.8 - Answers to question 8 in percentage.

To represent all the information in one graphic we calculated the mean value of each question using the responses 1 to 5 as numeric value. With that, we get a representation of the opinions of the participants (figure 3.9).

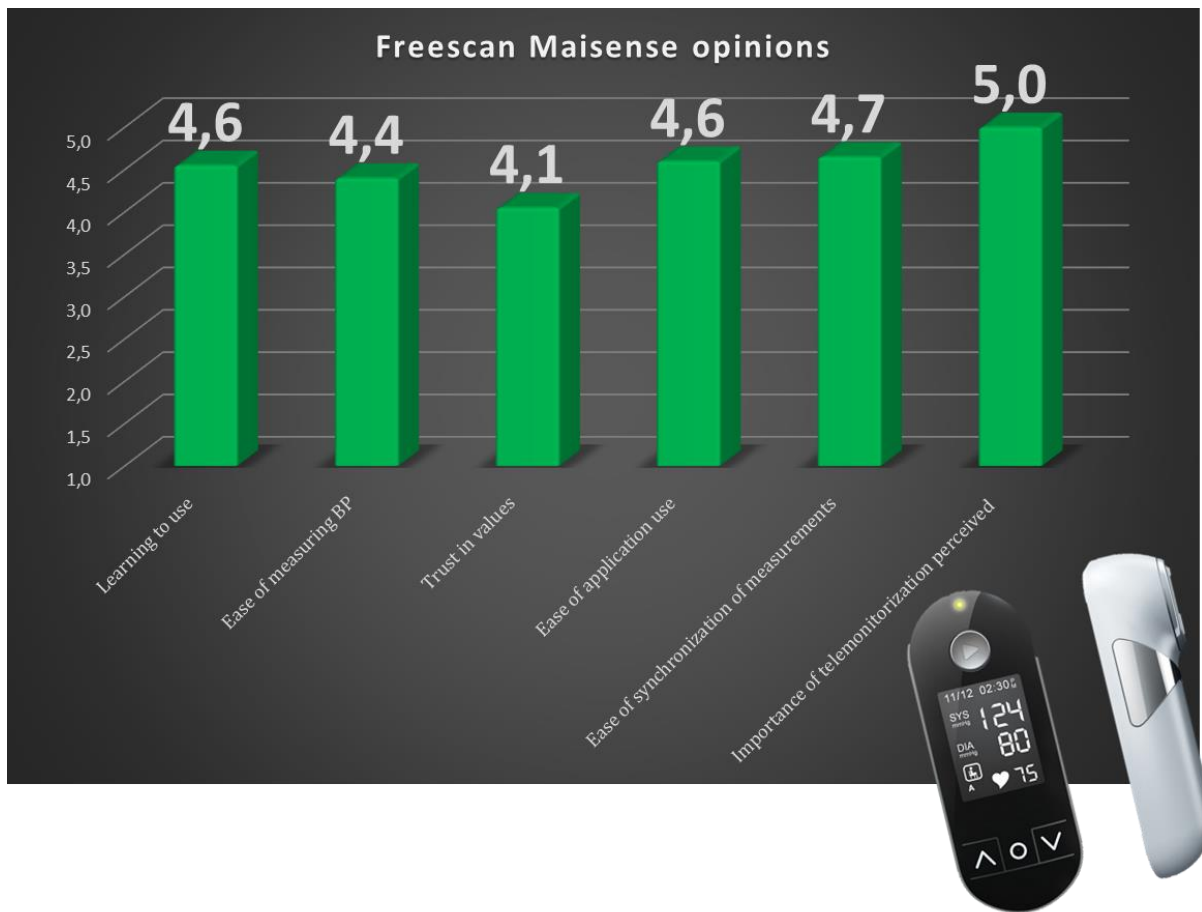


Figure 3.9 - Global results of questionnaire. Answers were transformed in mean value from the responses 1-5.

Relation between Age and Number of recommended measurements

A Pearson Correlation test was applied to evaluate if the number of recommended measurements taken were related with age (table 3.3). The normality of both variables was verified with Shapiro-Wilk test (available to consult in appendix 2). We showed that Age and Number of measurements were not related as $p > 0,05$ ($p = 0,173$).

Table 1.3 - Pearson correlation test.

| | | Correlations | |
|---------------|---------------------|---------------|-------------|
| | | Recommended_M | Idade |
| Recommended_M | Pearson Correlation | 1 | ,317 |
| | Sig. (2-tailed) | | ,173 |
| | N | 20 | 20 |

Relation between Sex and Number of recommended measurements

An independent-Samples T-test was applied to evaluate if the number of recommended measurements taken were related with sex (table 3.5). The normality of both groups “number of recommended measurements by men” and “number of recommended measurements by women” were verified by the Shapiro-Wilk test (available to consult in appendix 2) and the principle of equality of variances was confirmed by Levine’s test. We founded that they were no differences in the means of the two groups (Mean= 52,11 +/- 28,74 for men and Mean=69,73 +/- 40,68 for woman) as $p > 0,05$ ($p = 0,289$).

Table 3.4 - Descriptive analysis the mean of each group (M: Men, W: Women).

| | Sex | N | Mean | Std. Deviation |
|---------------|-----|----|---------|----------------|
| Recommended_M | M | 9 | 52,1111 | 28,73780 |
| | W | 11 | 69,7273 | 40,68437 |

Table 3.5 - Independent Samples T-test.

| | | Levene's Test (equality of variances) | | t-test for Equality of Means | | | | |
|---------------|-------------------------|---------------------------------------|------|------------------------------|----|-----------------|-----------------|-----------------------|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Recommended_M | Equal variances assumed | 2,441 | ,136 | -1,093 | 18 | ,289 | -17,61616 | 16,12210 |

Chapter 4

Discussion

The results show that the majority of participants prefer the new blood pressure device from Maisense over the cuff-based blood pressure monitors they usually use. The ESH recommend 3 to 7 days of blood pressure measurements prior consultation for diagnosis of hypertension or to evaluate medication efficacy and 1 or 2 days per week during follow-up(20). We observed that 95% of our participants made at least 3 consecutive days of measurements and 80% made more than 1 or 2 days of measurements every week indicating that it could be used for these purposes.

The percentage of recommended measurements realized was 55,18%. It is important to note that after initial indications to participants, no reminders or contacts were made to incentive adherence. For that reason, this value could probably be improved by using techniques like reminders or logbooks where patients register some information about the recommended measurements like it was made in other studies(21). The application also gives the possibility to send messages to participants. We also demonstrated that the number of measurements was not related to age, showing a good adaptability to the device by all participants. Although positive, the fact that only participants who owned or had access to a smartphone may be a confounding factor.

About the participant's opinions on the device, we obtained positive answers to all the questions showing that it is easy to learn how to use the Freescan® Maisense device, and all the process of using the application, making the measurements and synchronize them are also easy to do. This result in 70% of participant preferring this new device.

The platform used to receive the data was simple to use and classify the patients in groups of normal BP or high BP and also identify the cases with abnormal rhythms allowing for a rapid evaluation of the cases that are out of normal values. Throughout this study, in 3 participants we had some days (between 1 and 4) that showed an error ("Error -1") and the values of BP were not available in the platform but they were easily recoverable from the measurements history in the mobile application. About the platform some features could be improved, for example the possibility to choose the limit to consider HBP between each subjects or group of subjects, the possibility to choose periods of measurements and calculate the respective mean of BP instead of presenting the mean for the last 7 days, and

the possibility to include or exclude some of the measurements in the evaluation of mean of BP and creation of automatic reports (one of the features of the platform). This last function could improve classification of blood pressure if we could select only the recommended measurements (2 in the morning before medication intake and 2 in the afternoon) as demonstrated by Wessel et al(22).

