KNOWLEDGE, ACCESSIBILITY AND ADHERENCE TO ANTIHYPERTENSIVE MEDICATIONS: A SMARTPHONE-BASED INTERVENTIONAL STUDY AMONGST PATIENTS SEEKING CARE IN THE ASHANTI REGION.

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PRESENTATION OUTLINE

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INTRODUCTION

- The incidence of hypertension, its prevalence and death due to complications have increased globally.
- Poor adherence is the most important cause of uncontrolled BP.
- Research has shown that an estimate of 50–70% of hypertensive patients do not adhere to their antihypertensive therapy as prescribed.
- Many hypertensive patients have limited knowledge about the condition, including its causes, symptoms, and treatment options.
- Access to antihypertensive agents have been shown to improve adherence.
- Enhanced self-management through incorporation of technology have improved clinical outcomes.

PROBLEM STATEMENT

- The morbidity and mortality associated with poor BP control continues to be a public health menace warranting the need to study the gaps in management and implementing interventions to optimize outcomes.

- Additionally, there the need to identify gaps in making antihypertensive medications accessible from the stakeholders' perspective suggesting suitable interventions where appropriate.

JUSTIFICATION

- With the surge in incorporation of technology in healthcare with notable successes, it is essential to pilot the use of smartphone applications as an intervention to improve blood pressure control and accessibility.

- The expected outcomes of this research will inform national policies to reduce the burden of hypertension in Ghana and help the country monitor progress towards achieving the 2025 NCD global targets.

RESEARCH QUESTIONS

- Will the use of a smartphone application (HeartCare) enhance adherence knowledge and accessibility as well as optimize BP control?

- Will the use of a smartphone application (Shipshape) improve supply chain practices among stakeholders?

OBJECTIVES

Evaluate the impact of knowledge, adherence, and accessibility of medicines on blood pressure control as well as identify lapses from the stakeholder's perspective concerning accessibility of antihypertensive medications.

1. **To assess the impact of adherence, knowledge and accessibility of antihypertensive medications on BP control.**

2. **To identify factors affecting accessibility to antihypertensive medications from the stakeholders' perspective.**

OBJECTIVES

Assess the impact a of smartphone application (Shipshape) as intervention to improving knowledge on supply chain practices to improve accessibility to essential medicines.

3

To implement a smartphone intervention in improving accessibility among stakeholders.

4

To assess post intervention deployment of the smartphone application in improving accessibility to medicines.

OBJECTIVES

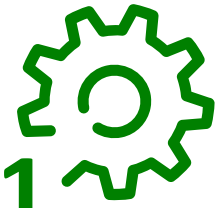
Assess the impact a of smartphone application (HeartCare) as intervention to improving knowledge adherence, accessibility as well as BP control.

5. To implement a smartphone intervention in to improve knowledge, adherence and accessibility to optimize outcomes in hypertensive patients.

6. To assess post intervention deployment of the smartphone application in improving and clinical outcomes (knowledge, adherence, BP control).

PRE-INTERVENTION

METHODS – PHASE 1



METHOD

- A mixed method cross-sectional study involving Outpatient Department (OPD) hypertensive patients.

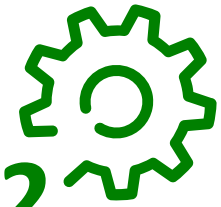
- Using Glenn's formula, 143 at KNUST Hospital (UHS) and 342 at Komfo Anokye Teaching Hospital (KATH) were included in the study.

- A face-to-face interview was also conducted with relevant stakeholders involved in procurement of medicines.

- Correlations were drawn to evaluate the effect of knowledge, accessibility and adherence on blood pressure control.

INTERVENTION

METHODS – PHASE 2



METHOD

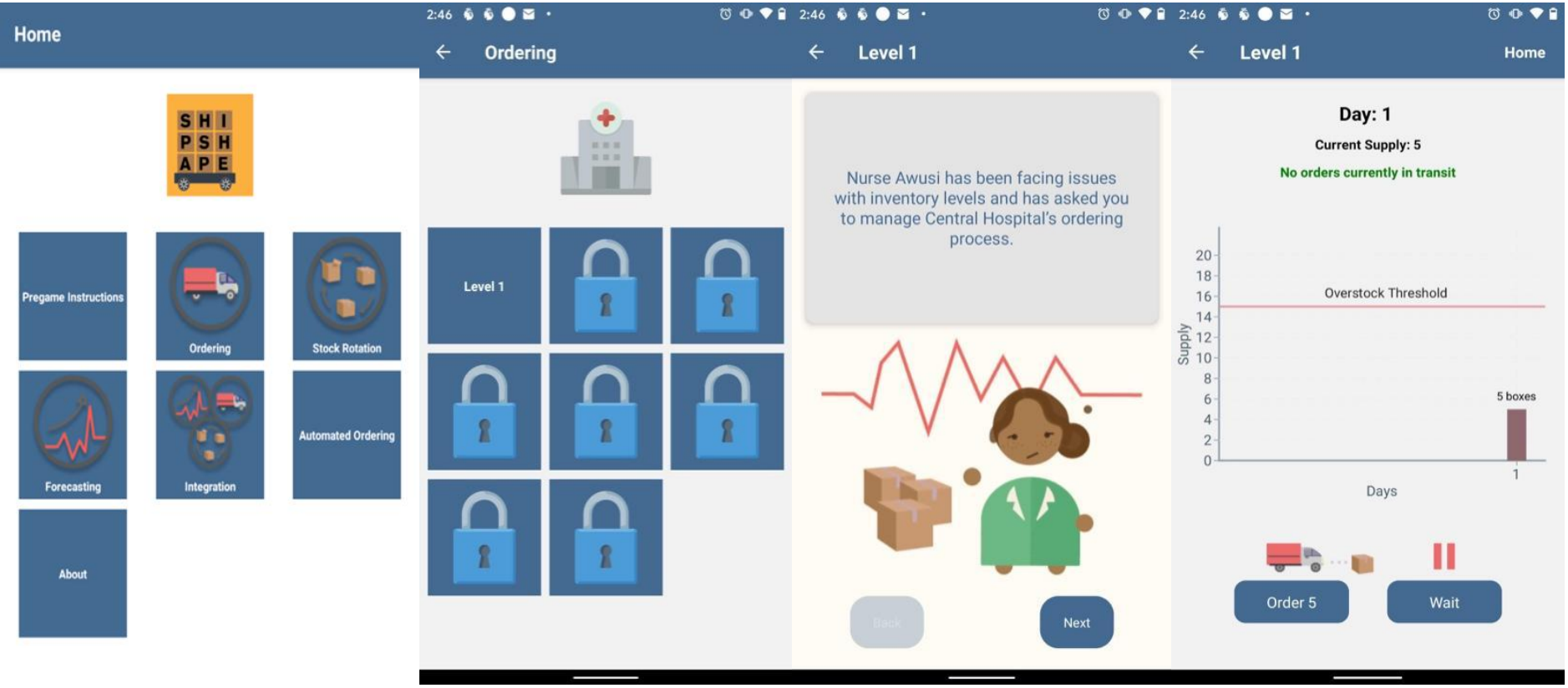
- The stakeholders after the pre-interventional interview were given the mobile application (Shipshape) to be used for a period of six weeks (between May and June 2022) after which a post-interventional interview was conducted.

