Supporting maternal outcomes in South Africa: A summary of the SAFEMOM study

An evaluation of the safety and feasibility of Ada's integration into MomConnect, the mobile information service for pregnant women and new mothers in South Africa

Monitoring and Evaluation Report

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Ada Health, September 2023

ada

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A collaboration between **Ada Health**, a health technology company, **Reach Digital Health** (formerly Praekelt), a non-profit organization, and South Africa's **National Department of Health** with support from **Citizen Surveys.**

REACH

momconnect

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

ada

Abbreviations

AI: Artificial Intelligence
ANC: Antenatal Care
App: Mobile Application
CE: Conformité Européenne
EHR: Electronic Health Record
HCPs: Healthcare Professionals
HIV: Human Immunodeficiency Virus
HDP: Hypertensive Disorders of Pregnancy
IWI: International Wealth Index
MC: MomConnect
NDOH: National Department of Health
PMCF: Post-market Clinical Follow-up
QI: Qualitative Improvement
SC: Symptom Checker
SDGs: Sustainable Development Goals
WHO: World Health Organization

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High blood pressure that almost lead to the decision of c section at 7 months (premature) luckily I seek help before it late, thanks to MomConnect and symptoms checker [sic]

MOMCONNECT USER

Executive Summary

Problem Statement

Maternal and child mortality rates remain persistently high in Sub-Saharan Africa, most of which would be preventable. Inadequate antenatal care (ANC)/prenatal care attendance and delay in seeking care are one of the main reasons for high mortality rates.

By integrating the symptom checker Ada into MomConnect, a trusted government platform, millions of pregnant women and young mothers in South Africa can receive personalised health information and guidance if, when and where they need to seek healthcare for themselves and their children. This can empower mothers to make better decisions, seek care where needed, and therefore potentially reduce mortality rates.

M&E methodology

The methodology was developed to assess the safety and effectiveness of such an integration. A comprehensive mixed-method observational trial was used to survey a group of 1000 mothers, with the aim to comprehend the impact of using the symptom checker on their healthcare seeking behaviour. Simultaneously, an independent panel of physicians evaluated the safety and suitability of the symptom checker's advice for a subset of cases. Furthermore, evaluations of the integration's usability and potential cost savings were conducted, and insights on user demographics were gathered.

Over a period of 5 weeks, 1000 participants were included in the trial. 100 of these were included in the phone interviews, and 184 cases were evaluated by the physician panel consisting of 3 local independent physicians.

Summary of results

Reduction in unsafe behavior: The use of the symptom checker led to a 41.5% decrease in unsafe behavior among mothers who checked their symptoms or their infants and young children's symptoms.

Advice was deemed safe and appropriate: 98% of symptom checker's urgency advices were deemed safe and 94% was considered appropriate by the external independent physician panel.

Appropriate navigation for serious or threatening conditions: Out of the mothers with conditions confirmed as serious or potentially life-threatening by their medical provider, 51% were not intending to seek care before they used the symptom checker. Early diagnosis and treatment reduces the risk of complications and improves patient outcomes, ultimately also reducing costs for the healthcare system long-term.

Cost and Time Savings: Redirecting pregnant women to appropriate care options resulted in short-term cost and time savings. Approximately $65 USD per redirected participant was saved for the South African healthcare system.

High usability: 98% of participants considered the medical information provided as useful, and 96% considered it (very) easy to check their symptoms

The Challenge

Despite substantial global strides in reducing maternal and infant mortality rates, a disheartening number of preventable maternal, newborn, and infant fatalities persist each day. Approximately 800 women worldwide die due to pregnancy- or childbirth-related complications daily [1]. Sub-Saharan Africa and Southern Asia jointly account for nearly 87% of reported maternal deaths worldwide, with the majority of these occurring in resource-limited settings due to avoidable causes [1]. Moreover, children in low-income countries are more than 13 times more likely to die before age five than those living in high-income countries [2].

Through extensive efforts, South Africa's maternal mortality rate declined from its peak of 189 deaths per 100,000 live births in 2009 to 99 deaths per 100,000 live births in 2019 [3,4]. Following a spike during the Covid-19 pandemic, the current maternal mortality rate is at 110 per 100,000 live births [4]. This overall decrease was largely due to the success of antiviral treatment for Human Immunodeficiency Virus and the prevention of non-pregnancy-related infections [3].

Similarly, mortality among under 5 year old children was reduced from 79 per 1,000 live births in 2005 to 33 per 1,000 live births in 2021 [5]. However, despite this progress in reducing maternal and child mortality in South Africa over the last decade, the current rates remain unacceptably high [6,7].

As part of the Agenda for Sustainable Development, the World Health Organisation (WHO) aims to end preventable deaths of newborns and children under 5 years of age and reduce maternal mortality to less than 70 per 100,000 live births [8]. Inadequate antenatal care (ANC) attendance (less than 4 ANC visits), delay in seeking care, and poor initial assessment, in addition to lack of healthcare facilities and the presence of skilled healthcare attendants at birth, are some of the major causes for preventable maternal and child deaths [6,9].

In South Africa, many women and their families lack awareness of recommended health practices and also face financial and logistical barriers when seeking care, such as difficulties in arranging transport to visit healthcare facilities or in taking time off work. Inequitable distribution of healthcare professionals (HCPs) between the private and public sectors and between provinces results in unequal access to healthcare as well as uneven healthcare quality [7,10].

Thaddeus et al. developed the 3-delays model, a conceptual framework on key barriers to providing adequate care in case of obstetric complications [11]. According to this model, one of the three phases is delay at the stage of deciding to seek medical care.

To support decision-making, with the aim of reducing maternal mortality, a source of reliable medical information that is easy to access, use, and understand is needed to advise pregnant women and young mothers on what potentially is causing their symptoms and where and when to best seek medical care.

800

women worldwide die every day due to pregnancy- or childbirth-related complications

14

times greater risk of dying under the age of 5 for children in Sub-Saharan Africa compared to those in Europe or North America

87%

of **maternal deaths** worldwide occur in Sub-Saharan Africa and Southern Asia

About Ada Health

ADA IN NUMBERS

10,000 +
SYMPTOMS AND ATTRIBUTES

3,600
CONDITION MODELS COVERED

32
MILLION SYMPTOM ASSESSMENTS

11
LANGUAGES

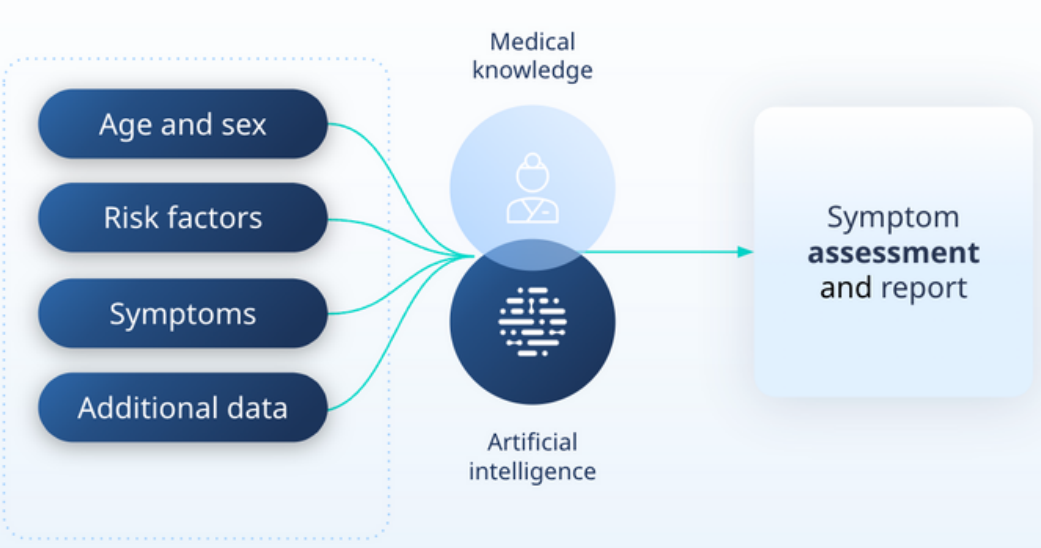
11 YEARS'
RESEARCH AND DEVELOPMENT

Ada, an AI-powered personal health companion, was established in 2011 with the collective expertise of medical professionals, engineers, and data scientists, aiming to provide trusted medical guidance to improve the health of a billion people globally. Collaborating with leading health systems, governments, and life sciences partners, Ada is available to over 60 million patients worldwide, with over 32 million assessments already completed.

The Global Health Initiative, initiated in 2018, reflects Ada's awareness of the demand for its technology in low-resource settings, striving to increase access to personalized health information and elevate healthcare delivery. With availability in multiple languages, Ada is a global symptom checker accessible through smartphones, tablets, desktops, electronic health records, and other healthcare systems.

By inputting basic patient information and guiding users through a series of symptom-related questions, Ada shares a likelihood estimation of potential conditions and recommends appropriate levels of care. The reasoning engine uses a medical knowledge base created by medical doctors in a curated process of knowledge integration from medical literature to infer disease probability estimations.

The medical knowledge base consists of disease models of all common and rare conditions, their corresponding symptoms, and clinical findings and is continuously expanded following a standardized process. Ada's medical intelligence is continually validated against a set of several thousand internal test cases and is further verified using a verification tool with hundreds of cases written by external doctors.



About Reach and MomConnect

Reach, previously known as Praekelt.org, builds on 16 years of experience scaling digital health programs for faster and more cost-effective implementations in various health domains. Reach designs, develops, and implements mobile solutions, WhatsApp or SMS, that empower vulnerable communities, provide easy access to health-related information and resources, allow for rapid health and well-being assessment, and provide personalized support for citizens.

As an award-winning organization, Reach empowers healthcare providers with powerful tools to improve patient care. Their software enables real-time feedback to health workers and health trend monitoring, allowing healthcare providers to offer faster and more efficient care.

Reach is also one of the key design, technology, and implementation partners for MomConnect, the National Department of Health's flagship RMNCH program in South Africa.

MomConnect
In 2014, the South African National Department of Health (NDOH) advocated for the use of mobile technology in educating women about self-care and maternal health. In parallel, the NDOH wanted to gather real-time data that would allow for the improvement of service delivery. As a result, MomConnect was later established as the NDOH's flagship maternal and child health program in South Africa, for which Reach is one of the key design, technology, and implementation partners.

MomConnect uses mobile technology to improve the health of pregnant women, newborns, and infants on a national scale. Through MomConnect, every pregnant woman in South Africa can register to receive free, informative, stage-based messaging during pregnancy for the first two years of her baby's life via either WhatsApp or SMS. The platform also provides access to a text-based helpdesk and the ability for women to rate the service they receive at the clinic. Ratings and questions are sent directly to NDOH officials, who respond to queries and ensure adequate service delivery and quality of care at every clinic.

Since its launch in 2014, over 4.7 million mothers in 95% of public health facilities have registered with MomConnect. Today, the platform services approximately 450,000 active users in any given month. The Helpdesk, operated by clinical nurses, receives, on average, 1,000 messages daily. These include messages from mothers seeking healthcare guidance on symptoms that they or their children are experiencing. Mothers are increasingly referring to MomConnect as a platform that supports them with clinical queries, and we now have the opportunity to provide clinical responses to address their needs.

