



## **ELECTRONIC REGISTRATION IN OUTPATIENT THERAPEUTIC FEEDING PROGRAMS**

**What electronic tools are appropriate to meet the needs of outpatient programs of Médecins Sans Frontières?**

Roelant Zwaanswijk, SC Synergie

Saskia van der Kam, MSF

Commissioned by MSF Amsterdam

Version 2, updated January 2019

## Summary

The objective of the research is identification of the existing electronic registration tools for patients in an outpatient Ambulatory Therapeutic Feeding Centres (ATFC). The aim of electronic registration is to replace the register book and to eliminate the use of pen and paper in the registration process. This would result in increased efficiency, higher accuracy of registration and instant data delivery to facilitate decision-making in the project and to feed the data directly into the Health Information System (HIS).

The app or platform facilitating the data collection process in an outpatient setting should be a Mobile Data Collection (MDC) tool using telephones or tablets, being able to function without Internet connection in a remote or outback place. The MDC tool should enable the follow up of patients over a time period, specifically track admission and discharge data, which categorises the tool as Electronic Medical Record (EMR). However, registration in an ATFC, a remote place without Internet, requires a simple follow-up of patients is a light version of an EMR (EMR-light).

Mobile Data Collection (MDC) tools have reportedly improved the quality of data, the accuracy, reliability, and timeliness of data collection, aggregation, analysis and reporting in these settings. High quality data is the evidence base to improve medical programs, operations, accountability, quality of care and to steer innovation. Besides registration and data collection, MDC tools can also be used for diagnosis and treatment support, identification, and instant follow up to strengthen patient care.

During the current paper based registration and data collection, several data are retrieved retrospectively from the patient cards and manually entered into the register book. In order to make the process more efficient, apps for electronic registration should cover data collection during the entire workflow, implying that more users should be able to work in the app simultaneously in an outpatient facility. The users devices should be able communicate or share data with each other instantly by a portable local network server or [share data via an electronic patient card \(e.g. an NFC chip or eHealth card\)](#).

Six apps and platforms were evaluated against predefined benchmarks on data requirements and technical functionalities. [In this report, we define an app as a single application for a certain purpose; and a platform as central software on which several apps can be built with similar underlying software and who potentially are able to complement each other. Feedback from current users and technical tests were incorporated in this second version of the report.](#) In the course of the process other features related to management were reviewed including relation to legal and ethical requirements, management of the app and costing structure.

The six apps / platforms evaluated were Survey CTO, CommCare, Dharma, Mango Logic, Easynut and Buendia. [The first four are platforms that are in use of NGO's and the latter two are electronic tools developed specifically for a certain purpose in MSF. MSF has stopped funding of the development of both tools as MSF found the investment too high.](#)

An external (commercial) MDC platform has advantages above a single apps specifically built for and in MSF: a platform will be automatically maintained and serviced and the organisation is supported in a consistent and sustainable way. Several apps can be developed using the same MDC platform, and these apps can therefore be connected , e.g. a nutrition registration app with logistics; or a nutrition app with an app to support diagnosis and treatment (e.g. eCare of OCG), enriching the data collection and analysis and preventing the same data collected several times. As a platform serves several apps and several organisations the use of a platform is more cost effective and is better scalable than in-house developed apps.

The platforms Dharma and Mangologic are the most suitable regarding requirements, functionalities, technical tests, users experience, service and cost. Mangologic has already developed apps for similar usage in outpatient reproductive health programs and has overcome the initial bugs inherent to building new apps.

However, fast technical developments go and negotiations with the producer can change the cost benefit balance. Consequently, a framework for platforms should be developed including technical features e.g. automatic feed to DHIS2, functions in remote settings, functions at several workstations, supports follow-up of patients.

It is strongly recommended to develop and implement a pilot on a platform for electronic data processes in an outpatient program to evaluate the feasibility and acceptance, the cost-effectiveness of data flows, the management of such a system, the impact on patient care and program management. A pilot would be indispensable for further development of data protection systems (e.g. rules of behaviour). Finally, a pilot would inform further development of the general MSF eHealth strategy in outpatient health programs.