- Patients' interventional study was a randomized controlled non-blinded study involving hundred (100) hypertensive patients on medications and categorized into a control and intervention groups.

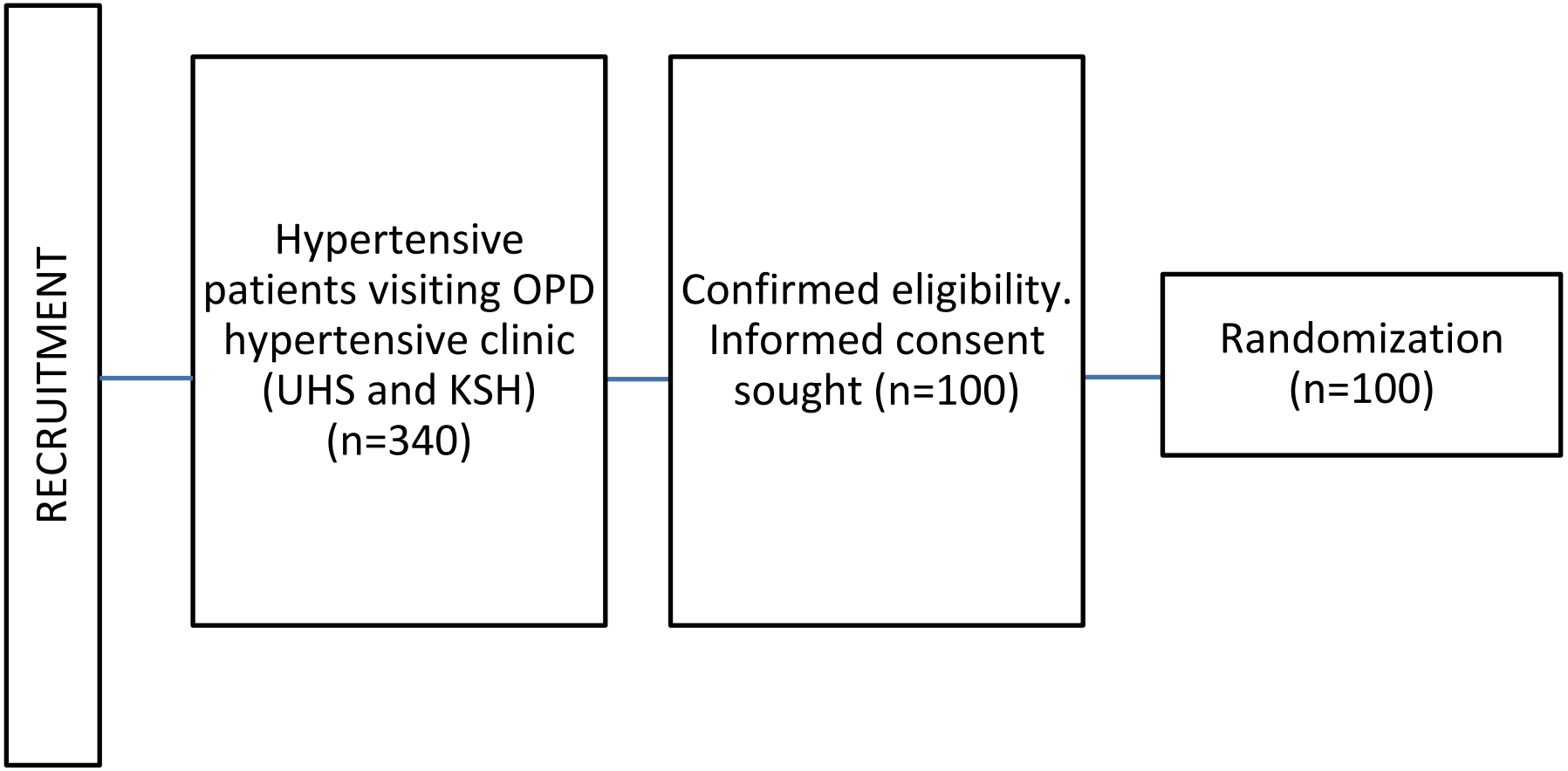
- The study was carried out in the University Health Services (KNUST Hospital) and Kumasi South Hospital from June 2022 to January 2023.