REACH & MOMCONNECT IN NUMBERS

16
YEARS EXPERIENCE

>4,700,000
REGISTERED MOMCONNECT USERS

450,000
ACTIVE USERS EACH MONTH

1,000
MESSAGES EACH DAY TO THE MOMCONNECT HELPDESK

95%
OF ALL PUBLIC HEALTHCARE FACILITIES IN SA HAVE REGISTERED

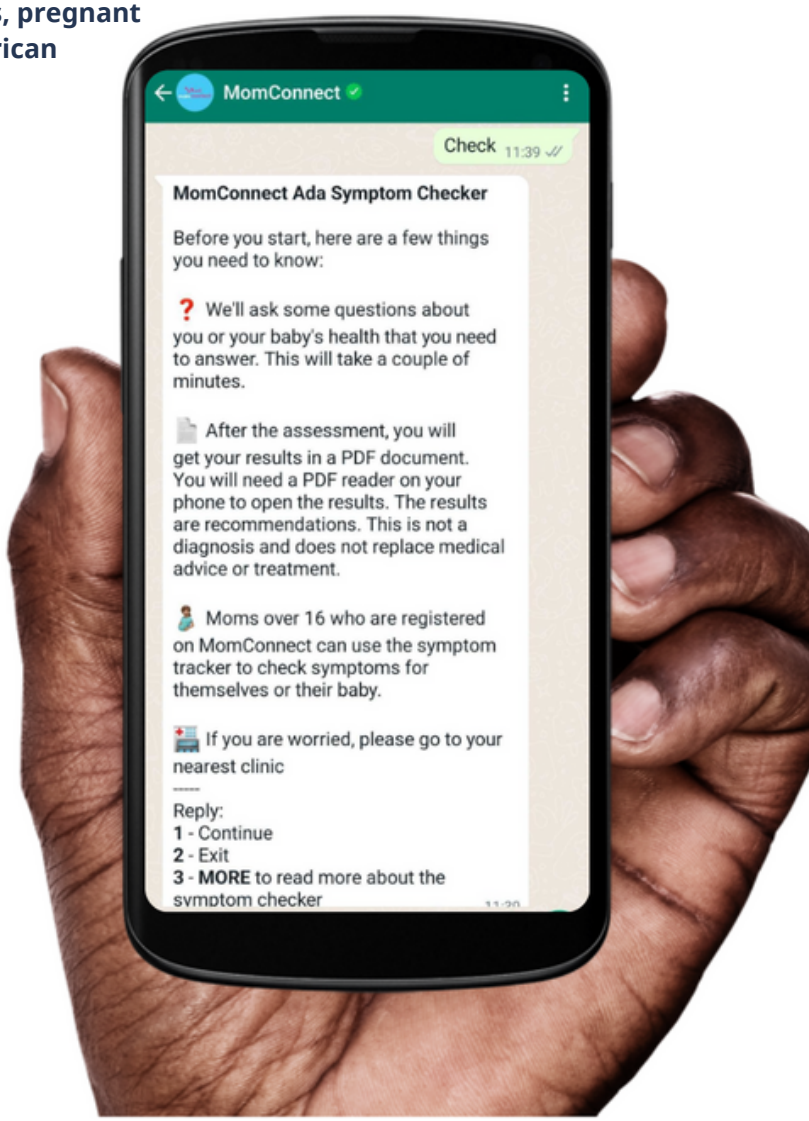
How Ada and MomConnect aim to support pregnant women and mothers in South Africa

Improve access to relevant health information and guidance 24/7

Identify mild cases and offer guidance on at-home care, preventing the healthcare system from becoming overwhelmed

Appropriately guide severe cases to the relevant services and reducing the increased costs associated with delaying treatments

Improve health outcomes for mothers, pregnant women and their children in South African



Study description

SAFEMOM is a Quality Improvement (QI) study being conducted in a post-market clinical follow-up (PMCF) setting, shortly after the solution was made available on the market. The purpose of this clinical investigation is to evaluate the quality, value, benefit, safety, and performance of Ada integrated into MomConnect for participants. The product's value is ultimately linked to the medical appropriateness and safety of medical information included in the assessment report, which is being measured in this clinical investigation.

The subjective opinions of participants utilizing the platform were collected with a focus on their health-seeking behavior before and after using the platform and their opinions on usability and utility. For those participants who consult a healthcare professional (HCP), information about their visit is being requested one week later. Additionally, data from the app's individually created assessment report is being collected, including recommended advice on if, when, and where to seek medical care, condition suggestions, and health information based on entered symptoms.

This investigation is collecting and assessing information on the impact of the newly implemented platform on the users' health-seeking behavior, the safety and accuracy of advice given, and the usability and utility of both the product and the health information provided.

Information about the background of the patient collective is also of interest, as the intended benefit of this product is to increase healthcare access for people within all socioeconomic groups of society. Besides that, we are planning to assess the economic impact on individuals and the healthcare system by measuring healthcare consultations initiated by Ada assessments, as well as costs saved from avoided healthcare consultations that may not have been necessary.

Study objectives

1

Determine the appropriateness, safety, and urgency level of advice provided by the symptom assessment

2

Identify changes to users' health-seeking behavior and subsequent effects on health outcomes as a result of utilizing the symptom assessment

3

Assess the economic consequences for both individuals and the larger healthcare system resulting from conducting a symptom assessment

Study timeline and Inclusion Flowchart

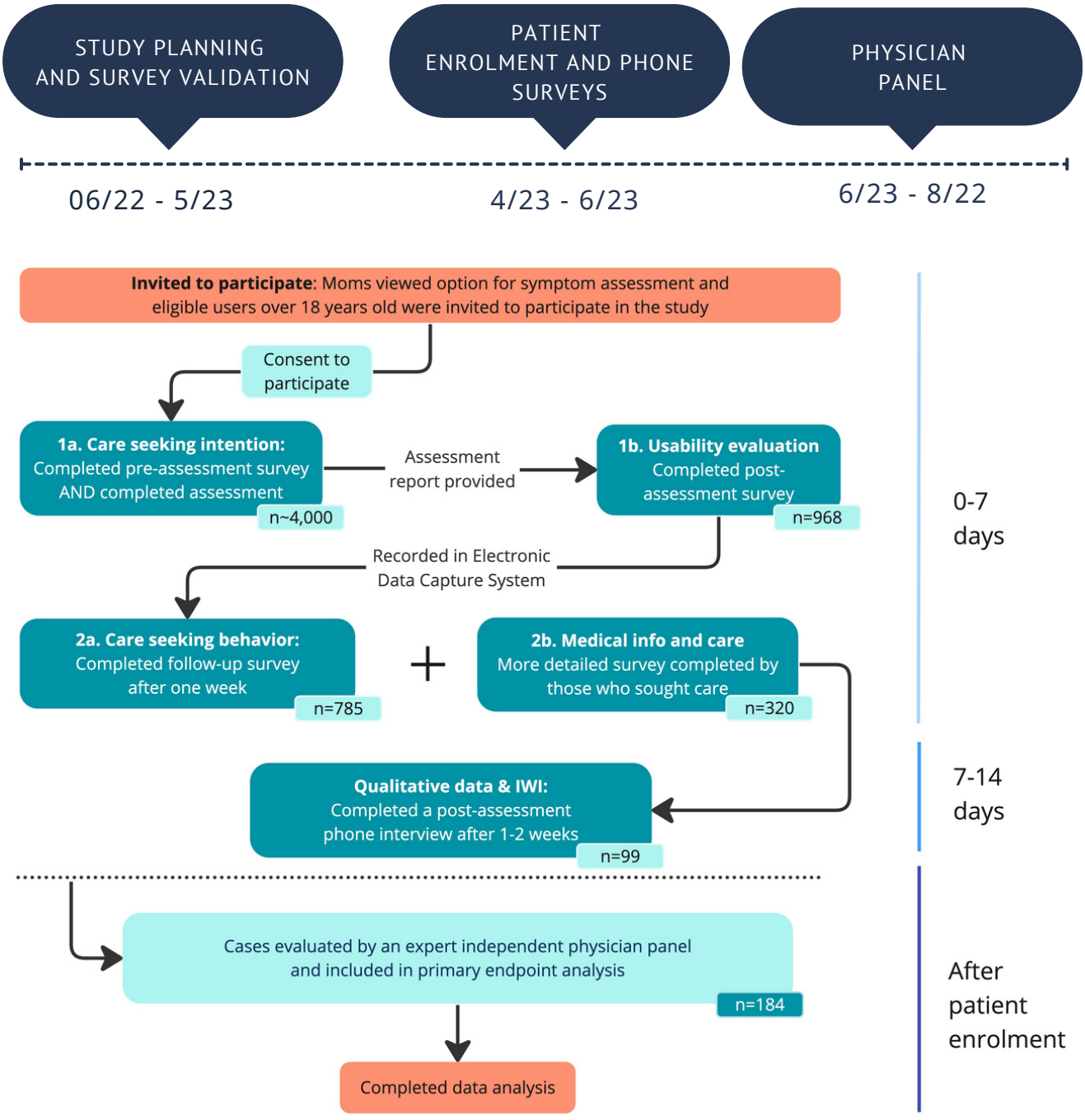


Figure 1. Study inclusion flowchart.

Pre-assessment survey
Questions about their perceived urgency to seek medical care, time and cost to access healthcare, income, and employment situation.

Assessment report
Indicated whether, when, and where to seek medical care, along with 3-5 potential conditions and their probabilities, and a list of confirmed and denied symptoms

Post-assessment survey
Perceived urgency to seek medical care after checking their symptoms, usefulness of the medical information provided and ease of using the SC.

Phone surveys
Qualitative data gathering on moms decision making process and their experience with the SC as well as quantitative data to evaluate their socio-economic background.

Patient Population: demographics

Age:
Pregnant women or mothers who conducted a symptom assessment were between the age of 18 and 47 with an average age of 27 (SD: 5.5 years).

In 55 cases, they conducted the assessment for their child. 65% of the times their mother used the symptom checker for children under 1 years.

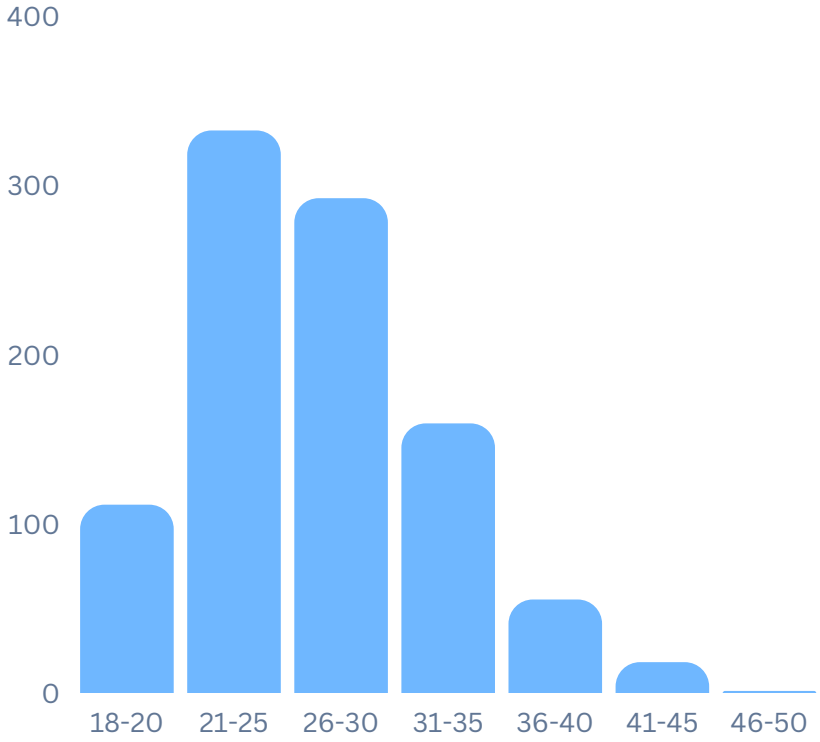
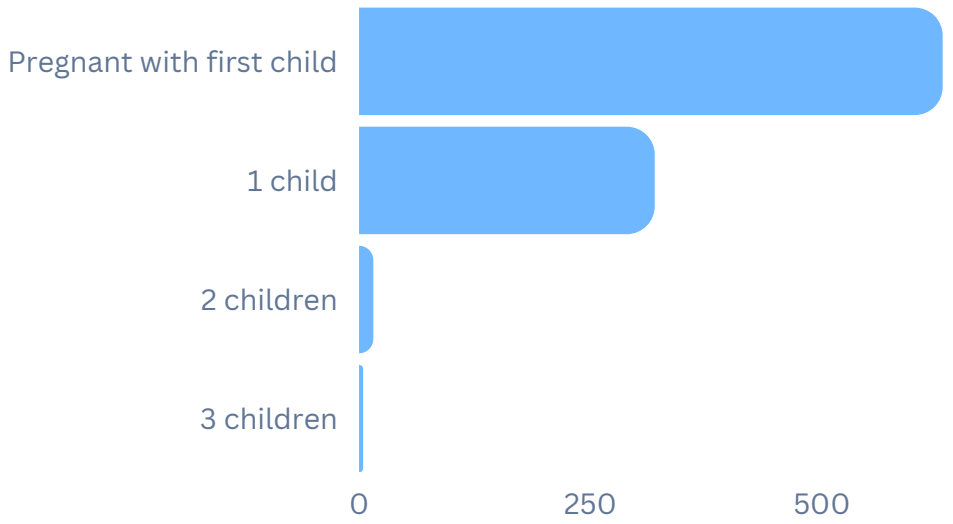


Figure 2. Age distribution of mothers performing symptom assessments for themselves or on behalf of their children.