Taking all that into account, we can affirm that this type of devices may have a promising future in the field of hypertension control. With the advantage of portability, telemonitorization and detection of abnormal rhythms like AF, this type of devices could help improve blood pressure control, reducing morbidity and mortality associated with HBP(6) and possibly reduce follow-up consults in cases of controlled BP in patient that doesn't have any other complains.

About the limitations of this study, a few aspects should be considered. First, the total number of patients seen in HBP consults that could not participate either by choice or because they did not own or had access to a smartphone were not registered. This could help us understand the percentage of eligible patients that could use this kind of devices at this moment. Second, people other than the intended patient could have used the BP device despite recommendations not to do so, and the number and influence of these measurements could not be evaluated. Finally it would have been interesting to compare our study group with another group of participant with the same characteristics (followed in HBP consults and access to a smartphone) but using a cuff-based digital blood pressure meter and compare the differences in measurements. This was not made because of the difficulty in recruiting such participants in the duration of our study.

Chapter 5

Conclusion

Most participants had a very good opinion about the new cuffless blood pressure monitor Freescan® from Maisense and preferred this device over cuff-based blood pressure monitors. We demonstrate that learning to use the device was easy, as well as take measurements and use the application to make the telemonitorization of data. We also showed that adherence to recommended measurements was not influenced by age or sex. By the number of recommended measurements taken, we can conclude that the Freescan® could be used both for the diagnosis of hypertension or the follow-up of hypertensive patients with the advantages of being small, portable and eliminating the need of a cuff that can be difficult to use in some patients. Other positive features like a long battery life (between 3 weeks and 1 month), telemonitorization and AF rhythms identification makes it a very interesting device. It is also certified by the ESH for BP monitoring contrary to most other cuffless technologies.

Previous studies demonstrated Freescan® effectiveness in BP measurement and in AF detection. Our study now shows that the participants had a very good adaptation to the Freescan®, with most classifying it as easy to use in all the process of measurement to telemonitorization, preferring it over cuff-based BP meters.

In the future, it would be important to evaluate this kind of devices in a bigger setting, with more participants, and evaluate the impact in healthcare that these devices could have if in fact the reduction in consults and morbidity and mortality related to HBP could be achieved.

Chapter 6

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APPENDICES

Mai de 2020

Appendix 1 – Questionnaire



Questionário

Os dados recolhidos sobre cada utente serão armazenados numa base de dados com acesso exclusivo ao responsável pelo trabalho de investigação (Mikael Xufre) e ao seu orientador (Prof. Dr. Miguel Castelo Branco). A partir da base de dados será atribuído um código a cada indivíduo que será utilizado no trabalho de investigação de modo a garantir a sua privacidade e a anonimidade dos dados. Esta base de dados será destruída no período de 1 mês após terminar o projeto respeitando assim o Regulamento Geral de Proteção de Dados. Agradecemos a sua colaboração!

Idade: ____

Sexo: Masculino

Feminino

1- Foi fácil aprender a utilizar o dispositivo Freescan Maisense?

| | | | | | | |
|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Discordo plenamente | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Concordo plenamente |

2- A medição da pressão arterial foi fácil de realizar?

| | | | | | | |
|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Discordo plenamente | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Concordo plenamente |

3- Confio nos resultados obtidos pelo dispositivo?

| | | | | | | |
|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Discordo plenamente | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Concordo plenamente |

4- A aplicação móvel (myFreescan) é fácil de utilizar?

| | | | | | | |
|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Discordo plenamente | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Concordo plenamente |

5- A sincronização dos dados é simples de realizar?

| | | | | | | |
|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Discordo plenamente | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Concordo plenamente |

6- Qual para si a importância do médico receber as medições regularmente?

| | | | | | | |
|------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Pouco importante | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Muito importante |

7- Qual a maneira de medir a pressão arterial que prefere?

Dispositivo SEM braçadeira
(Maisense Freescan)



Dispositivo COM braçadeira
(Medidor Tradicional)



| | |
|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> |
|-----------------------|-----------------------|

8- Fez alguma alteração à sua medicação sem consultar o médico baseado nos valores das suas medições no período em que utilizou o dispositivo sem braçadeira?

| | | | |
|-----|-----------------------|-----------------------|-----|
| Sim | <input type="radio"/> | <input type="radio"/> | Não |
|-----|-----------------------|-----------------------|-----|

9- Antes da utilização do novo dispositivo SEM braçadeira, quantas vezes consultava o seu médico devido à Hipertensão arterial?

10- Sugestões

Obrigado pela sua participação!

Appendix 2 – Statistic

Normality of variables

| | Tests of Normality | | | | | |
|--------------|---------------------------------|----|-------------------|--------------|----|-------------|
| | Kolmogorov-Smirnov ^a | | | Shapiro-Wilk | | |
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Recomended_M | ,105 | 20 | ,200 [*] | ,943 | 20 | ,272 |
| Age | ,124 | 20 | ,200 [*] | ,916 | 20 | ,085 |

P > 0,05 – we do not reject the hypothesis that the variable has a normal distribution

| | Se x | Tests of Normality | | | | | |
|--------------|---------|---------------------------------|----|-------------------|--------------|----|-------------|
| | | Kolmogorov-Smirnov ^a | | | Shapiro-Wilk | | |
| | | Statisti c | df | Sig. | Statistic | df | Sig. |
| Recomended_M | M | ,196 | 9 | ,200 [*] | ,961 | 9 | ,809 |
| | W | ,190 | 11 | ,200 [*] | ,871 | 11 | ,080 |

P > 0,05 – we do not reject the hypothesis that the variable has a normal distribution

(M – Men W – Women)

Appendix 3 - Blood Pressure measurements

| Maisense 1 | | | | | | | |
|------------|---------|---------|---------|-----------|---------|---------|---------|
| Day | Morning | | | Afternoon | | Mean | |
| 1 | 170/103 | 159/107 | | 180/106 | 184/104 | 184/105 | 178/104 |
| 2 | 167/107 | 168/108 | | 193/98 | 202/88 | 206/84 | |
| 3 | 167/103 | 178/97 | | 185/104 | 172/110 | | |
| 4 | 172/102 | 167/108 | | 179/109 | 173/104 | | |
| 5 | 208/69 | 184/105 | 182/103 | 175/106 | 174/108 | | |
| 6 | 178/108 | 181/106 | | 178/103 | 187/99 | 182/100 | |
| 7 | 182/103 | 182/105 | | 185/100 | 181/101 | | |
| 8 | 183/100 | 190/100 | | 173/105 | 170/106 | | 173/105 |
| 9 | 177/106 | 182/105 | | 179/105 | 171/109 | | |
| 10 | 179/102 | 184/102 | | 177/105 | 163/107 | 163/106 | |
| 11 | 161/109 | 169/108 | 170/106 | 179/104 | 169/107 | | |
| 12 | - | - | | 162/107 | 164/108 | | |
| 13 | 168/107 | 170/106 | | 163/111 | 164/110 | | |
| 14 | 170/107 | 174/105 | | 190/95 | 175/105 | | |
| 15 | 181/103 | 180/102 | | - | - | | 174/106 |
| 16 | 175/108 | 173/106 | | 181/111 | 179/109 | | |
| 17 | 169/106 | - | | 167/107 | 166/107 | | |
| 18 | 181/105 | 180/103 | | 181/104 | 170/107 | | |
| 19 | - | - | | 182/104 | - | | |
| 20 | - | - | | - | - | | |
| 21 | - | - | | - | - | | |
| 22 | - | - | | - | - | | - |
| 23 | - | - | | - | - | | |
| 24 | - | - | | - | - | | |
| 25 | - | - | | - | - | | |
| 26 | - | - | | - | - | | |
| 27 | - | - | | - | - | | |
| 28 | - | - | | - | - | | |