- The differences in their knowledge, adherence and blood pressure levels in control and the intervention groups at month 3 and 6 were assessed using two tailed students' T test at 95% Confidence Interval (CI).

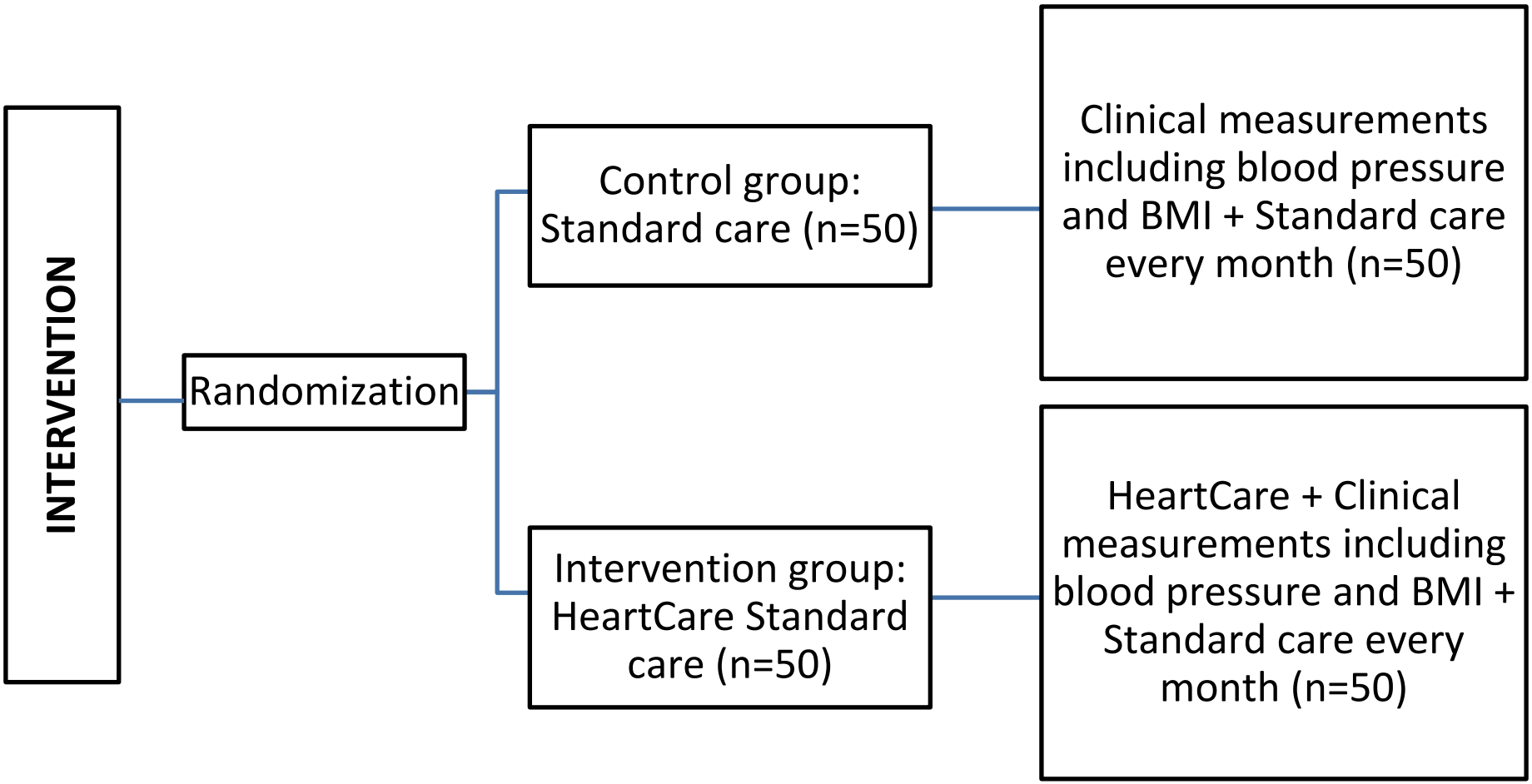
USER INTERFACE OF SHIPSHAPE