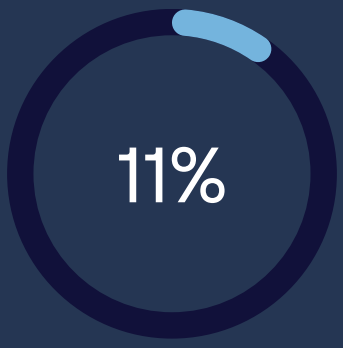
Pregnancy:

The majority of women were pregnant with their first child (65%).

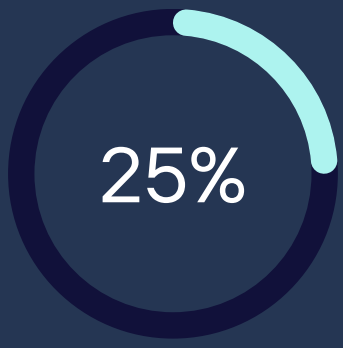
During their first pregnancy, women encounter numerous unfamiliar experiences and often found themselves with a variety of questions.

Figure 3. Number of pregnancies among participating users.

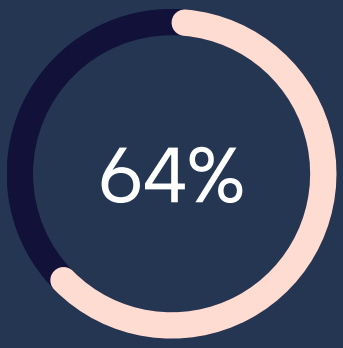
Patient Population: background



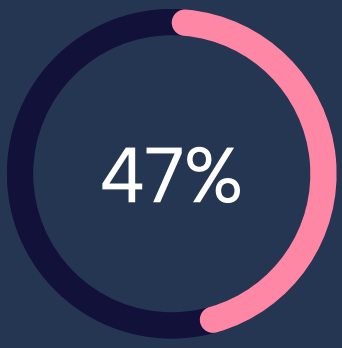
Still in school



Working



No work



Household income less than 1600 R (87 USD)

662 of moms conducted an assessment while being pregnant - 630 of these in their first pregnancy. On average, moms were in their 28 pregnancy week when checking their symptoms (standard deviation).

306 of moms already gave birth when conducting an assessment.

1st trimester: 34

2nd trimester: 291

3rd trimester: 335

Puerperium (first 6 weeks after giving birth): 48

First year since giving birth: 213

More than one year since giving birth: 45

968 total participants

913 adults

55 children

913 women used the symptom checker for themselves, and in 55 instances, they were using the symptom checker on behalf of their child. The low number of assessments being done on behalf of their children is due to the fact that most participants were still in their first pregnancy.

Patient Population: medical specialties for suggested conditions

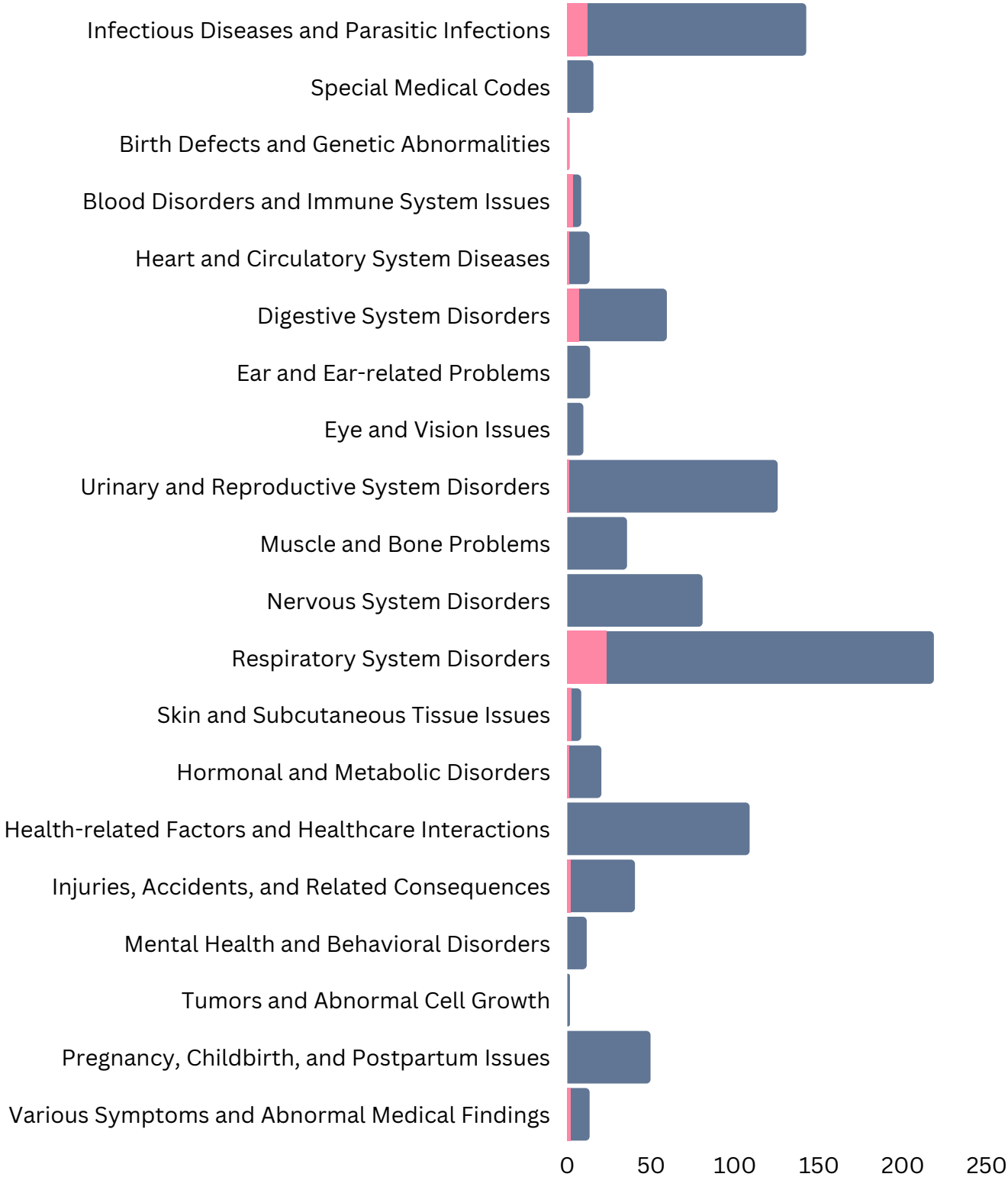


Figure 4. Categorisation of suggested conditions into medical specialties for all participants. Pink shading denotes conditions applicable to children, while blue represents those for adults. The categorisation aligns with the globally recognised ICD10 classification, with minor adjustments to enhance comprehension.

Patient Population: maternal mortality rate distribution

One of the Sustainable Development Goals (SDGs) set by the United Nations is to achieve a maternal mortality rate of under 70 per 100,000 live births by the year 2030. As of 2020, only two provinces in South Africa, namely Western Cape and Mpumalanga, had met this target.

A primary objective of this integration effort is to reduce mortality rates by providing guidance to healthcare for pregnant women and young mothers when necessary.

The map below illustrates a significant disparity in maternal mortality rates (MMR) among South African provinces. To ensure that the integration effectively assists pregnant women and young mothers in areas where assistance is most critical, it's imperative that the solution was accessible and beneficial to them.

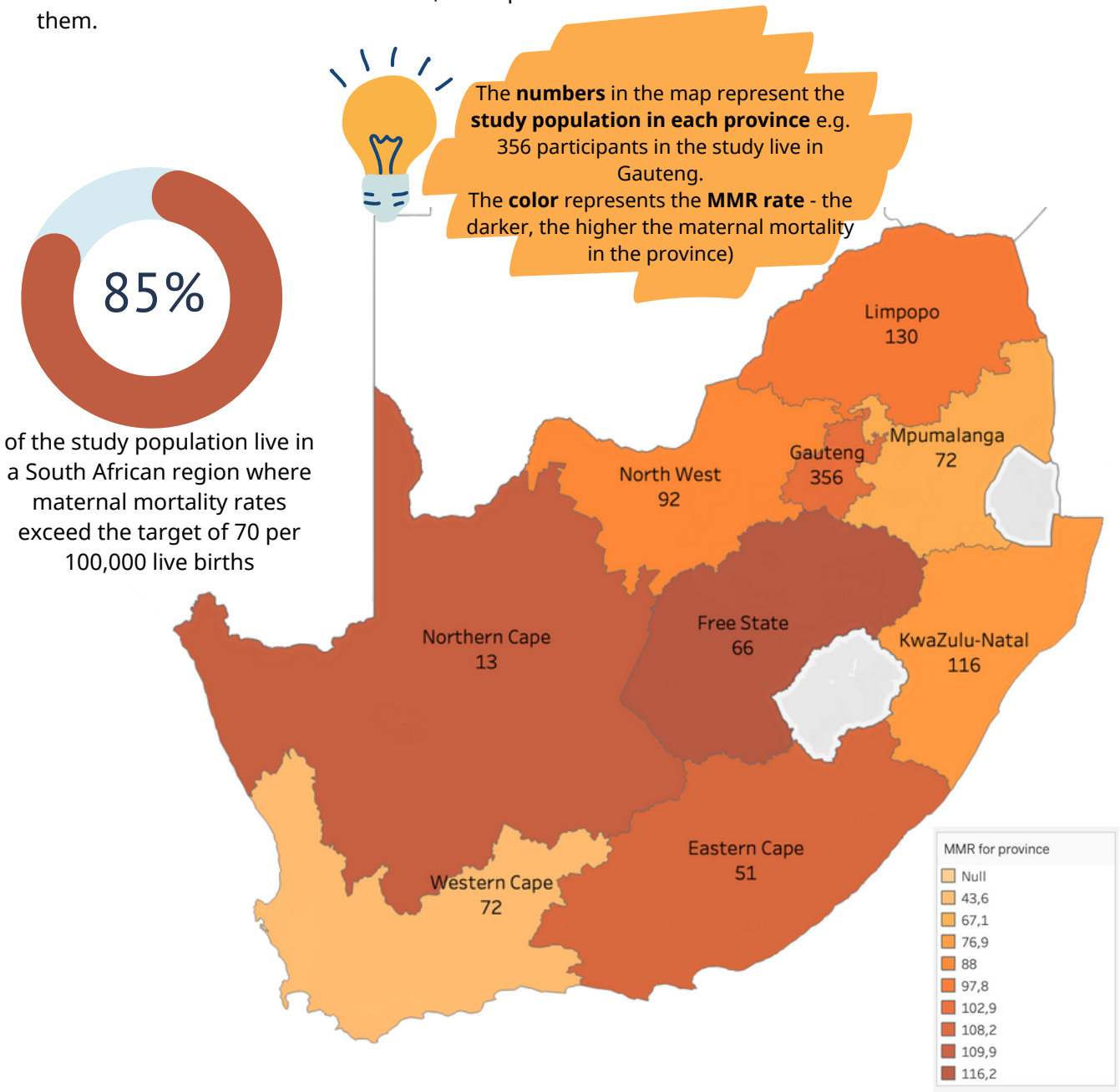
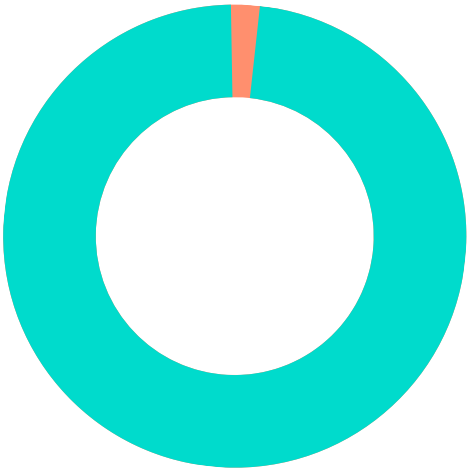