| Maisense 2 | | | | | | | |
|------------|---------|--------|--|-----------|--------|------|--------|
| Day | Morning | | | Afternoon | | Mean | |
| 1 | 142/80 | 139/80 | | 116/80 | - | | 134/79 |
| 2 | 127/79 | 115/78 | | 125/82 | - | | |
| 3 | 127/82 | 135/82 | | 150/77 | - | | |
| 4 | 141/77 | - | | - | - | | |
| 5 | 139/78 | 125/80 | | 160/65 | - | | |
| 6 | 137/80 | 139/77 | | 137/84 | - | | |
| 7 | 138/79 | 120/79 | | 128/83 | - | | |
| 8 | 149/72 | 139/78 | | 147/80 | - | | 129/80 |
| 9 | 122/80 | 114/79 | | 130/84 | - | | |
| 10 | 120/81 | 113/78 | | 127/83 | - | | |
| 11 | 118/79 | 150/79 | | 130/85 | - | | |
| 12 | 121/81 | 119/80 | | 122/81 | 139/82 | | |
| 13 | 139/79 | 148/74 | | 140/81 | - | | |
| 14 | 110/76 | 137/78 | | 118/80 | - | | |
| 15 | 131/79 | 131/78 | | 129/83 | - | | 133/81 |
| 16 | 125/80 | 122/79 | | 120/81 | - | | |
| 17 | 136/81 | 149/73 | | 127/83 | - | | |
| 18 | 130/79 | 135/78 | | 141/80 | - | | |
| 19 | 118/79 | 143/75 | | - | - | | |
| 20 | 148/90 | 139/90 | | 131/83 | - | | |
| 21 | 116/79 | 120/80 | | 144/83 | - | | |
| 22 | 133/80 | 118/79 | | 145/88 | - | | 129/80 |
| 23 | 143/78 | 115/78 | | 134/85 | - | | |
| 24 | 117/78 | 131/80 | | - | - | | |
| 25 | 114/78 | 115/79 | | - | - | | |
| 26 | 130/79 | 139/77 | | - | - | | |
| 27 | 144/76 | - | | - | - | | |
| 28 | 135/81 | 128/81 | | 129/85 | - | | |

| Maisense 3 | | | | | | | |
|------------|---------|--------|--------|-----------|--------|--------|--------|
| Day | Morning | | | Afternoon | | | Mean |
| | 1 | 135/74 | 135/75 | 131/78 | 124/78 | 138/78 | |
| 2 | 131/80 | 130/80 | | 130/78 | 138/75 | 137/78 | |
| 3 | 134/77 | 124/79 | | 123/80 | 150/74 | 139/76 | |
| 4 | 128/81 | 131/79 | | 140/76 | 145/70 | 138/76 | |
| 5 | 132/78 | 135/76 | | - | - | | |
| 6 | 134/79 | 128/78 | 132/78 | - | - | | |
| 7 | - | - | | 134/81 | 135/80 | | |
| 8 | 143/80 | 130/79 | | - | - | | 135/79 |
| 9 | 128/80 | 142/79 | 130/79 | 136/76 | 138/78 | | |
| 10 | 129/80 | 132/80 | | - | - | | |
| 11 | 129/77 | 128/78 | | 137/78 | 148/77 | | |
| 12 | 132/79 | 134/80 | | - | - | | |
| 13 | 128/80 | 130/77 | | 142/76 | 142/77 | | |
| 14 | 134/81 | 134/79 | | - | - | | |
| 15 | 148/62 | 141/69 | 131/77 | 140/78 | 136/79 | | 138/77 |
| 16 | 136/77 | 138/81 | | - | - | | |
| 17 | 132/80 | 130/79 | | 139/76 | 139/75 | | |
| 18 | 116/78 | 132/79 | | 137/76 | 138/77 | | |
| 19 | 129/78 | 128/78 | | 131/78 | 136/77 | | |
| 20 | 129/80 | 131/78 | | 139/75 | 146/73 | | |
| 21 | 129/80 | 132/79 | | 159/72 | 152/76 | | |
| 22 | 128/81 | 135/78 | | 144/70 | 139/78 | | 135/77 |
| 23 | 123/78 | 137/75 | | - | - | | |
| 24 | 136/76 | 135/77 | | - | - | | |
| 25 | 146/70 | 137/75 | | 139/76 | 141/77 | | |
| 26 | 132/77 | 133/79 | | 138/77 | 140/74 | | |
| 27 | 138/75 | 128/79 | | 138/74 | 136/74 | | |
| 28 | 133/77 | 134/78 | | 131/78 | 141/71 | | |

| Maisense 4 | | | | | | | |
|------------|---------|---------|--------|-----------|--------|---|--------|
| Day | Morning | | | Afternoon | | | Mean |
| | 1 | 129/90 | 115/82 | | 125/89 | - | |
| 2 | 118/84 | 125/86 | | 132/92 | - | | |
| 3 | 140/91 | 150/97 | | 129/91 | - | | |
| 4 | 132/91 | 124/86 | | 127/90 | 117/84 | | |
| 5 | 122/87 | 113/81 | | 124/89 | - | | |
| 6 | 122/86 | 127/88 | | 128/92 | - | | |
| 7 | 147/101 | 137/96 | | 130/92 | - | | |
| 8 | 147/100 | 134/93 | | 114/82 | - | | 129/90 |
| 9 | 131/91 | 123/87 | | - | - | | |
| 10 | 121/86 | 145/101 | 134/93 | 136/95 | - | | |
| 11 | 128/90 | 125/86 | | 118/85 | - | | |
| 12 | 139/90 | 123/85 | | 114/82 | - | | |
| 13 | 129/91 | 116/83 | | 127/90 | - | | |
| 14 | 133/91 | 121/86 | | 125/89 | - | | |
| 15 | 130/90 | 122/85 | | 134/94 | - | | 130/90 |
| 16 | 126/88 | 121/86 | | - | - | | |
| 17 | - | - | | - | - | | |
| 18 | 125/89 | 112/81 | | 124/88 | - | | |
| 19 | 154/99 | 131/92 | | 130/91 | - | | |
| 20 | 132/90 | 131/89 | | 125/89 | - | | |
| 21 | 116/82 | 115/81 | | 139/97 | - | | |
| 22 | 145/98 | 126/90 | | - | - | | 127/89 |
| 23 | 141/96 | 124/88 | | 123/88 | - | | |
| 24 | 138/96 | 147/98 | | - | - | | |
| 25 | - | - | | 130/92 | - | | |
| 26 | 122/86 | 113/81 | | - | - | | |
| 27 | 126/88 | 125/86 | | 119/85 | - | | |
| 28 | 118/84 | 117/84 | | - | - | | |