IMPLEMENTATION



IMPLEMENTATION



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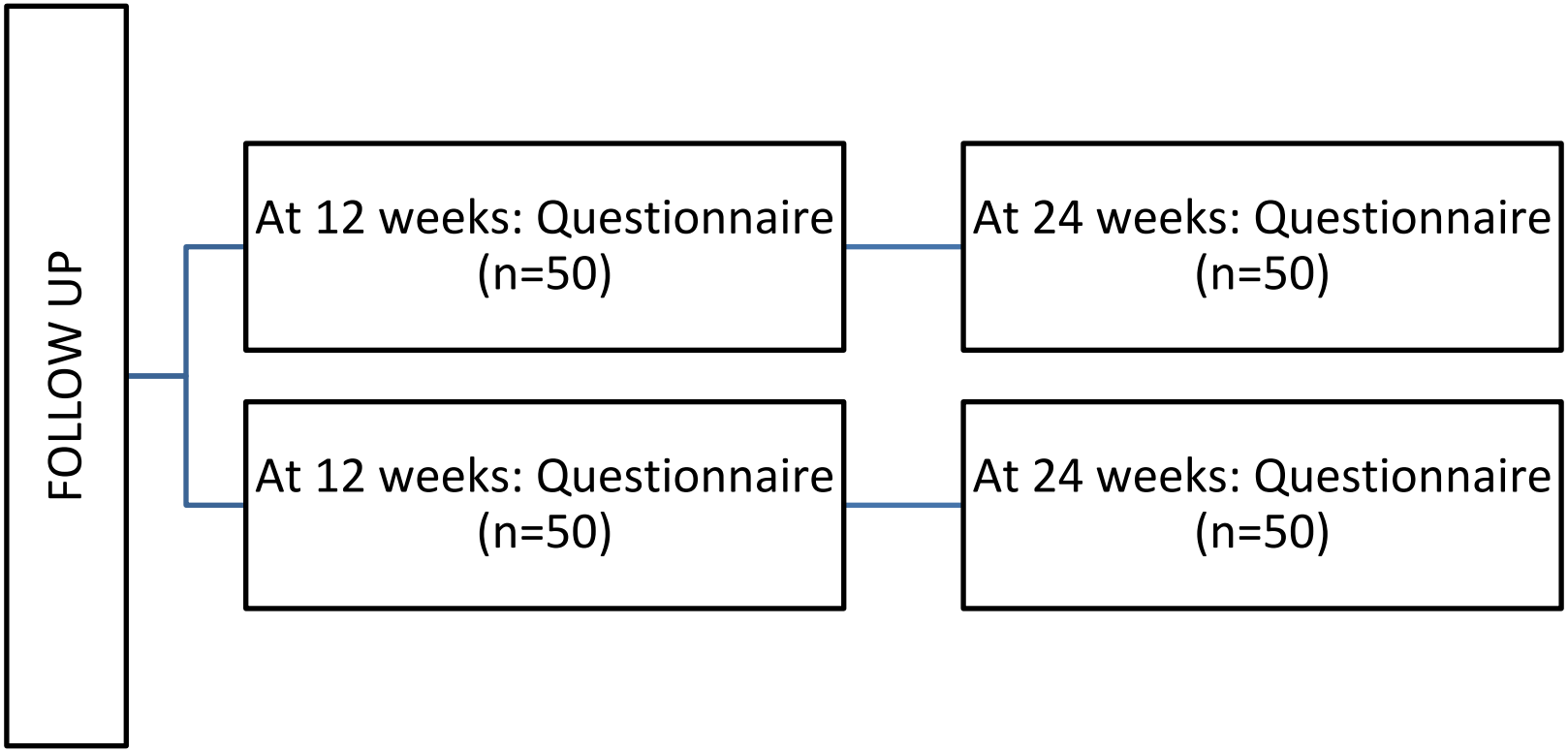
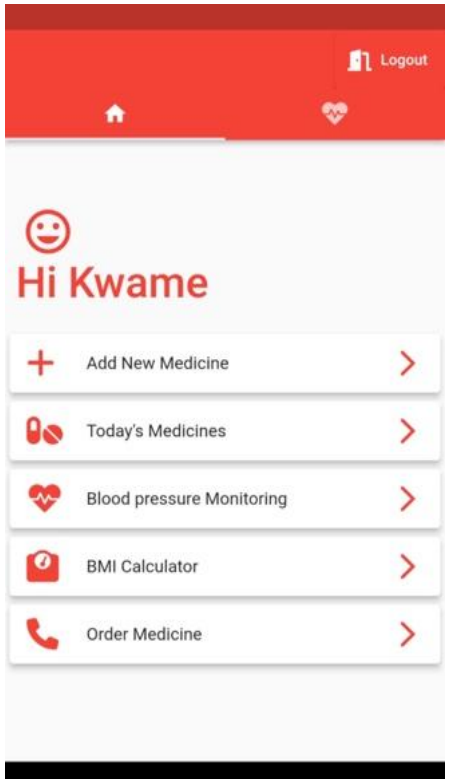
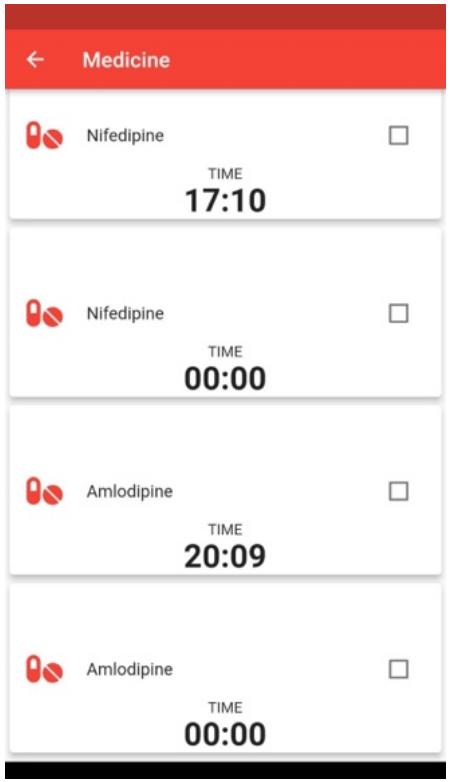
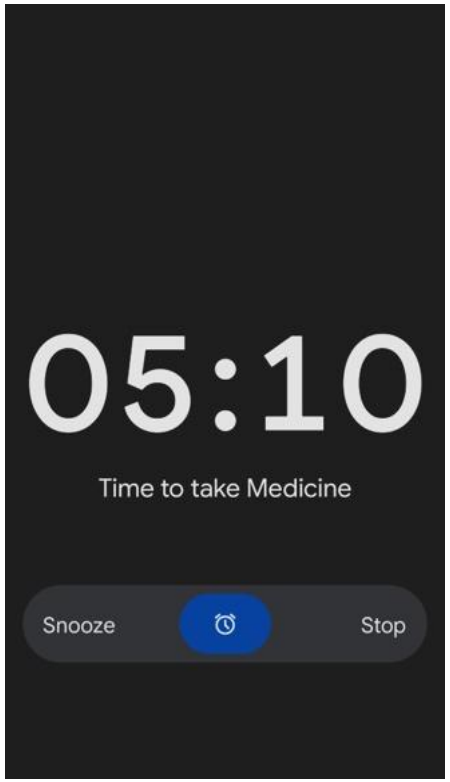
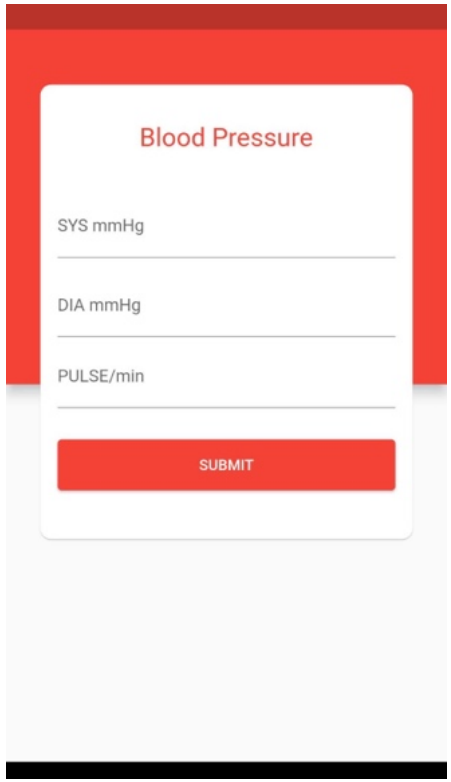