Figure 5. Distribution of maternal mortality rates across South Africa regions accompanied by the corresponding study participant counts. Maternal mortality rates were based on 2020 data provided by the South African National Department of Health.



98%

of participants considered the medical information provided as useful

96%

considered it (very) easy to check their symptoms

Change of healthseeking behaviour

90%

reduction in women not knowing what to do

Initially **18.4%** of moms did not know what to do. Right after checking their symptoms, that decreased to 6.1% and after one week to **1.8%**.

140%

increase in women seeking care

The numbers of moms deciding to seek care through primary care, urgent primary care or emergency care **increased from 18.1% to 43.5%** when comparing intent with behavior.

14%

reduction in women choosing self-care

The number of moms who took care of their care at home decreased from **63.4.% to 54.7%.**

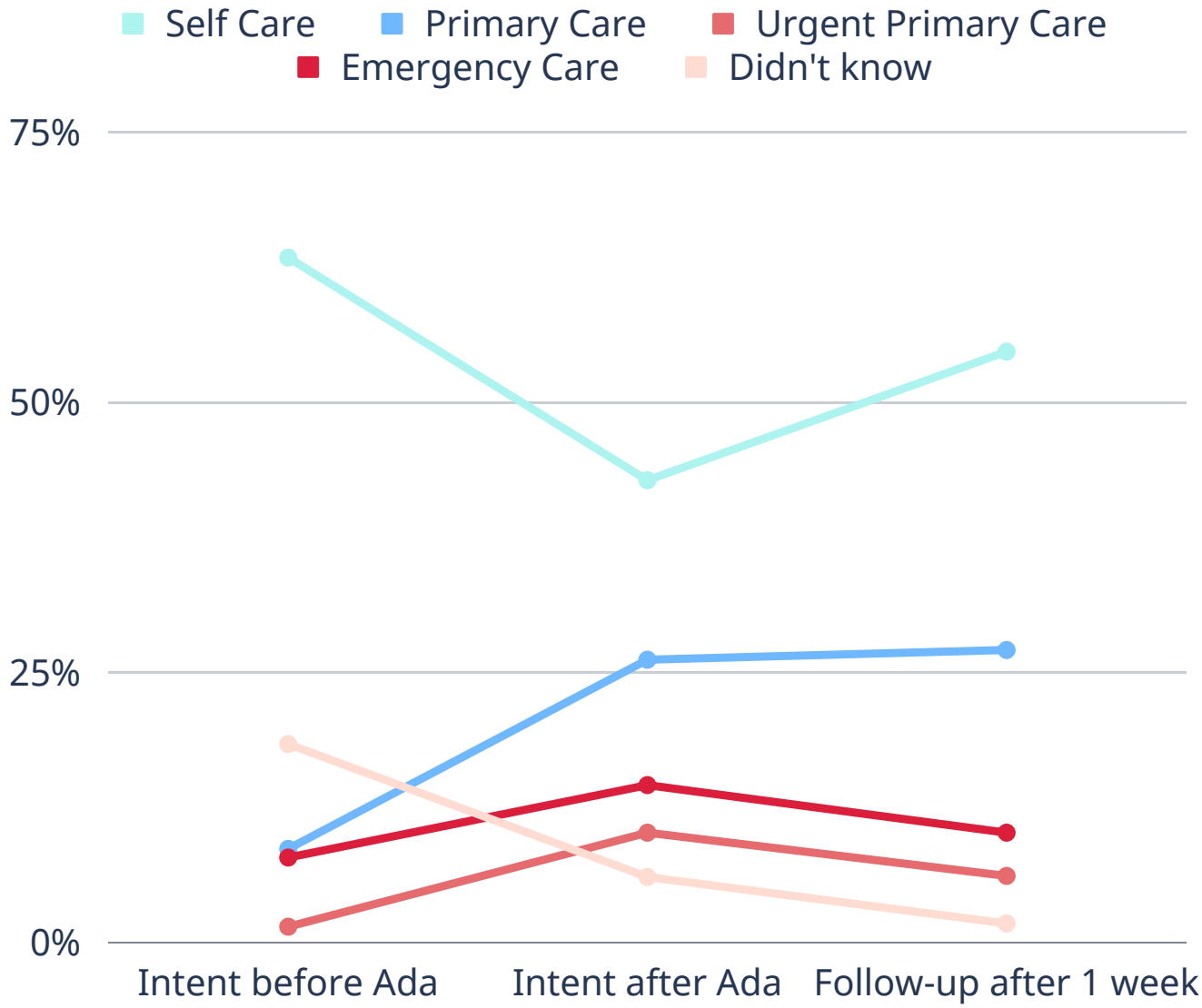


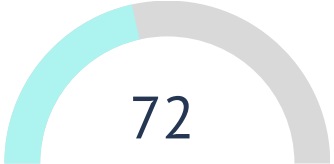
Figure 6. Development of participants' stated intentions to seek care before and immediately after using the symptom checker, and one week later based on responses from all 785 participants in the follow-up survey.

98.2%

of participants knew if, when or where to seek care one week after checking their symptoms

167

participants did not know what to do before checking their symptoms



72

of them chose to take care of their symptoms at home

50

chose to seek care in the week following their assessment

5

of them were still unsure what to do

41

did not respond to the follow-up survey

Change of healthseeking behaviour

16.6%
of participants now knew what to do about their symptoms despite being unsure before the assessment

37.4%
of participants changed their intended behavior

45.3%
stayed with their intended behavior

27.7%
of participants sought care at a higher level of urgency than originally intended

8.8%
of participants decreased the level of care

When only evaluating those who stated a clear behavior:

45% changed their behavior
55% stayed with their behavior

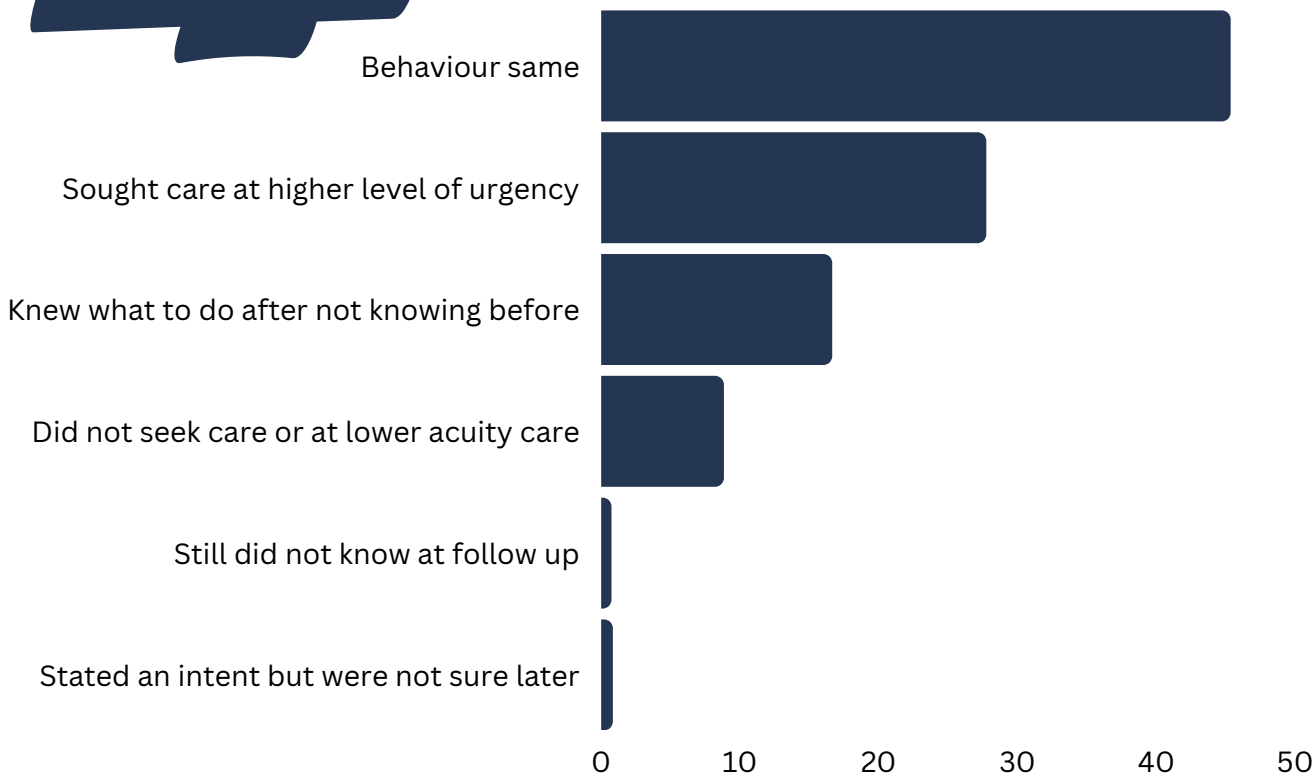
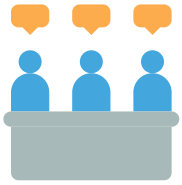


Figure 7. A comparison of health-seeking behavior among individuals, excluding 240 participants who did not provide information regarding their intent or behavior.

98% of Ada's urgency advices were deemed safe



We included a panel of three senior South African physicians specialised in either gynecology or family medicine in the study following the Semigran et al. approach [12]. After participant enrolment was complete, a subset of randomly selected 184 cases was shared with 2 of the participating physicians who were asked to choose the most appropriate urgency advice as well as the lowest urgency advice that could still be considered safe for each case.

184

If both physicians disagreed, a third physician served as a tiebreaker and was able to choose between the two different urgency advice provided by her colleagues.

The answers were then compared with the urgency advice provided by the symptom checker and the intent as well as the action taken by the participants after checking their symptoms.