#### **Note**

After completion of this report we shared the content with the companies and / or developers of these applications and with the NGO's using these tools. Their feedback was used to update the 2<sup>nd</sup> version of this report. The text in blue are the updated sections.

We also received the information that an application was developed by WFP in cooperation with Unicef. This application or tool is called Scope Coda and is developed for optimizing the workflow and the mobile data management of moderate and severe malnourished patients. The scope of the tool is larger than our research objectives. As we already completed our report and do not have the resources to benchmark all the aspects of the tool of WFP we have added only a description.

#### **Authors:**

Roelant Zwaanswijk – Project Manager - SC Synergie – The Netherlands, Baarn – [roelantzwaanswijk@gmail.com](mailto:roelantzwaanswijk@gmail.com)

Saskia van der Kam – Project Responsible – Médecins Sans Frontières Operational Centre Amsterdam (MSF-OCA) – The Netherlands, Amsterdam, May 2018 – [Saskia.van.der.kam@amsterdam.msf.org](mailto:Saskia.van.der.kam@amsterdam.msf.org)

## Contents

Summary .....	2
1. Background .....	6
1.1. Introduction .....	6
1.2. Technical framework of electronic registration .....	7
1.3. Concepts.....	8
2. Methods.....	11
2.1 Define data requirements and functionalities.....	11
2.2 Explore the market for MDC tools .....	11
2.3 Evaluation of MDC tools .....	11
3. Development of data requirements and functionalities .....	12
3.1 Interviews.....	12
3.2 Data Requirements .....	12
3.3 Functionalities.....	13
3.4 Other considerations .....	14
4. Evaluation of existing software.....	14
4.1 Description apps and platforms.....	15
4.2 Benchmarking the apps and platforms.....	17
4.3 Functionalities.....	20
4.4 Evaluation of the Mobile Data Collection tools by their users .....	26
4.5 Considerations for MSF.....	30
5. Discussion, conclusions and recommendations.....	35
5.1. Discussion.....	35
5.2. Conclusion.....	42
5.3 Recommendations .....	42
6. References.....	43
7. Annexes.....	45
7.1. Platforms and tools considered for evaluation.....	45
7.2. Acknowledgements .....	47
7.3. Conflict of interest statement .....	48
7.4. Disclaimer .....	48

**Concepts, abbreviations and acronyms**

<b>Concept, abbreviation</b>	<b>Explanation</b>
ACF	Action Contre le Faim
API	Application Program Interface
App; application	A digital tool for a specific purpose
ATFC	Ambulatory Therapeutic Feeding Centre
Buendia	OCA EMR for ATFC and ITFC
DHIS2	District Health Information System version 2
eATFC	Electronic registration tool for Ambulatory Therapeutic Feeding Centre
EMR	Electronic Medical Records
GDPR	General Data Protection Regulation
HDPP	Health Data Protection Policy (MSF)
HIPAA	International Patient Record Standard
HIS	Health Information System
HMIS	Hospital Management and Information System
ICRC	International Committee Red Cross
IT department	Information Technology
IMC	International Medical Corps
IMCI	Integrated Management of Childhood Illnesses
ITFC	Inpatient Therapeutic Feeding Centre
MDC tools	Mobile Data Collection tools (software functioning on smartphone or tablet)
MOH	Ministry of Health
MSF	Médecins Sans Frontières
NFC	Near Field Communication
OCA	MSF Operational Centre Amsterdam
OCBA	MSF Operational Centre Barcelona
OCB	MSF Operational Centre Brussels
OCG	MSF Operational Centre Geneva
Platform	Electronic environment on which several apps can be built
SCF	Safe the Children
Scope Coda	Nutrition program App built by WHP and UNICEF
TfH	Terre des Hommes
TFP	Therapeutic Feeding Program (ITFC and ATFC)
WHO	World Health Organisation
WVI	World Vision International