USER INTERFACE OF HEARTCARE









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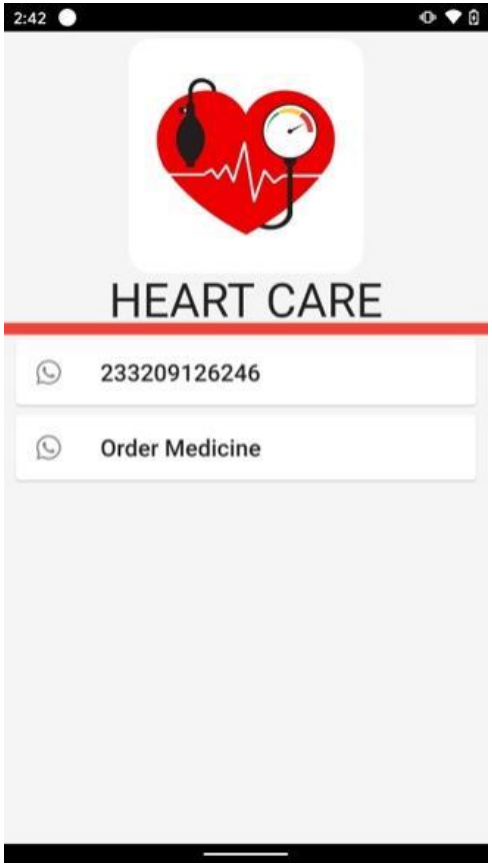

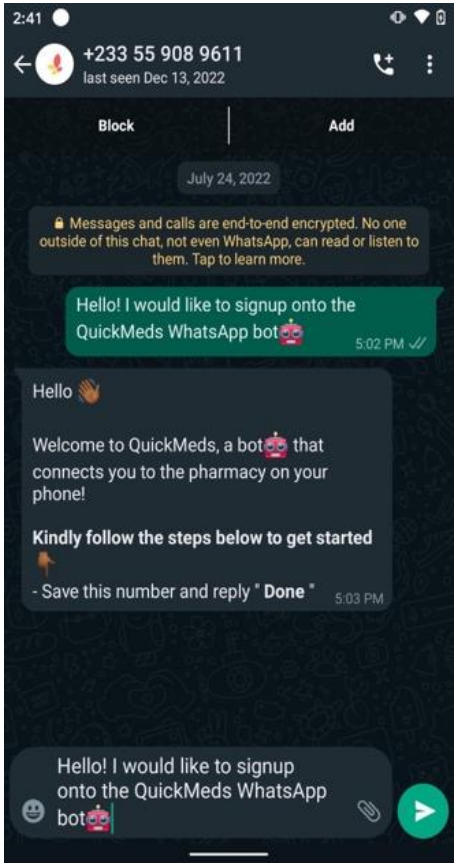

PRE-INTERVENTION

RESULTS AND DISCUSSION – PHASE 1

Table 1: Demographic characteristics of participants

Parameter	UHS (n=143) n (%)	KATH (n=342) n (%)
Age		
30-40 years	4 (2.8)	21 (6.1)
41-50 years	25 (17.5)	47 (13.7)
51-60 years	31 (21.7)	88 (25.7)
61-70 years	56 (39.2)	186 (54.4)
more than 70 years	27 (18.9)	0
Sex		
Male	48 (33.8)	94 (27.5)
Female	94 (66.2)	248 (72.5)
Duration of disease		
1-5	42 (29.4)	54 (15.8)
6-10	66 (46.2)	73 (21.3)
11-15	17 (11.9)	118 (34.5)
16-20	15 (10.4)	39 (11.4)
20 and above	3 (2.1)	58 (17.0)