(1) Appropriateness of urgency advise proposed by the symptom checker

Metrics: Comparison of Ada's urgency advise with the urgency advise deemed as most appropriate by the panel

Main outcome: 94% of Ada's urgency advises were deemed appropriate

- in 6% of cases, Ada's urgency advise was less cautious
- in 49% of cases, the urgency advice matched completely
- in 45% of cases, Ada's urgency advice was more cautious

(2) Safety of urgency advise proposed by the symptom checker

Metrics: Comparison of Ada's urgency advise with the urgency advise deemed as the lowest to still be safe by the panel

Main outcome: 98% of Ada's urgency advises were deemed safe

- in 2% of cases, Ada's urgency advise was unsafe
- in 24% of cases, the urgency advice matched completely
- in 75% of cases, Ada's urgency advice was more cautious

Increase of safe healthseeking behavior

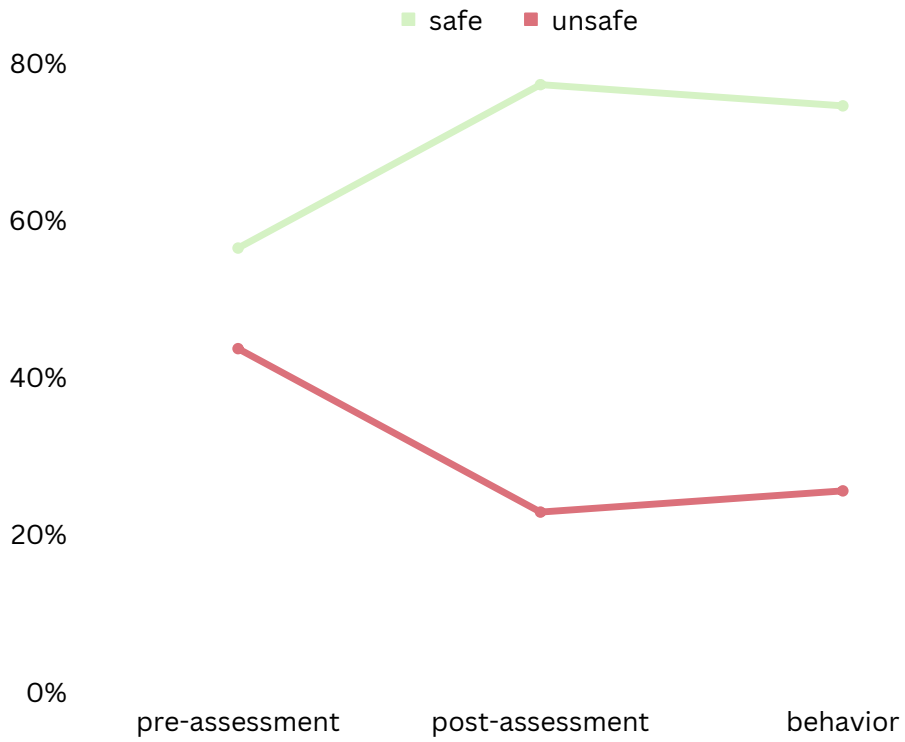


Figure 8. Development of safety of intent before and after the symptom assessment as well as actual behaviour of participants, while excluding those who skipped the question, responded with 'I don't know,' or did not participate in the follow-up survey.

Figure 9. Distribution of safe and unsafe intent and behavior among all participants.

Before checking their symptoms, **43.6%** of participants planned a behaviour that was judged as unsafe by the physician panel. This decreased to **25.5%** when looking at their behaviour after checking their symptoms, resulting in a **41.5% decrease.**

Even though we observed this effect, we can not judge how much the symptom assessment alone influenced their decision-making process.

However, as there is already a strong decrease of unsafe intent right after the symptom assessment (peak in figure on the left), it seems plausible to consider that the symptom assessment played a big role in changing their decision-making process.

After checking their symptoms, a

41.5%

decrease in unsafe health-seeking behaviour was observed.

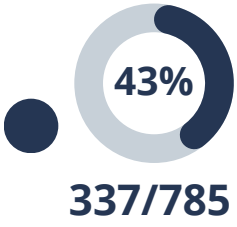
The influence of Ada on healthcare journeys

A majority of moms changed their mind after checking their symptoms and sought care. This resulted in many of them receiving treatment and getting admitted to hospital for further investigation.

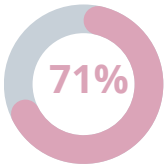
320/337
moms answered questions about their medical visit

213/320
were **treated**:
- 172 received new medication
- 9 had surgery
- 33 moms were treated differently
- 43 were admitted to hospital

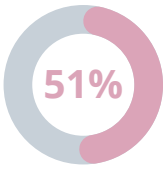
would have not received treatment without checking their symptoms



337/785
of moms sought medical care after checking their symptoms

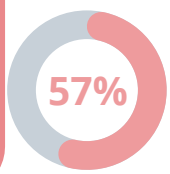


228/320
of medical problems were seen as **serious or potentially life-threatening** condition by their medical provider



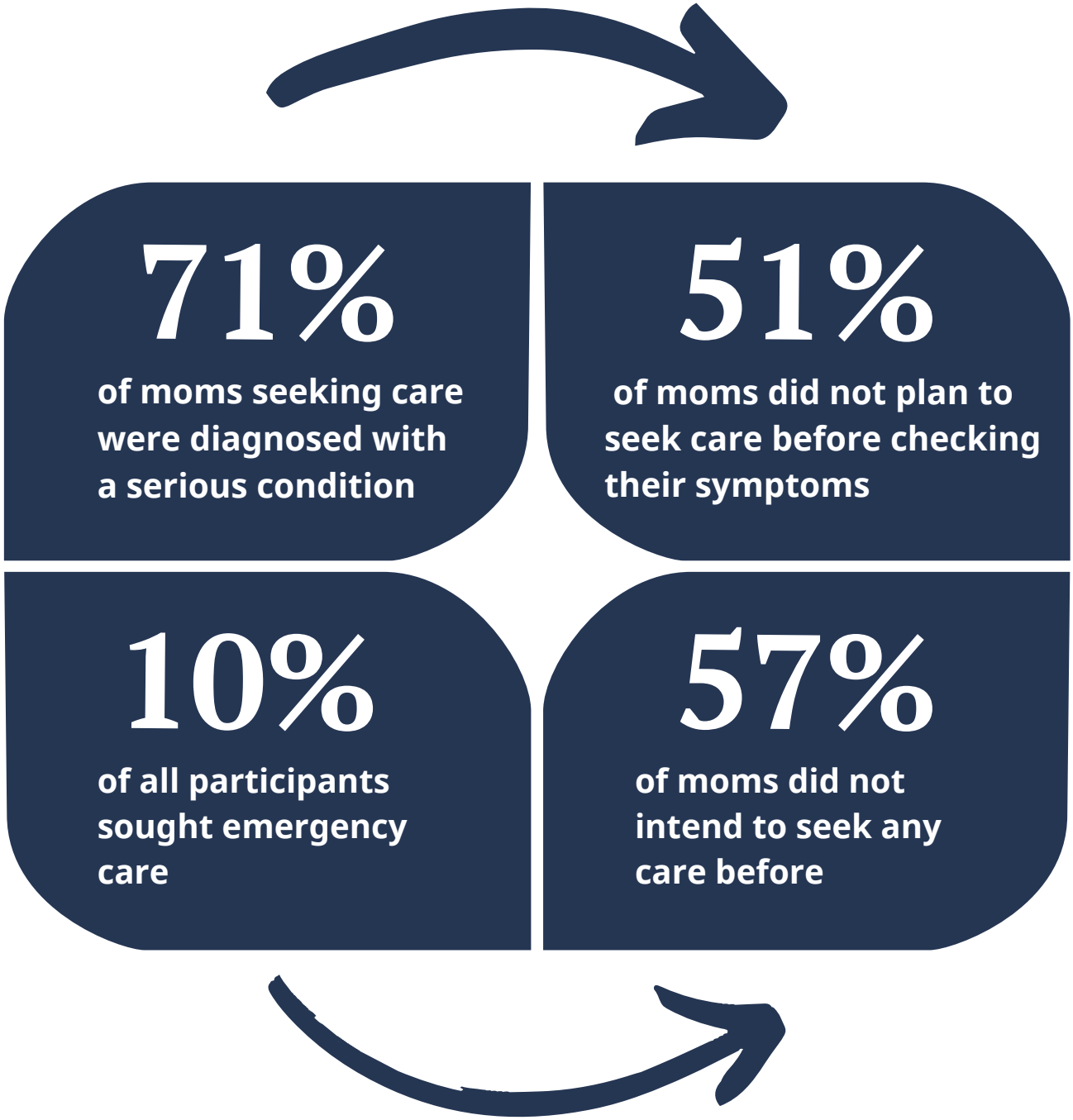
of those considered to have had a serious condition were not planning to seek care before checking their symptoms

79/337
of moms sought emergency care



of those moms wanted to manage their symptoms at home or did not know what to do

Saving lives by guiding people to care appropriately



How unsafe decisions on if, when or where to seek care can effect health outcomes and costs

Health seeking behavior plays a pivotal role in determining the overall well-being of individuals and communities. Unsafe or inappropriate health seeking behavior can lead to a cascade of negative effects that not only impact individuals' health but also have far-reaching consequences on healthcare systems and society as a whole.

Late disease diagnoses with poorer patient outcomes
One of the most concerning outcomes of delayed or inadequate healthcare seeking is the late detection of diseases. When individuals postpone seeking medical attention, conditions that could have been managed effectively in their early stages can progress to advanced levels. This delay in detection often results in poorer patient outcomes, increased complexity of treatment, and reduced chances of full recovery. In cases like cancer, for instance, delayed diagnosis can lead to a need for more aggressive treatments, reduced treatment options, and a higher likelihood of complications.

Spreading of infectious diseases
Furthermore, inappropriate health seeking behavior can contribute to the spread of infectious diseases. Failing to seek prompt medical advice when experiencing symptoms of a contagious illness can lead to the unwitting transmission of the disease to others. This is particularly relevant in the context of global health crises, such as pandemics, where swift and appropriate health seeking behavior can play a significant role in containing the spread of diseases.

Increase in healthcare costs for individuals and healthcare systems
From an economic perspective, unsafe health seeking behavior can lead to increased healthcare costs. When individuals delay seeking care, their conditions often worsen, necessitating more intensive interventions and treatments. This not only drives up medical expenses but also places an additional burden on healthcare systems and resources. Moreover, prolonged illnesses due to inappropriate health seeking behavior can result in more sick days for individuals, leading to productivity losses for both individuals and their employers.

South Africa and pregnancy-specific considerations
This issue is particularly pertinent for vulnerable populations like pregnant women and children. The primary factors contributing to maternal mortality in South Africa, accounting for approximately 40% of cases, are the lack of attendance at antenatal care and delays in seeking medical assistance [13].

It has been shown that by encouraging pregnant women to visit healthcare facilities regularly, maternal mortality can be reduced. When South Africa introduced the eight-contact antenatal care recommendations in 2017, this led to an increase of antenatal care visits and a first time reduction of maternal mortality in 2019 in over a decade in almost all underlying causes of maternal mortality [14].

The effect of reducing inappropriate healthcare visits

Maintaining a delicate balance between directing individuals to seek professional medical care and empowering them to manage their symptoms at home is essential in promoting overall health and well-being. While immediate medical attention is indispensable for certain conditions, it's equally crucial to provide guidance for addressing minor ailments and concerns independently. Striking this balance ensures that critical medical resources are allocated efficiently while fostering a sense of self-care and responsibility among individuals. This approach not only safeguards the healthcare system from unnecessary strain but also empowers individuals to make informed decisions about their health. By recognizing the appropriateness of each scenario, we can foster a healthcare environment that is both responsive and supportive, ultimately contributing to the betterment of individual and community health outcomes.