| Maisense 5 | | | | | |
|------------|---------|--------|-----------|---|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | 136/82 | 137/81 | 132/83 | - | 128/82 |
| 2 | 144/82 | - | 142/84 | - | |
| 3 | 136/82 | - | 118/81 | - | |
| 4 | 116/79 | - | 116/81 | - | |
| 5 | 122/82 | - | 136/83 | - | |
| 6 | 125/82 | - | - | - | |
| 7 | 133/82 | - | 129/83 | - | |
| 8 | 141/86 | - | 136/83 | - | 131/83 |
| 9 | 129/85 | - | 132/85 | - | |
| 10 | 137/83 | - | 131/85 | - | |
| 11 | 131/81 | - | - | - | |
| 12 | 130/82 | - | 137/80 | - | |
| 13 | 134/83 | - | - | - | |
| 14 | 140/81 | - | - | - | |
| 15 | 140/81 | - | 134/82 | - | 139/82 |
| 16 | 141/80 | - | 150/82 | - | |
| 17 | 132/83 | - | 137/81 | - | |
| 18 | 139/84 | - | 141/84 | - | |
| 19 | 141/84 | - | 145/82 | - | |
| 20 | 139/80 | - | - | - | |
| 21 | 136/83 | - | 129/82 | - | |
| 22 | 143/83 | - | 132/83 | - | 134/83 |
| 23 | 140/84 | - | - | - | |
| 24 | 119/80 | - | - | - | |
| 25 | 128/82 | - | - | - | |
| 26 | 140/82 | - | 137/86 | - | |
| 27 | 138/82 | - | - | - | |
| 28 | 140/83 | - | 131/83 | - | |

| Maisense 6 | | | | | |
|------------|---------|--------|-----------|---------------|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | - | - | 126/79 | - | 124/75 |
| 2 | - | - | 125/76 | - | |
| 3 | - | - | - | - | |
| 4 | 109/72 | - | 124/75 | - | |
| 5 | 124/74 | - | - | - | |
| 6 | - | - | 133/78 | - | |
| 7 | 129/77 | - | - | - | |
| 8 | 126/76 | - | 114/74 | - | 127/76 |
| 9 | 127/73 | - | - | - | |
| 10 | 125/74 | - | - | - | |
| 11 | - | - | - | - | |
| 12 | - | - | 128/78 | 130/78 | |
| 13 | 126/77 | 149/75 | 120/75 | 128/76 120/76 | |
| 14 | - | - | - | - | |
| 15 | 149/71 | 127/74 | - | - | 132/74 |
| 16 | 125/75 | 116/72 | 137/76 | 118/75 | |
| 17 | - | - | 136/72 | 137/71 | |
| 18 | - | - | - | - | |
| 19 | - | - | - | - | |
| 20 | - | - | 135/76 | 110/72 | |
| 21 | - | - | - | - | |
| 22 | - | - | 114/74 | - | 120/76 |
| 23 | - | - | - | - | |
| 24 | - | - | 118/76 | 112/73 | |
| 25 | 125/77 | - | - | - | |
| 26 | - | - | 125/80 | - | |
| 27 | - | - | - | - | |
| 28 | - | - | - | - | |

| Maisense 7 | | | | | |
|------------|---------|---|-----------|---|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | 152/89 | - | 155/85 | - | 148/88 |
| 2 | 146/92 | - | 149/92 | - | |
| 3 | 135/91 | - | 149/87 | - | |
| 4 | 154/86 | - | 147/91 | - | |
| 5 | 146/89 | - | 161/83 | - | |
| 6 | 147/84 | - | 128/91 | - | |
| 7 | 145/92 | - | 161/81 | - | |
| 8 | 143/91 | - | - | - | 139/91 |
| 9 | 134/90 | - | 145/90 | - | |
| 10 | 136/92 | - | 140/89 | - | |
| 11 | 149/91 | - | 141/92 | - | |
| 12 | - | - | - | - | |
| 13 | - | - | 144/92 | - | |
| 14 | 137/93 | - | 131/92 | - | |
| 15 | 147/90 | - | 141/93 | - | 147/90 |
| 16 | 148/92 | - | 143/93 | - | |
| 17 | 143/92 | - | 149/91 | - | |
| 18 | 146/90 | - | 154/85 | - | |
| 19 | 142/92 | - | - | - | |
| 20 | 148/90 | - | - | - | |
| 21 | 147/91 | - | 144/90 | - | |
| 22 | 151/89 | - | 143/91 | - | 147/89 |
| 23 | 153/84 | - | 146/91 | - | |
| 24 | 145/90 | - | - | - | |
| 25 | 148/89 | - | - | - | |
| 26 | - | - | 142/92 | - | |
| 27 | 143/92 | - | - | - | |
| 28 | - | - | 153/86 | - | |

| Maisense 8 | | | | | | |
|------------|---------|--------|--------|-----------|-----------------------------|---------|
| Day | Morning | | | Afternoon | | Mean |
| 1 | 102/70 | - | - | 123/86 | - | 1126/84 |
| 2 | 107/74 | - | - | 119/82 | - | |
| 3 | 118/80 | 109/75 | - | 140/93 | 127/87 | |
| 4 | - | - | - | 125/87 | - | |
| 5 | 128/86 | 127/84 | - | 137/94 | 132/90 | |
| 6 | 145/88 | - | - | 136/90 | - | |
| 7 | - | - | - | 129/88 | 124/83 | |
| 8 | 129/84 | - | - | 134/90 | - | 125/85 |
| 9 | 110/75 | - | - | 132/91 | 124/86 125/87 | |
| 10 | 92/63 | - | - | 136/92 | - | |
| 11 | - | - | - | 132/89 | 113/79 117/82 115/81 | |
| 12 | 111/77 | 121/81 | 126/82 | 138/92 | - | |
| 13 | 127/87 | 128/88 | - | 133/89 | - | |
| 14 | 127/87 | - | - | 126/81 | - | |
| 15 | 132/87 | - | - | 126/87 | - | 126/84 |
| 16 | 122/83 | 108/74 | - | 122/85 | - | |
| 17 | 115/79 | - | - | - | - | |
| 18 | 125/83 | - | - | 126/83 | 114/78 | |
| 19 | 139/91 | 136/88 | 123/83 | 131/90 | 115/80 125/86 | |
| 20 | 129/85 | 114/76 | - | 142/93 | 129/87 | |
| 21 | 123/83 | 117/78 | 141/87 | 128/84 | 148/95 135/91 | |
| 22 | 133/88 | 111/77 | 105/73 | 132/85 | 110/76 119/80 119/81 126/86 | 129/85 |
| 23 | 116/79 | - | - | 146/91 | 143/95 123/84 | |
| 24 | 128/86 | 128/86 | - | 151/95 | 150/96 130/89 130/89 | |
| 25 | - | - | - | - | - | |
| 26 | 136/86 | - | - | 139/89 | - | |
| 27 | 120/80 | - | - | 123/84 | - | |
| 28 | 126/82 | - | - | 131/86 | - | |

| Maisense 9 | | | | | |
|------------|---------|--------|-----------|---------------|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | 126/71 | 110/71 | - | - | 109/72 |
| 2 | - | - | 106/71 | 105/70 | |
| 3 | - | - | - | - | |
| 4 | 122/76 | - | 111/73 | 109/73 | |
| 5 | 107/70 | 101/67 | - | - | |
| 6 | 111/72 | 113/73 | 111/73 | 107/72 | |
| 7 | 107/70 | 106/70 | 107/70 | 109/72 | |
| 8 | 106/70 | 104/69 | 106/71 | 106/71 | 108/71 |
| 9 | 111/72 | 108/70 | 116/75 | 105/70 | |
| 10 | 110/71 | 102/68 | 111/73 | 108/72 100/67 | |
| 11 | 112/73 | 108/70 | 113/74 | 110/72 | |
| 12 | 105/69 | 112/72 | 113/73 | 111/73 | |
| 13 | 113/72 | 111/71 | 109/71 | 109/72 | |
| 14 | 103/68 | 106/70 | 120/73 | 108/71 | |
| 15 | 110/72 | 106/69 | 111/73 | 114/74 | 108/71 |
| 16 | 101/68 | 102/68 | 113/75 | 102/68 | |
| 17 | 106/70 | 107/70 | 111/73 | 107/71 | |
| 18 | 109/72 | 104/68 | 109/73 | 103/68 | |
| 19 | 100/67 | 100/67 | 108/71 | 101/67 | |
| 20 | 105/69 | 105/70 | 111/72 | 119/76 | |
| 21 | 111/73 | 107/71 | 116/74 | 115/74 | |
| 22 | - | - | 108/71 | 109/72 | 114/73 |
| 23 | - | - | 118/75 | 113/73 | |
| 24 | - | - | 111/71 | 110/70 | |
| 25 | - | - | 129/80 | 129/78 | |
| 26 | 111/71 | 102/67 | 119/77 | 110/72 | |
| 27 | 112/74 | 126/77 | 108/71 | 107/69 | |
| 28 | 111/72 | 109/71 | 118/75 | 123/74 | |