UHS University Health Services
KATH Komfo Anokye Teaching Hospital

Table 2 : Clinical Characteristics of Participants

Parameter	UHS (n=143) n (%)	KATH (n=342) n (%)
Medication refill duration (months)		
1-3	89 (62.1)	118 (34.5)
4-6	54 (37.8)	207 (60.5)
7-9	0	17 (5.0)
BP categories (mmHg)		
< 120/80	21 (14.7)	55 (16.1)
120-139/80-89	50 (34.9)	106 (31.0)
Above 140/90	72 (50.4)	181 (52.9)
Comorbid conditions		
Stroke	0	17 (5.0)
CKD	7 (4.9)	9 (2.6)
Diabetes	23 (16.1)	9 (2.6)

UHS University Health Services
KATH Komfo Anokye Teaching Hospital

Table 3: Accessibility To Healthcare Facilities

Parameter	UHS (n=143) n (%)	KATH (n=342) n (%)
Time		
10-20 minutes	75 (53.2)	35 (25.5)
21-30 minutes	36 (25.5)	31 (22.6)
41-50 minutes	9 (6.4)	46 (33.6)
51-60 minutes	21 (14.9)	25 (18.2)
More than 60 minutes	0	205 (59.9)
Mode of transport		
Public transport	109 (76.2)	245 (71.6)
Private transport	31 (21.7)	84 (24.6)
Walking	3 (2.1)	13 (3.8)
Affordability of transportation		
No	18 (1.8)	13 (3.8)
Yes	125 (98.2)	329 (96.2)

UHS University Health Services
KATH Komfo Anokye Teaching Hospital

Table 4: Coverage of Healthcare Costs

Parameter	UHS (n=143) n (%)	KATH (n=342) n (%)
NHIS	124 (86.7)	296 (86.5)
Private Insurance	12 (8.4)	1 (0.3)
Cash	5 (3.5)	44 (12.9)

Table 5: Association between access to antihypertensive medications and blood pressure control

Parameter	UHS (n=143) n (%)		KATH (n=342) n (%)	
Percentages of medicines obtained from hospital	Controlled	Uncontrolled	Controlled	Uncontrolled
70-100	46 (70.7)	37 (47.4)	98 (60.9)	102 (56.4)
69 and below	19 (29.3)	41(52.6)	63 (39.1)	79 (43.6)
Total	65 (100)	78 (100)	161 (100)	181 (100)

UHS University Health Services
KATH Komfo Anokye Teaching Hospital

Table 6: Comparing awareness and adherence with blood pressure control

Parameter	UHS (n=143) n (%)		KATH (n=342) n (%)	
Awareness of precautionary measures	Controlled	Uncontrolled	Controlled	Uncontrolled
No	24 (36.9)	46 (59.0)	37 (23.0)	109 (60.2)
Yes	41 (63.1)	32 (41.0)	124 (77.0)	72 (39.8)
Total	65 (100)	78 (100)	161 (100)	181 (100)
Adherence score				
Adherent (6-10)	37 (56.9)	33 (42.3)	94 (58.3)	84 (46.4)
Non-adherent (0-5)	28 (43.1)	45 (57.7)	67 (41.7)	97 (53.6)
Total	65 (100)	78 (100)	161 (100)	181 (100)

UHS University Health Services
KATH Komfo Anokye Teaching Hospital

Table 7: Associations between knowledge, adherence and accessibility and BP control

Parameter	UHS (n=143) p	KATH (n=342) p
Awareness of precautionary measures and BP control	0.023	< 0.001
Adherence and BP control	0.038	0.043
Accessibility to antihypertensive medications and BP control	0.031	0.198

Where $p < 0.05$ is statistically significant

UHS University Health Services
KATH Komfo Anokye Teaching Hospital

Stakeholder's interview: What affects accessibility or availability of medicines in you facility?

Reimbursement of medicines supplied by NHIA is mostly delayed which affects continuous supply of medicines to the facility (irregular/reduced). It was realized that NHIS does not cover all prescribed medicines hence clients are required to make payments. Also, the delay poses a lot of challenge to the facility and the patients:

"*Unavailability of drugs to clients results in the worsening of their disease conditions* (*CP*)."

"*10% of the total claim bill submitted to NHIS is withheld to defray errors in claim form preparation however, NHIS does not refund even when no errors are detected* (*DP*)."

CP Clinical Pharmacist
DP Director of Pharmacy

Stakeholder's interview: How difficult is it to decrease quantities lost to expiries?

Expiration of medicines seemed to be a problem for all stakeholders who gave the problem a 5 rating however, they all had measures put in place to curb the situation.

"*I will rate the difficulty at 5 and this depends on the particular product* (*DDPS*)."

"*We send a list of medicines nearing expiry to prescribers indicating quantities and sometimes, we call other hospitals and swap* (*MS*)."

Stakeholder's interview: What do you need to do your job well?

Stakeholders emphasized the need for refresher courses on supply chain to help them remember what they had previously learnt and be abreast with new trends that are emerging.

"*More training will help from time to time, so we learn new ways to do the job* (*MS*)."

MS Medical Stores
DDPS Deputy Director of Pharmacy Services

KEY FINDINGS (PRE-INTERVENTION)

- BLOOD PRESSURE CONTROL was inadequate among participants in both facilities. Accessibility to medicines was better at the secondary facility compared to tertiary facility.

- ACCESSIBILITY, KNOWLEDGE and ADHERENCE to antihypertensives have a direct impact on blood pressure control.

- GOOD SUPPLY CHAIN PRACTICES and prompt payment by the National Health Insurance Agency would enhance accessibility to antihypertensive medications.