11% of participants chose a less cost and/or time intense care option than they were planning to do initially after checking their symptoms

Methodological considerations for calculating economic benefits on the next page:

- To ensure the robustness of our analysis, we exclusively incorporated data from participants who not only completed the follow-up survey but also made decision on seeking care, excluding responses where uncertainty on timing, location, or necessity of care-seeking was expressed.
- To quantitate individual costs and time saved, we derived estimates of travel duration to the nearest healthcare facility as well as the associated costs from the responses shared by all study participants. Inquiries were limited to the nearest healthcare facility, making it impossible to differentiate between primary care, urgent primary care, and emergency care facilities. This limitation potentially implies an underestimation of both time and cost savings, given that the distinctions between these facilities were not accounted for.
- For insights into the average time allocation during visits to various healthcare facilities, we drew upon pertinent literature originating from South Africa [15,16].
- In relation to the costs for the public health sector, we drew upon the official cost data for medical consultations at distinct healthcare facilities in South Africa, as published by the government for 2023 [17,18]. Some expenses, not cataloged within these document, necessitated the utilisation of alternative published sources [19]. All costs that were not published for 2023 were inflation-adjusted [20].
- Only the public health sector was considered as it is assumed that most participants will seek care at public healthcare facilities. Costs for the private healthcare sector would be substantially higher than the estimates used here.
- Out of pocket expenses were not considered.

The financial impact of reducing inappropriate healthcare on individuals and health systems

7 hours saved per person by avoiding unnecessary healthcare visits or by seeking care at a less urgent healthcare facility (on average)

30 ZAR (1,5 USD) travel costs saved per visit per person (on average)

146- 334 ZAR (8 - 18 USD) Income retained for working moms: between 145,8 - 334 ZAR (7,65 - 17,54 USD)

78,915 ZAR (4,140 USD) saved for the public healthcare sector for the participants in this study

1,233 ZAR (65 US) saved for the public healthcare sector per user being redirected (on average)

281,905 ZAR (14,729 USD) saved for the public healthcare sector each month for all active MomConnect users checking their symptoms

Evaluating the effect on health outcomes and cost savings on the example of Hypertension in pregnancy (1/2)

One might ask: What about all these people that sought care because Ada advised them to do so? Isn't that creating costs? Correct. Short-term, directing people to seek care creates costs. However, as described above, directing people to care appropriately when it is required is saving costs in the long run.

When individuals proactively seek care aligned with their medical needs, it mitigates the progression of potentially minor health concerns into more severe and complex conditions that demand extensive medical interventions. Such early interventions not only reduce the overall duration and intensity of treatment required but also avert the need for expensive emergency interventions and hospitalisations, reduction of productivity losses from prolonged illnesses, allowing individuals to continue their work.

This can best be demonstrated when looking at the main cause of maternal mortality

It is particularly relevant for pregnant women to seek care regularly. A majority of maternal and child mortality cases could be prevented if moms seek out care early and attend antenatal care visits.

Hypertensive disorders of pregnancy (HDP) stand as the leading direct cause of maternal mortality, constituting 18% of all maternal deaths in South Africa [1,21]. The spectrum of hypertensive disorders encompasses different categories, with eclampsia and pre-eclampsia as the prevailing reasons for fatal outcomes.

Close to 75% of maternal deaths attributable to HDP were deemed potentially preventable, increasing in recent years and positioning HDP as the second largest contributor to preventable mortality.

Pregnant women with HDP suffer from increased risks for a variety of medical diseases [22,23].

Chronic hypertension is associated with e.g.

- a **26%** increased risk for **superimposed pre-eclampsia**
- a **41%** increased risk for **C-sections**
- a **28%** increased risk for **preterm delivery**
- a **17%** increased risk for fetal growth restriction
- a **21%** increased risk for **neonatal intensive care** being required
- a **4%** increased risk for **perinatal death**

Gestational hypertension is associated with e.g.

- an increased risk of developing **pre-eclampsia** (up to **25%**, depending on the gestation at presentation)
- the development of **cardiovascular disease**

On the next page we take a closer look at those cases in which moms were diagnosed with HDP after checking their symptoms

Evaluating the effect on health outcomes and cost savings on the example of Hypertension in pregnancy (2/2)

21

moms reported to have been diagnosed with HDP after checking their symptoms

11

of them did not plan to seek care before or did not know what to do (1 mom skipped the question)

20

of the moms received treatment after being diagnosed

Uncomplicated pregnancy: $13.187

Mother with hypertension: $24.182

Mother with Preeclampsia: $41.790

Reducing disease progression and adverse events

Comparison of paired mother-infant costs in the US (2015) [24]
Maternal costs measured from gestational week 20 until 6 weeks postpartum
Child costs measured until one year after birth

2.2

days was the average time between completing an assessment and seeking care

1. Any hypertensive disorder of pregnancy (HDP) can result in preeclampsia and other diseases.
2. Strict blood pressure control and close monitoring of moms with HDP can reduce the risk of developing further diseases, ultimately reducing maternal and child mortality, increasing life quality and reducing direct and indirect medical costs.
3. Ada has the potential to increase rates of moms being diagnosed with HDP by guiding them to seek care when symptoms occur.

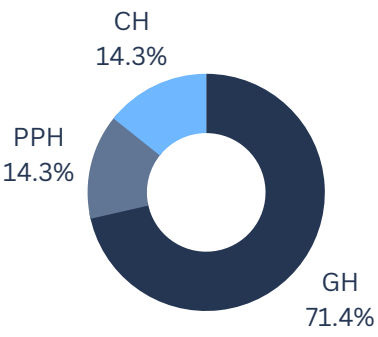


Figure 10. Hypertension classification
CH = Chronic hypertension
GH = Gestational hypertension PPH = Post-Partum Hypertension)

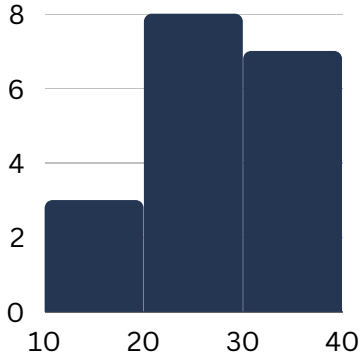


Figure 11. Pregnancy week distribution at time of diagnosis

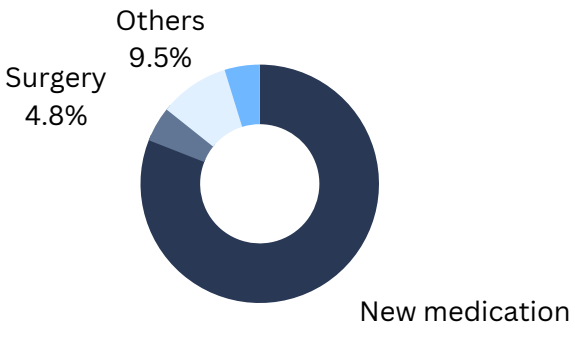


Figure 12. Treatment provided for participants diagnosed with hypertension.

Why we can generalise these results

To ensure that these observations hold true for the broader study population, and the MomConnect population utilising the symptom checker, it is necessary to perform a comparative analysis between these distinct populations.

Participants from the randomly selected panel population evaluating safety and appropriatness of behavior and advice closely mirror the overall study population in terms of evaluated data variables, suggesting a strong potential for generalising the results to the broader study population.

When comparing the overall study population to the broader MomConnect population using the symptom checker, noticeable similarities emerge. The mean age, province distribution, and mean pregnancy week are nearly identical. However, distinctions arise in the slighlty higher inclusion of pregnant women in the study and the lower number of study participants conducting assessments on behalf of their children.

The phone survey population does exhibit some variations from the broader study population. Most notably, it comprises nearly 7% fewer working mothers, which is reasonable considering their willingness to partake in a time-intensive phone interview, often scheduled during working hours. Additionally, a higher proportion of these mothers were still pregnant and conducted self-assessments, aligning with their pregnancy status.

Table 1: Comparison of the overall study population with the sub-study-populations selected for the (1) physician panel and the (2) phone surveys and the overall MomConnect population using the SC during the study period

	Study population	Panel population	Phone survey population	MomConnect population using the SC
Mean Age	26.8 (SD: 5.49)	26.2 (SD: 5.41)	27.6 (SD: 5.69)	27.0 (SD: 5.7)
95% CI for Age	15.8 - 37.8	15.4 - 37.0	16.2 - 39.0	16.6 - 38.4
Mean pregnancy week	29.2 (SD: 9.1)	28.5 (SD: 8.7)	28.7 (SD: 9.1)	31 (SD: 8.6)
% of Moms in provinces with MMR >70 per 100,000 life birhts	85.1%	82.6%	85.9%	85.0%
% of currently pregnant women	68.6%	65.8%	73.7%	55.3%
% of assessments conducted on behalf of their children	5.7%	5.1%	2.1%	10%
% of changed behavior (excl. skipped)	37.4%	37.4	41.2%	NA
% of don't know --> behavior	16.6%	17.3%	15.3%	NA
% of working moms or in school	36%	38.6%	29.3%	NA
Mean Household income	ZAR 3539	ZAR 3858	ZAR 3531	NA

Case reports (1/2)

Patient Profile: A 21-year-old woman in her fourth month of pregnancy presented with complaints of abdominal pain, painful urination, and a sore throat. These symptoms were indicative of a potential urinary tract infection or gonorrhea infection which was suggested by Ada.

Initial Intentions: Initially, the patient had planned to self-care for her symptoms.

Impact of Ada's Assessment: However, after utilising Ada's symptom checker, her intention shifted toward seeking urgent primary care.

Timely Action: Consequently, she promptly sought out urgent primary care within a week of using the symptom checker.

Healthcare Outcome: As a result of her visit to a healthcare professional, the healthcare team initiated a new medication regimen, ensuring that the patient received the appropriate treatment and care for the **sexually transmitted infection** (STI). This case highlights how the symptom checker influenced her health-seeking behaviour and facilitated timely medical intervention during her pregnancy.

> *“They found that I have an STI and they gave me an injection and pills. I'm feeling much better now.”*

Patient Profile: A 39-year-old woman, two months postpartum, reported a persistent cough, consistent with pneumonia which was suggested by Ada.

Initial Intentions: Initially, the patient had intended to self-care for her symptoms.

I**mpact of Ada's Assessment:** However, following an assessment with Ada's symptom checker, her plan shifted towards seeking primary care.

Timely Action: Subsequently, she proactively sought out primary care within a week of using the symptom checker.

Healthcare Outcome: Following her consultation with a healthcare professional, the healthcare team recognised the seriousness of her condition and promptly initiated a new medication regimen. The diagnosis revealed that she was suffering from **tuberculosis**. This case illustrates how the symptom checker prompted her to take timely action, leading to the appropriate medical intervention and treatment for tuberculosis during her postpartum period.

Case reports (2/2)

Patient Profile: A 23-year-old mother in her 11th week of pregnancy presented with a fever. The suggested conditions included acute schistosomiasis, pneumonia, typhoid fever, and mycoplasma pneumonia.

Initial Intentions: Initially, the patient had intended to practice self-care for her symptoms.

I**mpact of Ada's Assessment:** However, her approach changed to seeking primary care within one week after utilising a symptom checker.

Timely Action: Consequently, she promptly sought out urgent primary care within a week of using the symptom checker.

Healthcare Outcome: Following a medical examination, the patient received a new diagnosis of **HIV**, which was considered a serious condition by the healthcare provider. HIV can increase susceptibility to various opportunistic infections, such as those suggested in her assessment. Consequently, she was started on a new medication regimen. This case illustrates the importance of recognizing the potential coexistence of HIV and these infections and highlights the need for prompt diagnosis and treatment, particularly during pregnancy.

Patient Profile: A 23-year-old woman, two months postpartum, presented with complaints of headaches and abdominal pain, which raised concerns about hypertension as the primary suggested condition. She was advised to seek care from her general practitioner (GP) the same day.