| Maisense 10 | | | | | |
|-------------|---------|---------------|-----------|---------------|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | 105/72 | 109/74 110/75 | 123/83 | - | 118/80 |
| 2 | 117/79 | 115/78 118/80 | 124/84 | - | |
| 3 | 119/81 | 118/81 | 123/84 | - | |
| 4 | 127/84 | 120/80 | 120/81 | - | |
| 5 | 120/80 | 113/77 113/76 | - | - | |
| 6 | 126/84 | 122/82 | 121/81 | 124/83 | |
| 7 | 114/76 | 117/80 | 117/80 | 112/77 | |
| 8 | 115/78 | 115/78 | 118/81 | 116/80 | 117/80 |
| 9 | 115/78 | 117/79 | 119/80 | 125/85 118/80 | |
| 10 | 114/77 | 120/80 | 131/87 | 131/88 | |
| 11 | 112/76 | 112/76 | 119/81 | 119/81 | |
| 12 | 107/73 | 121/82 | 117/79 | 121/82 | |
| 13 | 116/79 | 111/75 | 119/81 | 118/80 | |
| 14 | 129/85 | 117/79 | 128/87 | 121/82 | |
| 15 | 119/80 | 124/80 | 124/83 | 122/83 | 123/82 |
| 16 | 122/81 | 121/81 | - | - | |
| 17 | 118/80 | 117/80 | 126/85 | 121/82 | |
| 18 | 120/80 | 113/77 | 123/84 | 118/81 | |
| 19 | 131/84 | 143/86 | 122/82 | 121/82 118/80 | |
| 20 | 125/83 | 120/80 | 131/87 | 125/84 | |
| 21 | 118/80 | 118/80 | 130/86 | 122/83 | |
| 22 | 121/81 | 108/74 | 126/85 | 117/81 | 121/81 |
| 23 | 122/79 | 126/82 | 127/85 | 129/86 | |
| 24 | 121/81 | 118/80 | 123/82 | 122/82 | |
| 25 | 125/82 | 116/78 | 118/80 | 118/80 | |
| 26 | 124/83 | 124/82 | 131/88 | 124/84 | |
| 27 | 126/83 | 118/80 | - | - | |
| 28 | 114/77 | 107/73 | - | - | |

| Maisense 11 | | | | | |
|-------------|---------|--------|-----------|--------|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | - | - | 125/67 | - | 115/63 |
| 2 | 122/62 | 125/65 | 128/57 | - | |
| 3 | 105/62 | 112/63 | 110/64 | - | |
| 4 | 119/63 | - | 121/66 | - | |
| 5 | 105/60 | 106/61 | - | - | |
| 6 | 115/63 | 101/61 | - | - | |
| 7 | - | - | - | - | |
| 8 | - | - | - | - | 109/64 |
| 9 | - | - | - | - | |
| 10 | 105/62 | - | 108/63 | - | |
| 11 | - | - | 112/65 | 113/65 | |
| 12 | - | - | 104/64 | 104/63 | |
| 13 | - | - | - | - | |
| 14 | - | - | - | - | |
| 15 | - | - | - | - | - |
| 16 | - | - | - | - | |
| 17 | - | - | - | - | |
| 18 | - | - | - | - | |
| 19 | - | - | - | - | |
| 20 | - | - | - | - | |
| 21 | - | - | - | - | |
| 22 | - | - | - | - | - |
| 23 | - | - | - | - | |
| 24 | - | - | - | - | |
| 25 | - | - | - | - | |
| 26 | - | - | - | - | |
| 27 | - | - | - | - | |
| 28 | - | - | - | - | |

| Maisense 12 | | | | | |
|-------------|---------|---|-----------|--------|--------|
| Day | Morning | | Afternoon | | Mean |
| 1 | 140/47 | - | 138/57 | - | 136/56 |
| 2 | 140/46 | - | 135/56 | - | |
| 3 | 139/56 | - | 133/60 | - | |
| 4 | 130/57 | - | 128/63 | - | |
| 5 | 140/53 | - | 142/52 | - | |
| 6 | 128/64 | - | 134/60 | - | |
| 7 | 134/52 | - | 138/54 | - | |
| 8 | 135/50 | - | 136/59 | - | 135/58 |
| 9 | 130/63 | - | 137/55 | - | |
| 10 | 131/61 | - | 147/51 | - | |
| 11 | 133/59 | - | 141/55 | - | |
| 12 | 136/52 | - | 131/63 | - | |
| 13 | 132/59 | - | 142/47 | - | |
| 14 | 128/63 | - | 134/61 | - | |
| 15 | 128/64 | - | 137/58 | - | 133/60 |
| 16 | 129/66 | - | 134/60 | - | |
| 17 | 133/60 | - | 138/55 | - | |
| 18 | 134/58 | - | 147/42 | 142/49 | |
| 19 | 135/58 | - | 139/56 | - | |
| 20 | 122/67 | - | 140/49 | - | |
| 21 | 129/59 | - | 126/64 | - | |
| 22 | 132/59 | - | 133/60 | - | 136/55 |
| 23 | 127/66 | - | 140/51 | - | |
| 24 | 127/62 | - | 140/54 | - | |
| 25 | 141/46 | - | 141/45 | - | |
| 26 | 139/50 | - | 144/40 | - | |
| 27 | 141/42 | - | 131/62 | - | |
| 28 | 133/56 | - | 143/46 | - | |

| Maisense 13 | | | | | | |
|-------------|---------|--------|--------|-----------|--------|--------|
| Day | Morning | | | Afternoon | | Mean |
| | 1 | 101/65 | 104/66 | | 105/65 | |
| 2 | 112/69 | 105/67 | | 118/72 | 106/66 | |
| 3 | 118/73 | 110/69 | 113/71 | 114/72 | - | |
| 4 | 110/70 | - | | 116/71 | - | |
| 5 | 100/63 | - | | 101/65 | - | |
| 6 | 103/66 | - | | 105/67 | - | |
| 7 | 108/68 | - | | 102/66 | - | |
| 8 | 107/68 | - | | 103/66 | - | 110/69 |
| 9 | 115/71 | - | | 110/69 | - | |
| 10 | 111/68 | - | | 118/71 | - | |
| 11 | 109/68 | - | | 116/71 | - | |
| 12 | 109/68 | - | | 104/65 | - | |
| 13 | 108/69 | - | | 106/67 | - | |
| 14 | 109/68 | - | | 112/71 | - | |
| 15 | 110/70 | - | | 121/71 | - | 111/69 |
| 16 | 111/69 | - | | 111/69 | - | |
| 17 | 112/67 | - | | 115/71 | - | |
| 18 | 118/72 | - | | 109/70 | - | |
| 19 | 105/67 | - | | 119/70 | - | |
| 20 | 110/66 | - | | 107/68 | - | |
| 21 | 109/68 | - | | 111/70 | - | |
| 22 | 103/66 | - | | 117/71 | - | 111/70 |
| 23 | 111/69 | - | | 102/66 | - | |
| 24 | 112/69 | - | | 112/69 | - | |
| 25 | 109/69 | - | | 114/73 | - | |
| 26 | 112/70 | - | | 114/71 | - | |
| 27 | 117/73 | - | | 114/72 | - | |
| 28 | - | - | | 112/71 | - | |