INTERVENTION

RESULTS AND DISCUSSION – PHASE 2

Table 8: Demographic characteristics of participants

Parameter	Total	Control	Intervention
	n=100	n=50	n=50
Age (years)			
31-40	2 (2.0%)	0 (0.0%)	2 (4.0%)
41-50	16 (16.0%)	10 (20.0%)	6 (12.0%)
51-60	57 (57.0%)	28 (56.0%)	29 (58.0%)
> 60	25 (25.0%)	12 (24.0%)	13 (26.0%)
Sex			
Male	41 (41.0%)	18 (36.0%)	23 (46.0%)
Female	59 (59.0%)	32 (64.0%)	27 (54.0%)
Education			
Uneducated	0 (0.0%)	0 (0.0%)	0 (0.0%)
Junior High	14 (14.0%)	9 (18.0%)	5 (10.0%)
Senior High	58 (58.0%)	25 (50.0%)	33 (66.0%)
Undergraduate	19 (19.0%)	11 (22.0%)	8 (16.0%)
Postgraduate	4 (4.0%)	0 (0.0%)	4 (8.0%)

Table 8: Demographic characteristics of participants

Parameter	Total	Control	Intervention
	n=100	n=50	n=50
How often participants go for review			
Monthly	11 (11.0%)	7 (14.0%)	4 (8.0%)
Two months	51 (51.0%)	23 (46.0%)	28 (56.0%)
Three months	34 (34.0%)	17 (34.0%)	17 (34.0%)
Six months	4 (4.0%)	3 (6.0%)	1 (2.0%)
Duration of condition (years)			
0-3	33 (33.0%)	19 (38.0%)	14 (28.0%)
4-7	59 (59.0%)	23 (46.0%)	36 (72.0%)
8-11	3 (3.0%)	3 (6.0%)	0 (0.0%)
≥ 12	5 (5.0%)	5 (10.0%)	0 (0.0%)

Table 8: Demographic characteristics of participants

Parameter	Total	Control	Intervention
	n=100	n=50	n=50
Blood pressure reading (mmHg)			
< 120/80	2 (2.0%)	2 (4.0%)	0 (0.0%)
120-139/80-89	37 (37.0%)	16 (32.0%)	21 (42.0%)
≥140/90	61 (61.0%)	32 (64.0%)	29 (58.0%)
Blood pressure control			
Controlled	39 (39.0%)	18 (36.0%)	21 (42.0%)
Uncontrolled	61 (61.0%)	32 (64.0%)	29 (58.0%)
History of comorbid disease			
Yes	42 (42.0%)	25 (50.0%)	17 (34.0%)
No	58 (58.0%)	25 (50.0%)	33 (66.0%)
Type of comorbid condition			
Diabetes	40 (40.0%)	24 (48.0%)	16 (32.0%)
Stroke	1 (1.0%)	0 (0.0%)	1 (2.0%)
CKD	1 (1.0%)	1 (2.0%)	0 (0.0%)

Table 9: Effect of HeartCare on patients' knowledge about hypertension

Groups	Pre-intervention (mean ± SD)	3 months post-intervention (mean ± SD)	6 months post-intervention (mean ± SD)	Mean change over time (95% CI)
Control group	8.320±2.114	9.280±1.949	10.280±1.796	1.46 (0.668-2.253)
		p=0.063	p=0.052	
Intervention group	9.360±3.062	15.00±0.00	15.00±0.00	5.64 (4.781-6.499)
		p<0.0001	p<0.0001	

Table 10: Effect of HeartCare on adherence to antihypertensives

Groups	Pre-intervention (mean ± SD)	3 months post-intervention (mean ± SD)	6 months post-intervention (mean ± SD)	Mean change over time (95% CI)
Control group	5.060±1.878	5.840±1.742	5.840±1.742	0.78 (0.061-1.499)
		p=0.642	p=0.320	
Intervention group	6.280±1.970	8.600±0.495	9.640±0.495	2.32 (0.750-1.890)
		p=0.020	p=0.014	

Table 11: Effect of HeartCare on Blood Pressure Control

Groups	Pre-intervention (mean ± SD)	3 months post-intervention (mean ± SD)	6 months post-intervention (mean ± SD)	Mean change over time (95% CI)
Control				
Systolic (mmHg)	141.22±13.88	139.72±13.66	137.64±15.37	2.54 (3.098-8.178)
Diastolic (mmHg)	86.52±8.21	82.64±10.22	80.78±10.99	4.81 (1.046-8.57)
		p=0.528	p=0.419	
Intervention				
Systolic (mmHg)	138.10±10.97	130.96±7.93	128.62±9.01	8.31 (4.419-12.200)
Diastolic (mmHg)	87.38±8.88	79.86±7.26	76.70±8.04	18.2 (5.810-12.390)
		p=0.023	p=0.004	

Effect of Shipshape on Stakeholders

Factors influencing quantities ordered

All respondents-based ordering points on consumption rates and prescription patterns prior to the introduction of the intervention. Key changes the Shipshape app introduced was the incorporation of **forecasting** in ordering as reported by the fifth respondent who is in charge.

Interviewee 5 before: "*The kind of cases we see, so if we see a particular case is coming often and we don't have those medications, we know that this particular period, these cases will come so we have to make provisions for*".

Interviewee 5 after: "*For our locality we know the trends. We use that to predict the kind of medicines and the quantities we should order. I learnt forecasting from your game. Yes, so we are also looking at that too*".

Effect of Shipshape on Stakeholders

Determinants of when to place an order.

Respondents use data from the reorder stock level and place orders as they approach the minimum stock level. Key intervention of shipshape was factoring in **delivery time/lead time in** the ordering process as reported by the third respondent.

Interviewee 3 before "*When there is about to be a shortage because we record and so we know when a particular drug is going to get finished as we dispense so through the recording, we know the one that is finishing*".