Initial Intentions: Initially, the patient had planned to self-care for her symptoms.

I**mpact of Ada's Assessment:** However, following an assessment with Ada's symptom checker, her intention shifted toward seeking urgent primary care.

Timely Action: Consequently, she promptly sought out urgent primary care.

Healthcare Outcome: After being examined at the healthcare facility, she received a diagnosis of **hypertension** and was prescribed new medication. The healthcare team also considered this condition to be serious. This case underscores how the symptom checker facilitated the timely recognition and treatment of hypertension, emphasizing the importance of seeking prompt medical attention during the postpartum period.

The International Wealth Index

The International Wealth Index (IWI) is a composite measurement used to assess the socio-economic status and wealth distribution of individuals or households on a global scale [24,25]. It typically combines various indicators, including income, assets, housing quality, and access to basic services, to categorise populations into wealth quintiles or other divisions. The IWI is employed to gauge economic disparities within and among countries, providing valuable insights into patterns of wealth accumulation, poverty levels, and inequality. Researchers, policymakers, and international organisations frequently utilise the IWI to inform development strategies, allocate resources effectively, and monitor progress in poverty alleviation and equitable economic growth, thereby guiding efforts aimed at improving the well-being and living standards of populations worldwide.

The IWI for phone survey participants ranged **from 28 to 100, with a range of 72 points**. This demonstrates an inclusion of participants from diverse socioeconomic backgrounds.

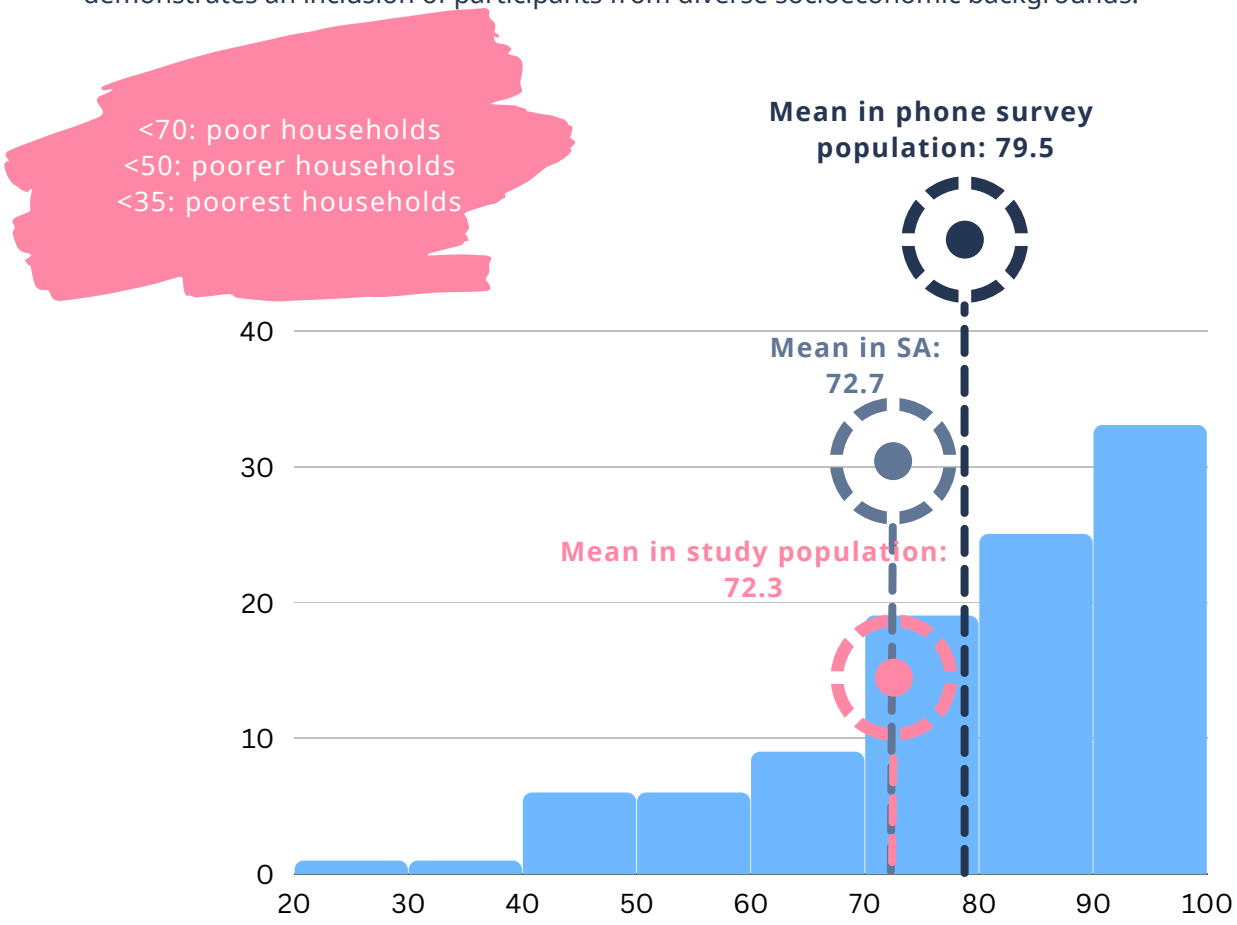


Figure 13. IWI distribution for the phone survey participants compared to the average South African population (2019) and the overall study population based on participant location.

1. The average IWI for the overall study population is slightly lower than for the general South African population.
2. The average IWI for the phone survey population is higher than for the general South African population.
3. Participants from diverse socioeconomic backgrounds were included in the study.

Increasing access to healthcare for mothers all over SA

88%
of participants live in rural areas or towns

40%
of participants live in the provinces with a mean IWI of <70

43%
of participants sometimes or always don't seek care because of money

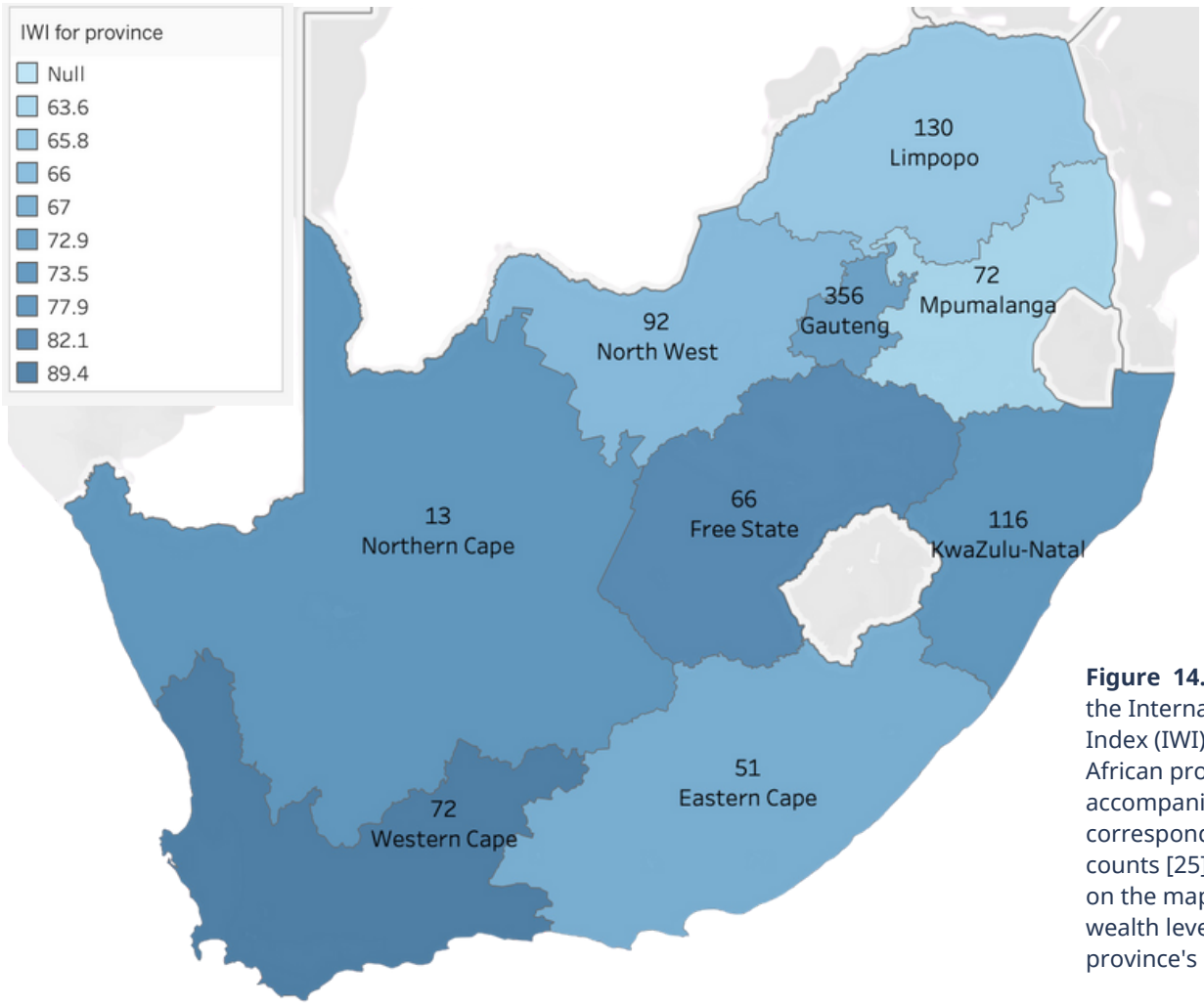


Figure 14. Distribution of the International Wealth Index (IWI) across South African provinces, accompanied by the corresponding participant counts [25]. Lighter colors on the map indicate lower wealth levels among the province's residents .

In South Africa, inequality remains a deeply entrenched and pressing concern, as evidenced by one of the world's highest Gini coefficients, indicating significant disparities in income, wealth, and access to essential services. This inequality is mirrored not only in officially published data measuring the International Wealth Index (IWI) for the South African population but also in our study's participant pool.

When comparing provinces, the IWI exhibits its highest value in the Western Cape (89.4) and its lowest in Mpumalanga (63.6). The province of residence in South Africa serves as a critical determinant of healthcare access due to variations in healthcare infrastructure, available resources, and socio-economic circumstances. Effectively addressing these regional disparities poses an ongoing challenge for healthcare policymakers in South Africa, with the goal of ensuring equitable access to healthcare services for all citizens. The integration of a symptom checker into a trusted platform like MomConnect helps mitigate the healthcare access barriers, especially in rural areas with lower levels of education.

Qualitative insight through phone interviews - health information

During the phone interview, participants were asked about their priorities when seeking health information, and their qualitative responses were categorised. Participants could respond several times.

The findings indicate that 67% of participants emphasised the importance of health information services being recommended by a government clinic or their hospital.

Furthermore, 32% of respondents placed a high value on the trustworthiness of the health information provided, while 25% prioritised quick access, and 28% favoured affordability or low costs. Recommendations from friends held a lesser role, with only 9% mentioning it.

The integration of a symptom checker into MomConnect provides a no-cost, government-supported and easy to access solution which meets several of the points made by participants. To build further trust, with pregnant women and young mothers in South Africa, a close collaboration with local healthcare providers is essential.

Furthermore, we inquired about participants' typical actions when facing a medical issue, allowing for multiple choices.

The predominant choice was to seek consultation from healthcare professionals: 95% expressed their inclination to visit government hospitals or day clinics, while 18% mentioned contacting their general practitioner or nurse, and 8% indicated a preference for visiting pharmacies.

In contrast, 18% of respondents reported consulting MomConnect when encountering a medical problem, a relatively lower figure compared to the preference for healthcare professionals. This discrepancy may be attributed to the recent integration of the symptom checker into MomConnect, which was only a few weeks old at the time of the study and not widely recognised. Additionally, it's worth noting that many participants were using the symptom checker for the first time when invited to participate in the study.