| Maisense 14 | | | | | | |
|-------------|---------|---|---|-----------|---|------|
| Day | Morning | | | Afternoon | | Mean |
| | 1 | - | - | | - | |
| 2 | - | - | | - | - | |
| 3 | - | - | | - | - | |
| 4 | - | - | | - | - | |
| 5 | - | - | | - | - | |
| 6 | - | - | | - | - | |
| 7 | - | - | | - | - | |
| 8 | - | - | | - | - | - |
| 9 | - | - | | - | - | |
| 10 | - | - | | - | - | |
| 11 | - | - | | - | - | |
| 12 | - | - | | - | - | |
| 13 | - | - | | - | - | |
| 14 | - | - | | - | - | |
| 15 | - | - | | - | - | - |
| 16 | - | - | | - | - | |
| 17 | - | - | | - | - | |
| 18 | - | - | | - | - | |
| 19 | - | - | | - | - | |
| 20 | - | - | | - | - | |
| 21 | - | - | | - | - | |
| 22 | - | - | | - | - | - |
| 23 | - | - | | - | - | |
| 24 | - | - | | - | - | |
| 25 | - | - | | - | - | |
| 26 | - | - | | - | - | |
| 27 | - | - | | - | - | |
| 28 | - | - | | - | - | |

| Maisense 15 | | | | | | |
|-------------|---------|--------|--------|-----------|--------|--------|
| Day | Morning | | | Afternoon | | Mean |
| | 1 | 105/69 | 108/69 | | 109/69 | |
| 2 | 99/64 | 98/64 | | 126/72 | 114/69 | |
| 3 | 101/67 | 98/64 | 106/69 | 127/70 | 136/73 | |
| 4 | 102/66 | 107/68 | 97/64 | 111/68 | 110/70 | |
| 5 | 106/70 | 105/67 | | 115/72 | 120/69 | 126/75 |
| 6 | 102/67 | 98/64 | | 115/68 | 116/72 | |
| 7 | 103/68 | 103/68 | | 112/71 | 114/71 | |
| 8 | 107/68 | 99/66 | 100/66 | 116/72 | 119/70 | |
| 9 | 104/68 | 112/69 | | 115/72 | 114/71 | |
| 10 | 100/66 | 102/67 | | 118/70 | 114/69 | |
| 11 | 110/70 | 101/66 | | 137/71 | 123/74 | |
| 12 | 99/65 | 106/68 | | 124/74 | 120/71 | |
| 13 | 87/58 | 102/66 | | 115/70 | 112/71 | |
| 14 | 102/67 | 103/67 | | 114/72 | 109/70 | |
| 15 | 111/72 | 101/66 | | 116/72 | 113/70 | |
| 16 | 100/66 | 101/65 | | 124/74 | 126/73 | |
| 17 | 101/66 | 101/66 | | 116/72 | 109/68 | 109/69 |
| 18 | 101/66 | 96/63 | | 107/67 | 117/71 | |
| 19 | 104/68 | 100/64 | 97/63 | 109/68 | 110/68 | |
| 20 | 102/68 | 105/69 | | 122/69 | 118/68 | |
| 21 | 102/67 | 101/67 | 101/66 | 112/72 | 109/69 | |
| 22 | 106/70 | 105/67 | 97/64 | 114/71 | 112/68 | |
| 23 | 97/64 | 93/61 | | 109/67 | 101/63 | |
| 24 | 98/64 | 94/61 | | 117/70 | 111/70 | |
| 25 | 96/63 | 95/62 | | 94/62 | - | |
| 26 | 111/72 | 108/70 | | 115/73 | 110/70 | |
| 27 | 97/64 | 101/67 | | 113/70 | 109/69 | |
| 28 | 107/68 | 99/65 | | - | - | |

| Maisense 16 | | | | | | |
|-------------|---------|---------|---|-----------|---------|---------|
| Day | Morning | | | Afternoon | | Mean |
| | 1 | - | - | | - | |
| 2 | - | - | | - | - | |
| 3 | - | - | | - | - | |
| 4 | - | - | | - | - | |
| 5 | - | - | | 87/59 | 110/67 | |
| 6 | - | - | | 157/115 | 149/111 | |
| 7 | 152/111 | 152/110 | | - | - | 144/103 |
| 8 | - | - | | - | - | |
| 9 | - | - | | - | - | |
| 10 | - | - | | - | - | |
| 11 | - | - | | - | - | - |
| 12 | - | - | | - | - | |
| 13 | - | - | | - | - | |
| 14 | - | - | | - | - | |
| 15 | - | - | | - | - | |
| 16 | - | - | | - | - | |
| 17 | - | - | | - | - | |
| 18 | - | - | | - | - | |
| 19 | - | - | | - | - | |
| 20 | - | - | | - | - | |
| 21 | - | - | | - | - | |
| 22 | - | - | | - | - | |
| 23 | - | - | | - | - | |
| 24 | - | - | | - | - | |
| 25 | - | - | | - | - | |
| 26 | - | - | | - | - | |
| 27 | - | - | | - | - | |
| 28 | - | - | | - | - | |

| Maisense 17 | | | | | |
|-------------|---------|---------|-----------|---------|--------|
| Day | Morning | | Afternoon | | Mean |
| | 1 | 140/98 | 141/96 | 141/99 | |
| 2 | 144/97 | 141/96 | 147/98 | 147/100 | |
| 3 | 141/97 | 140/96 | 152/101 | 144/98 | |
| 4 | 135/95 | 148/100 | 156/103 | 155/101 | |
| 5 | 137/96 | 142/97 | 142/99 | 153/101 | |
| 6 | 144/98 | 140/95 | 150/100 | 146/99 | |
| 7 | 145/97 | 142/96 | 161/104 | 148/99 | |
| 8 | 131/93 | 139/95 | 151/96 | 161/91 | 143/93 |
| 9 | 134/93 | 132/92 | 142/96 | 166/90 | |
| 10 | 143/94 | 154/91 | 148/96 | 156/92 | |
| 11 | 147/94 | 141/95 | 156/96 | 132/93 | |
| 12 | 130/91 | 132/92 | 140/95 | 142/96 | |
| 13 | 145/93 | 133/92 | 141/94 | 144/95 | |
| 14 | 149/96 | 125/90 | 143/94 | 135/95 | |
| 15 | 139/94 | 142/93 | 158/97 | 153/97 | 147/95 |
| 16 | 152/92 | 148/93 | 169/86 | 134/93 | |
| 17 | 147/93 | 141/91 | 156/96 | 155/97 | |
| 18 | 151/96 | 154/95 | 157/97 | 140/96 | |
| 19 | 148/98 | 140/94 | 142/95 | 150/93 | |
| 20 | 150/96 | 140/92 | 140/95 | 143/98 | |
| 21 | 146/96 | 141/92 | 150/100 | 146/96 | |
| 22 | 129/91 | 137/93 | 167/94 | 168/87 | 144/96 |
| 23 | 138/95 | 142/95 | 148/99 | 142/97 | |
| 24 | 135/95 | 134/95 | 142/96 | 159/92 | |
| 25 | 149/99 | 147/98 | 133/95 | 143/99 | |
| 26 | 143/98 | 135/95 | 149/99 | 152/101 | |
| 27 | 143/100 | 149/99 | 145/98 | 135/96 | |
| 28 | 143/94 | 141/95 | 148/97 | 144/97 | |