Interviewee 3 after: "*We do stock taking so from that, we have an idea of the quantities and use that to order. Now we factor in the delays also since sometimes it takes a while to get the medicines from the RMS*".

Effect of Shipshape on Stakeholders

Methods put in place to prevent expiry.

Interventions employed here as stated by the respondents include **stock rotation inter and intrahospital** and **LIFO/FIFO/FEFO** approach as taught by the Shipshape app.

Interviewee 4; "*What we do is, I provide the doctors and pharmacists information on drugs that will be expiring. I can give updates for one month, two, three, nine and even the whole year. And at this point, it's from their part to make discussions to encourage it to move. If we realize it cannot be consumed, we call the suppliers and ask them if they can replace it with a better date*".

Interviewee 4: "*We use the LIFO/ FEFO/FIFO to arrange the medicines on the shelves, so we serve the ones closer to expiry first*".

KEY FINDINGS

- Shipshape was beneficial as it played a key role in reminding the stakeholders of some of the practices they formerly knew and brought to light new areas to help them in their practice.

- Central to this was the term “forecasting” which run across all the post interventional surveys as a key lesson learnt from the application.

- Significant improvements in adherence and knowledge as shown in this study were attributed to the design where users received daily notifications on summarized knowledge on hypertension and its management (6).

- This study also discovered that patients who received a significant number of their medicines at the comfort of their homes had reductions in blood pressure levels which is in line with previous studies (7).

KEY FINDINGS

- Also, an improvement in self-monitoring was observed. Approximately 80% of HeartCare users measured and recorded the BP more than 20 times over a period of 8 weeks.

- This gave users an overview of their BP control to serve as a positive drive to keep their BP within optimum range.

- The control group as well had marginal improvements in knowledge, adherence and BP control.

- This could partly be as a result of the effectiveness in the usual care received from the hospital, or improvement in adherence and knowledge probably stemming from the follow-ups done on the participants.

- This proves that offering more care through technological interventions and even follow-ups can contribute to improvement in blood pressure control with subsequent optimization in the long run.

CONCLUSION

- Constant supply chain training and retraining of stakeholders may improve accessibility of essential medicines. From this study, Shipshape improved knowledge of stakeholders specifically in forecasting and planning.

- The use of smartphone applications as part of the management algorithm may be essential in improving self-management with the high penetration of technology in our daily activities.

- Combination of technological advancements with routine medicine use may result in a synergistic effect on BP control. From this study, HeartCare effectively improved the knowledge of hypertension and its pharmacological and nonpharmacological management as well as adherence to antihypertensive medications.

RECOMMENDATIONS

Recommendations for practice

- mHealth must be encouraged as it can improve visibility in hypertension management by encouraging self-management and self-monitoring, as well as patient education.

- Telephone calls can be used for follow-ups to check up on patients, encourage and educate them, especially for those without access to smartphones.

- Stakeholders in charge of medicine procurement and supply should receive constant training and retraining to be up-to-date with current trends in supply chain practices to boost medicine availability.

RECOMMENDATIONS

Recommendations for policy

- The Ministry of Health should decentralize specialist clinics to district hospitals and polyclinics and increase the number of healthcare centres and providers to reduce the burden on current hospitals and providers.

- There must be sustainable funding allocation to the National Health Insurance Authority (NHIA) to ensure prompt disbursement of funds to hospitals for replenishing depleted medicines distributed to patients under the scheme.

- Hospital staff in charge of medicine procurement should undergo sponsored training and retraining in supply chain management to keep up with current trends in logistics control.

RECOMMENDATIONS

Recommendations for further research

- Researchers can explore the long-term effects of mHealth on knowledge and adherence to hypertension management beyond the 6-month study period.

- The use of smartwatches for ambulatory blood pressure measurement and synchronization with a smartphone application can establish trends in blood pressure control.

- A web-based approach can provide healthcare providers with direct access to patient data remotely.

- In communities where technology and internet access is an issue, community-based hypertensive centres can be established, and key persons trained on hypertension detection and monitoring.

PUBLICATIONS

Published

Nana Ofori Adomako, Afia Frimpomaa Asare Marfo, Mercy Naa Aduele Opare-Addo, Nathaniel Nyamekye, Frances Thelma Owusu-Daaku, "Blood Pressure Control, Accessibility, and Adherence to Antihypertensive Medications: Patients Seeking Care in Two Hospitals in the Ashanti Region of Ghana", *International Journal of Hypertension*, vol. 1 2021, Article ID 9637760, 9 pages, 2021.

Under Review

Nana Ofori Adomako, Afia Frimpomaa Asare Marfo, Ivan Eduku Mozu, John Serbe Marfo, Pauline Boachie-Ansah, Paul Atawuchugi, Kwame Ohene Buabeng

“Knowledge, Accessibility and Adherence to Antihypertensive Medications: A Smartphone-Based Interventional Study Amongst hypertensive Patients in Ghana”. Scientific African Journal Manuscript Number SCIAF-D-23-00466.

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Accepted for presentation

1. Nana Ofori Adomako, Afia Frimpomaa Asare Marfo, Ivan Mozu, John Serbe Marfo, Paul Atawuchugi, Kwame Ohene Buabeng. 81st FIP World Congress of Pharmacy and Pharmaceutical Sciences. Brisbane Australia 24th-28th September 2023.

COLLABORATIONS

The project was in line with the vision of Arizona State University in collaboration with the USAID to improve the knowledge base of Supply Chain Management using an intervention (Shipshape App) to ensure continuity of medicine supply and enhance health of patients in the environs of the study centres and beyond.

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