These findings underscore the importance of raising awareness about this solution, ideally through partnerships with healthcare professionals and government clinics.

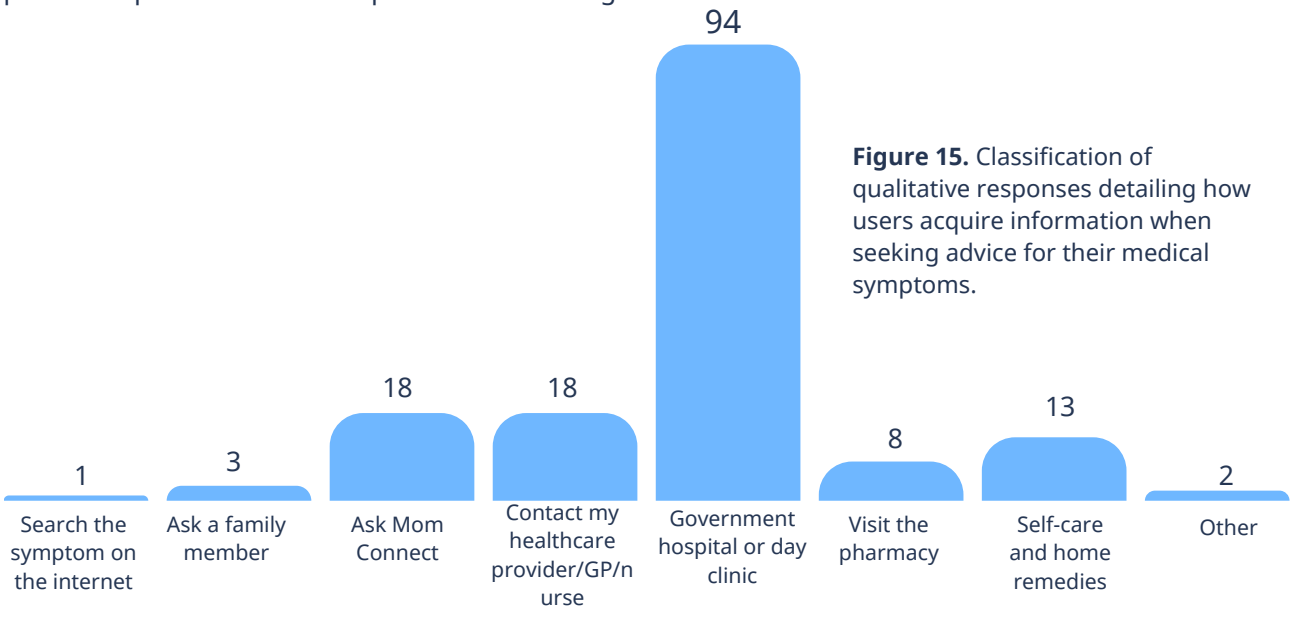


Figure 15. Classification of qualitative responses detailing how users acquire information when seeking advice for their medical symptoms.

Qualitative insights through phone interviews - Ada experience

We also asked participants to share more insights about their experience with the integration, and answers were again categorized for analysis purposes.

Most participants reported an overall positive experience (e.g., "*It was good. They gave me information that I needed.*"). No negative experience was reported.

The integration served diverse purposes, including providing information, assisting with health concerns, and offering guidance on self-care and symptoms, reflecting its versatility in addressing user needs.

> *It was excellent because it teaches me how to check my health. I have **learnt something I did not know** about self care.*

> *It made me understand why I am experiencing the kind of symptoms I had. It made me realize that **I must seek for help**. It helped me a lot because it was something I was worried about.*

> *It was so helpful because after getting what I wanted to know about my health **I was referred to the clinic**.*

> *It was the best, It really helped me because it tell make me to **look after my health** and to make sure that if I see something I go to the clinic.*

> *It was helpful for me because at the end of the day **I decided to consult at the clinic.** I had symptoms such as fever, high blood and fluish. It give advise on what might be wrong with me and what I can do.*

> *It was so helpful because even if you do not feel sick I can check the symptoms and I can even know the things I did not know about. **It makes me feel more safe** because everything I want to know appear on the symptom checker.*

> *I have gained a lot of knowledge when using that symptom checker and when it comes to my symptoms. I **start to understand the solutions** given.*

> ***I have learned a lot.** It says and it will tell me if I need to see the doctor.*

Summary of the user journey

Day 1

Initial onset of symptoms

On average, users had symptoms for **21 days** until they used the symptom checker

- 31,7% (301/950) waited 1 day
- 47,3% (449/950) waited 1-7 days
- 15,4% (146/950) waited 8-30 days

Checking their symptoms

Users presented mostly with headache (22%), abdominal pain(19%) and fever (10%).

The most common causes identified in the top 5 suggestions were common cold, symptoms of pregnancy and Covid-19.

Day 21

Receiving advise from the symptom checker

From entering their first symptom to receiving advice, it took users **10** minutes (median value, range from 2:40 min to 5:46 h).

Day 25

Diagnosis and treatment

After receiving advise from the symptom checker, moms took on average **4** days to seek care.

67% of moms seeking care received treatment, mostly in form of a new medication. 43 moms were admitted to hospital.

Day 28

Follow up

The most common conditions identified by their healthcare professional were hypertension, UTIs or STIs or other infectious diseases.

In 73% of the cases, a new medical problem was identified.

28% of moms stated their condition was seen as a serious medical problem by their healthcare provider.

Conclusions

1

37.4% of women changed their behaviour after checking their symptoms.

Unsafe behavior decreased by 41.5% after using Ada from 43.6% to 25.5%.

2

98% of urgency advice provided by the symptom checker was being considered safe and 94% considered appropriate by an external physician panel.

3

More than half of the mothers diagnosed with a severe or life-threatening condition had not initially planned to seek medical attention before using Ada to check their symptoms.

Ada's guidance for pregnant women and new mothers can expedite the diagnostic process and facilitate earlier treatment, ultimately resulting in improved patient outcomes.

4

By speeding up the time to diagnosis and treatment, the rate of complications decreases, resulting in reduced costs for the healthcare system.

Short-term cost and time savings can be achieved by redirecting pregnant women and mothers away from care appropriately. As 11% of participants chose a less costly and/or time-intensive care option, approximately 65 USD per redirected participant was saved for the South African healthcare system.

References

1. UN DESA. 2023. The Sustainable Development Goals Report 2023: Special Edition - July 2023. New York, USA: UN DESA. © UN DESA. Accessed September 21, 2023. https://unstats.un.org/sdgs/report/2023/The-Sustainable-Development-Goals-Report-2023.pdf

2. United Nations Inter-Agency Group for Child Mortality Estimation (UN IGME). Levels & Trends in Child Mortality: Report 2022, Estimates Developed by the United Nations Inter-Agency Group for Child Mortality Estimation, United Nations Children's Fund, New York, 2023. Accessed September 21, 2023. https://childmortality.org/wp-content/uploads/2023/01/UN-IGME-Child-Mortality-Report-2022.pdf

3. Moodley J, Fawcus S, Pattinson RC. 21 years of confidential enquiries into maternal deaths in South Africa : reflections on maternal death assessments. Published online December 2020. Accessed September 21, 2023. https://repository.up.ac.za/handle/2263/82230

4. National Department of Health. Fact sheet - Saving mothers 2022. Accessed September 21, 2023. https://www.health.gov.za/wp-content/uploads/2023/09/Fact-sheet-Saving-Mothers-2022.pdf

5. UNICEF. Key demographic indicators for South Africa. Accessed September 21, 2023. https://data.unicef.org/country/zaf/

6. Mabaso MHL, Ndaba T, Mkhize-Kwitshana ZL. Overview of Maternal, Neonatal and Child Deaths in South Africa: Challenges, Opportunities, Progress and Future Prospects. Int J MCH AIDS. 2014;2(2):182-189.

7. Barron P, Padarath A. Twenty years of the South African Health Review. South African Health Review. 2017;2017(1):1-10.

8. UN General Assembly, Transforming Our World : The 2030 Agenda for Sustainable Development.; 2015. Accessed September 21, 2023. https://www.refworld.org/docid/57b6e3e44.html

9. Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS. How many child deaths can we prevent this year? The Lancet. 2003;362(9377):65-71. doi:10.1016/S0140-6736(03)13811-1

10. Maphumulo WT, Bhengu BR. Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review. Curationis. 2019;42(1). doi:10.4102/curationis.v42i1.1901

11. Thaddeus S, Maine D. Too far to walk: maternal mortality in context. Soc Sci Med. 1994;38(8):1091-1110. doi:10.1016/0277-9536(94)90226-7

12. Semigran HL, Linder JA, Gidengil C, Mehrotra A. Evaluation of symptom checkers for self diagnosis and triage: audit study. BMJ. 2015;351:h3480. doi:10.1136/bmj.h3480

13. Moodley J, National Committee on Confidential Enquiries into Maternal Deaths, National Department ofHealth, South Africa. Maternal deaths associated with hypertension in South Africa: lessons to learn from the Saving Mothers report, 2005-2007. Cardiovasc J Afr. 2011;22(1):31-35. doi:10.5830/cvja-2010-042

14. Hlongwane TM, Bozkurt B, Barreix MC, et al. Implementing antenatal care recommendations, South Africa. Bull World Health Organ. 2021;99(3):220-227. doi:10.2471/BLT.20.278945

15. Karat AS, McCreesh N, Baisley K, et al. Estimating waiting times, patient flow, and waiting room occupancy density as part of tuberculosis infection prevention and control research in South African primary health care clinics. PLOS Global Public Health. 2022;2(7):e0000684. doi:10.1371/journal.pgph.0000684

References

16. Cohen K, Bruijns S. Describing key performance indicators for waiting times in emergency centres in the Western Cape Province, South Africa, between 2013 and 2014. S Afr Med J. 2018;108(7):579-584. doi:10.7196/SAMJ.2018.v108i7.12969

17. National Department of Health. Uniform Patient Fee Schedule. Accessed September 21, 2023. https://www.health.gov.za/uniform-patient-fee-schedule/

18. National Health Laboratory Service. NHLS State Price List 2018. Accessed September 21, 2023. https://paediatrics.org.za/wp-content/uploads/2023/05/NHLS-State-Price-List-2018.pdf

19. Discovery Health (Pty) Ltd. Flexicare GP handbook. Accessed September 21, 2023. https://www.yourremedi.co.za/assets/template-resources/general/flexicare-gp-handbook.pdf

20. Inflation Calculator - South Africa. Accessed September 21, 2023. https://inflationcalc.co.za/?date1=2018-01-09&date2=2023-01-09&amount=72.9

21. Bramham K, Parnell B, Nelson-Piercy C, Seed PT, Poston L, Chappell LC. Chronic hypertension and pregnancy outcomes: systematic review and meta-analysis. BMJ. 2014;348:g2301. doi:10.1136/bmj.g2301

22. National Department of Health. Saving mothers annual report 2017. Accessed September 12, 2023. https://www.westerncape.gov.za/assets/departments/health/saving_mothers_annual_report_2017.pdf

23. Beech A, Mangos G. Management of hypertension in pregnancy. Aust Prescr. 2021;44(5):148-152. doi:10.18773/austprescr.2021.039

24. Hao J, Hassen D, Hao Q, et al. Maternal and Infant Health Care Costs Related to Preeclampsia. Obstet Gynecol. 2019;134(6):1227-1233. doi:10.1097/AOG.0000000000003581

25. Data retrieved from the Area Database of the Global Data Lab, https://globaldatalab.org/iwi/, version v4.2.

26. Smits J, Steendijk R. The International Wealth Index (IWI). Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement. 2015;122(1):65-85.

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