| Maisense 18 | | | | | |
|-------------|---------|--------|-----------|--------|--------|
| Day | Morning | | Afternoon | | Mean |
| | 1 | 139/85 | 134/84 | 141/82 | |
| 2 | 170/78 | 161/75 | 156/72 | 152/71 | |
| 3 | 130/84 | 131/82 | 152/78 | 146/80 | |
| 4 | 142/84 | 127/81 | 155/88 | 132/88 | |
| 5 | 126/82 | 128/82 | 132/85 | 133/81 | |
| 6 | 142/88 | 138/85 | 145/80 | 135/81 | |
| 7 | 117/80 | 115/79 | 154/88 | 150/85 | |
| 8 | 138/83 | 136/83 | 136/85 | 133/84 | 140/83 |
| 9 | 139/83 | 139/81 | 153/77 | 150/77 | |
| 10 | 136/88 | 120/81 | 133/83 | 129/82 | |
| 11 | 130/84 | 123/82 | 140/86 | 138/86 | |
| 12 | 135/82 | 128/82 | 171/86 | 159/75 | |
| 13 | 146/83 | 131/81 | 138/86 | 131/82 | |
| 14 | 139/86 | 141/86 | 173/80 | 151/82 | |
| 15 | 148/85 | 151/75 | 132/83 | 130/82 | 138/83 |
| 16 | 148/79 | 143/82 | 150/74 | 146/78 | |
| 17 | 135/84 | 129/80 | 138/85 | 134/84 | |
| 18 | 144/83 | 131/82 | 154/87 | 144/86 | |
| 19 | 126/83 | 118/79 | 148/90 | 137/88 | |
| 20 | 134/85 | 131/85 | 136/85 | 133/84 | |
| 21 | 146/81 | 150/77 | 136/83 | 128/81 | |
| 22 | 142/86 | 141/86 | 126/84 | 134/86 | 138/83 |
| 23 | 135/86 | 133/84 | 133/85 | 134/84 | |
| 24 | 141/83 | 141/82 | 140/86 | 140/87 | |
| 25 | 138/84 | 143/78 | 129/84 | 119/81 | |
| 26 | 130/82 | 123/81 | 141/85 | 127/86 | |
| 27 | 146/85 | 133/86 | 165/72 | 150/72 | |
| 28 | 151/87 | 142/84 | 150/79 | 146/80 | |

| Maisense 19 | | | | | | | |
|-------------|---------|--------|--------|-----------|--------|--------|--------|
| Day | Morning | | | Afternoon | | Mean | |
| 1 | 161/83 | 149/89 | | 175/63 | 178/69 | | |
| 2 | 173/74 | 174/66 | | 153/86 | 164/81 | 161/79 | |
| 3 | 167/80 | 170/68 | | 175/74 | 175/73 | | |
| 4 | 157/85 | 164/77 | 161/84 | 171/74 | 153/91 | | |
| 5 | 181/73 | 158/84 | | 181/64 | 179/69 | 180/68 | 168/83 |
| 6 | 170/76 | 164/87 | | 163/83 | 160/84 | | |
| 7 | 159/88 | 148/86 | | 171/80 | 162/83 | | |
| 8 | 160/85 | 152/86 | | 181/57 | 172/70 | | |
| 9 | 147/84 | 152/86 | | 187/53 | 162/80 | | |
| 10 | 161/82 | 155/85 | | 166/81 | 163/83 | | |
| 11 | 165/80 | 146/90 | | 184/58 | 170/77 | | |
| 12 | 162/82 | 154/86 | | 163/81 | 159/80 | | |
| 13 | 157/83 | 153/85 | | 153/86 | 167/75 | | |
| 14 | 164/73 | 156/88 | | - | - | | |
| 15 | 165/77 | 160/81 | | 174/71 | 169/77 | | |
| 16 | 155/85 | 149/85 | | 172/78 | 174/67 | | |
| 17 | 173/68 | 166/78 | 159/83 | 183/55 | 162/82 | | |
| 18 | 162/80 | 138/92 | | 167/80 | 163/83 | | |
| 19 | 152/88 | 156/86 | | 168/75 | 161/82 | | |
| 20 | 156/86 | 155/88 | | 156/89 | 159/85 | | |
| 21 | 169/75 | 159/83 | | 174/79 | 164/83 | | |
| 22 | 149/91 | 165/78 | | 170/76 | 164/82 | | |
| 23 | 154/85 | 149/90 | | - | - | | |
| 24 | 155/85 | 160/77 | | 167/77 | 153/89 | | |
| 25 | 156/83 | 153/87 | | 172/70 | 167/78 | | |
| 26 | 164/82 | 159/81 | | 151/88 | 153/88 | | |
| 27 | 159/86 | 152/85 | | 171/77 | 173/72 | | |
| 28 | 145/90 | 152/88 | | 164/82 | 163/79 | | |


| Maisense 20 | | | | | | | |
|-------------|---------|--------|--------|-----------|---------|--------|--------|
| Day | Morning | | | Afternoon | | Mean | |
| 1 | 126/91 | 121/86 | | 138/98 | 139/99 | | |
| 2 | 132/91 | 128/91 | | 145/102 | 146/103 | | |
| 3 | 136/94 | 131/92 | | 144/100 | 145/100 | | |
| 4 | 126/91 | 125/90 | | 136/97 | 135/97 | 132/95 | |
| 5 | 110/71 | 109/70 | 123/75 | 115/72 | 105/68 | 103/67 | 120/74 |
| 6 | 113/71 | - | | - | - | | |
| 7 | 119/74 | - | | - | - | | |
| 8 | - | - | | - | - | | |
| 9 | 120/74 | - | | 109/66 | 110/68 | | |
| 10 | - | - | | 113/71 | 111/70 | | |
| 11 | - | - | | 128/77 | - | | |
| 12 | - | - | | 122/75 | - | | |
| 13 | - | - | | 115/72 | 117/73 | 119/74 | |
| 14 | - | - | | 114/72 | - | | |
| 15 | 117/73 | - | | 119/73 | 136/80 | | |
| 16 | - | - | | 119/74 | - | | |
| 17 | 109/70 | - | | 109/70 | - | | |
| 18 | - | - | | 118/73 | - | | |
| 19 | 118/73 | 161/87 | | 111/70 | 107/69 | 116/73 | |
| 20 | - | - | | 109/66 | - | | |
| 21 | - | - | | 112/71 | 113/71 | | |
| 22 | - | - | | 108/69 | - | | |
| 23 | - | - | | - | - | | |
| 24 | - | - | | - | - | | |
| 25 | 110/70 | - | | - | - | | |
| 26 | - | - | | - | - | | |
| 27 | - | - | | 107/69 | 117/73 | | |
| 28 | - | - | | - | - | | |



ANNEXES

Mai de 2020

Annex 1 – Informed consent

| | | | |
|---|--|-----------|------------|
|  | IMPRESSO Consentimento livre e informado Código: CHCB.IMP.CINVEST.18 | Edição: 2 | Revisão: 0 |
|---|--|-----------|------------|

Mikael Tomás Xufre, Estudante do 5º ano do Mestrado Integrado em Medicina da Faculdade de Ciências da Saúde da Universidade da Beira Interior, a realizar um trabalho de investigação subordinado ao tema: **“Innovative technologies in Hypertension control – A Telemonitored cuffless Blood Pressure device”** vem solicitar a sua colaboração neste estudo.

Informo que a sua participação é voluntária e que os dados não serão transmitidos a terceiros sem a sua prévia autorização.

Poderá retirar o seu consentimento em qualquer momento, sem prejuízo dos dados recolhidos à data e sem que por isso venha a ser prejudicado nos cuidados de saúde prestados pelo CHCB, EPE.

Informo ainda que a sua privacidade será respeitada, todos os dados recolhidos serão confidenciais e não serão fornecidas quaisquer compensações.

Objetivo do trabalho de investigação: Analisar a viabilidade e a utilidade de um novo dispositivo para medição da pressão arterial que não necessita de braçadeira no seguimento de doentes diagnosticados com Hipertensão Arterial (HTA) e avaliar a sua utilidade na deteção de situações de risco (arritmias) que possibilitem atuação precoce.

Critérios de inclusão:

- ✓ Doentes diagnosticados com HTA
- ✓ Seguidos em consulta no Centro Hospitalar Cova da Beira
- ✓ Possuir ou ter acesso a Smartphone (necessário para a telemonitorização)
- ✓ capacidade de aprendizagem para utilizar o novo dispositivo

Critérios de exclusão:

- ✗ Diagnóstico de qualquer tipo de arritmia

Nome do orientador: Prof. Dr. Miguel Castelo-Branco

Página: 1 de 4



IMPRESSO

Consentimento livre e informado

Código: CHCB.IMP.INVEST.18

Edição: 2

Revisão: 0

Metodologia: Será fornecido o aparelho e explicado o modo de funcionamento do mesmo e da aplicação móvel associada (myFreescan) e será ainda feita a calibração do aparelho da maisense com um aparelho de medição da PA com braçadeira (Modelo Rossmax X5 BT, validado pela European Society of Hypertension e British Hypertension Society). Será recomendado a medição diária com duas medições de manhã (consecutivas com 1min de intervalo) antes de tomar o pequeno-almoço e a medicação habitual e duas antes de deitar. Será ainda descartada a informação obtida nas primeiras 24h dado que alguns estudos indicam que neste período os valores são superiores aos restantes^[9]. A posição a adotar aquando a medição é sentado e em repouso por um tempo mínimo de cinco minutos antes de efetuar a medição, com o braço apoiado numa superfície plana, músculos descontraídos e com o dispositivo a um nível de altura aproximado ao do coração. Uma nova consulta será marcada para 1 mês depois de forma a recolher o aparelho. Durante este período o doente poderá ser contactado ou contactar os responsáveis do estudo sempre que sejam identificadas situações de risco (HTA elevada ou identificação de ritmos anormais pelo dispositivo) para agendar consulta e intervir se necessário seja através de alteração na medicação ou da realização de exames complementares de diagnóstico descritos na tabela 1 ou outros que o médico responsável entender ser necessário.

Na última consulta será recolhido o dispositivo e será entregue um questionário de forma a avaliar a opinião do utente sobre o dispositivo, a aplicação móvel e a sua experiência no geral.

Discriminação dos dados que irão ser colhidos: Nome, Idade, Sexo, Medições de parâmetros vitais (pressão arterial, frequência cardíaca, traçado eletrocardiográfico 1 derivação)

Local onde o investigador se vai encontrar com o participante, quantas vezes e durante quanto tempo: Consultas de Hipertensão no CHCB, mínimo de 2 encontros com períodos aproximados de 20 minutos. Ocasionalmente poderá ser marcada consultas adicionais para avaliação do doente relacionado com os resultados obtidos pelas medições e realização de exames complementares de diagnóstico se necessário (decisão a tomar pelo médico responsável pelo doente)

Risco / Benefício da sua participação: Visto o aparelho realizar medições de forma não invasiva e estar homologado para a medição da pressão arterial, não se identifica nenhum risco acrescentado atribuível ao estudo. Os participantes têm o potencial benefício de poder melhorar o controlo da pressão arterial e despistar doenças cardíacas que poderão ser identificadas pelo dispositivo utilizado durante o estudo.

Previsão da duração da participação no estudo: 30 dias



IMPRESSO

Consentimento livre e informado

Código: CHCB.IMP.CINVEST.18

Edição: 2

Revisão: 0

Os dados recolhidos serão mantidos tanto tempo quanto o que a lei determine, independentemente do suporte.

Nº aproximado de participantes: 50

Contacto para esclarecimento de dúvidas: Mikael Xufre: 969202351 / mikael.xufre@hotmail.com

Consentimento Informado – Aluno / Investigador

Ao assinar esta página, o investigador está a confirmar o seguinte:

- * Entregou esta informação;
- * Explicou o propósito deste trabalho;
- * Explicou e respondeu a todas as questões e dúvidas apresentadas pelo participante ou representante legal.

Nome do Aluno / Investigador (Legível)

Assinatura do Aluno / Investigador

____/____/____
Data

Consentimento Informado – Participante

Ao assinar esta página está a confirmar o seguinte:

- * O Sr. (a) leu e compreendeu todas as informações desta informação, e teve tempo para as ponderar;
- * Todas as suas questões foram respondidas satisfatoriamente;
- * Se não percebeu qualquer das palavras, solicitou ao aluno/investigador uma explicação, tendo este esclarecido todas as dúvidas;
- * Informa-se ainda:

O participante dos 6 aos 13 anos tem de ser informado verbalmente, sendo imprescindível a assinatura dos pais no consentimento livre e informado;

O participante dos 14 aos 16 anos assina, conjuntamente com os pais, o consentimento livre e informado;



IMPRESSO

Consentimento livre e informado

Código: CHCB.IMP.CINVEST.18

Edição: 2

Revisão: 0

A partir dos 16 anos assina apenas o participante;

* O Sr. (a) recebeu uma cópia desta informação, para a manter consigo.

Nome do Participante (Legível com número do cartão do cidadão ou bilhete de identidade) Representante Legal (Legível com número do cartão do cidadão ou bilhete de identidade)

(Nome do Participante)

(Nome do Representante Legal)

(Assinatura do Participante)

(Assinatura do Representante Legal)

___/___/___

Data

Annex 2 – Certificates



07 Fevereiro February

12:30

14:30 SALA 2

MESA REDONDA | ROUND TABLE

DISPOSITIVOS MÉDICOS NA HTA
MEDICAL DEVICES ON HTN

Moderadores | Chairpersons
Miguel Castelo-Branco, Portugal
Francisco Paisana, Portugal

Utilização de sistemas de medição de pressão inovadores
The use of the new blood pressure devices
Mikael Xufre, Portugal

Telemonitorização na insuficiência cardíaca - A importância da pressão arterial para o cardiologista
Telemonitoring on the heart failure - What's the matter of the blood pressure for the cardiologist

A group photo of five men standing on a stage in front of a presentation screen. The screen displays the congress logo and the text '13^o CONGRESSO PORTUGUÊS DE HIPERTENSÃO E RISCO CARDIOVASCULAR GLOBAL'.

26º Congresso Nacional de Medicina Interna / 7º Congresso Ibérico Medicina Interna | 26º CONGRESSO NACIONAL DE MEDICINA INTERNA

Comprovativo de submissão de resumo

ID Resumo: 1562

Submetido em : 19-02-2020 21:08:07

Última Alteração em : 19-02-2020 21:08:07

Título: TELEMONITORIZAÇÃO NA HIPERTENSÃO - AVALIAÇÃO DE UM NOVO DISPOSITIVO SEM BRACADEIRA NA PRÁTICA CLÍNICA

Modo de Apresentação: Comunicação Oral Inv. / Cas.

Conteúdo de Apresentação: Investigação Casuística

Tema: Doenças Cardiovasculares

Autores: Mikael Tomás Xufre, Miguel Castelo Branco Craveiro de Sousa

Documento gerado em : 2020-02-19 21:08:26

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