## 1. Background

### 1.1. Introduction

Over the past twenty years, MSF has developed a large number of protocols, tools and standards for both diversified and specialist care. This has led to new requirements in capturing work activities, to ensure and improve quality. Furthermore, the increased numbers of staff and patients treated have created a huge information machine that is mostly based on data gathered with pen and paper. Usually, this process is slow, gives difficulties in tracing back a patient file, and it is sensitive to registration mistakes. The written data from patient cards and registers are later copied to electronic databases. This step also makes the data capturing system slow, sensitive to mistakes and prone to misinterpretation. Most of the data from medical programs are aggregated manually before being analysed and reported.

The entire process of data capturing from patient to report involves tedious manual work, that introduces room for mistakes and delays and is unnecessarily expensive in terms of staff involved and time spent in entering and checking data.

An improvement is the implementation of a more modern system of data processing to replace the collection of data in Excel: the Health Information System (HIS). The HIS is a new data collection system that MSF developed and is implementing in its projects for data entry, aggregation, visualisation and reporting. The software for data entry changes, and the data are fed direct in an MSF data platform (HIS), from here it is automatically processed in a reporting format according to MSF OCA's requirements. However, the step from hand-written patient cards and registers to electronic data has not changed yet.

To address this, an application for electronic medical records (EMR) was developed in 2016. This EMR, called Buendia, made it possible to electronically register and follow individual patients in the in- and outpatient feeding programs. The objective of the EMR was to make the follow-up of patients more efficient and accurate, to improve treatment quality, and to improve the timely and efficient reporting of program data. Evaluation of the first version of the application showed that the system was hindered by the limited capacity to synchronize all data simultaneously: the number of data per patient, the number of users, the number of patients combined with instant backups in a context with limited connectivity. As it would require major investments to fix the application, the decision was taken to temporarily halt the development of electronic medical records.

MSF is not the only actor in the humanitarian world attempting to rationalise data flows. In the past few years, other humanitarian organisations working in the domain of nutrition have deployed mobile data collection (MDC) tools to register patients electronically.

In order to advance electronic registration, it would be helpful to explore which electronic registration tools are being used and to identify the pros and cons of every tool.

This research is restricted to electronic registration tools in the outpatient feeding centres, also known as Ambulatory Therapeutic Feeding Centres (ATFC). The electronic tools eligible for examination should be able to eliminate the use of pen and paper in the registration process, to increase efficiency and accuracy of registration, to deliver data instantly to program management to facilitate decision-making, and to feed directly and instantly into the core data capturing system (HIS).

Electronic tools used in ATFC's that are in the periphery (outside the main hospitals) should work on mobile electronic hardware, such as a mobile telephone or tablet, thus restricting the search to Mobile Data Collection tools (MDC tools)

The objective of this research is to identify and evaluate existing mobile data collection tools (apps and platforms) for registration in outpatient nutritional programs that meet MSF OCA objectives, standards and needs. As MDC tools are also being used in other medical disciplines, such as in outpatient maternal health and HIV programs also these tools are taken into account as these can, after minor adaptations, potentially meet requirements of MSF.

The evaluation of hardware is not a part of this scoping exercise, as it is a requirement for any application. The app or platform should function on low-cost hardware, using minimal power and offer sound connection possibilities to import and export data.

This research project was granted funding in August 2017 by the Sapling Nursery Fund. In October 2017, the project manager was contracted.

## 1.2. Technical framework of electronic registration

Figure 1 shows the flow of work and information ( data ) when a patient is registered electronically in an ATFC. Within MSF an ATFC is an ambulatory therapeutic feeding centre.

### Scope:

Ambulatory therapeutic feeding or ambulatory nutritional care is provided in outpatient facilities. Ambulatory is usually a place where MSF meets a group of patients on weekly basis, e.g. a mobile clinic under a tree, or a community health centre.

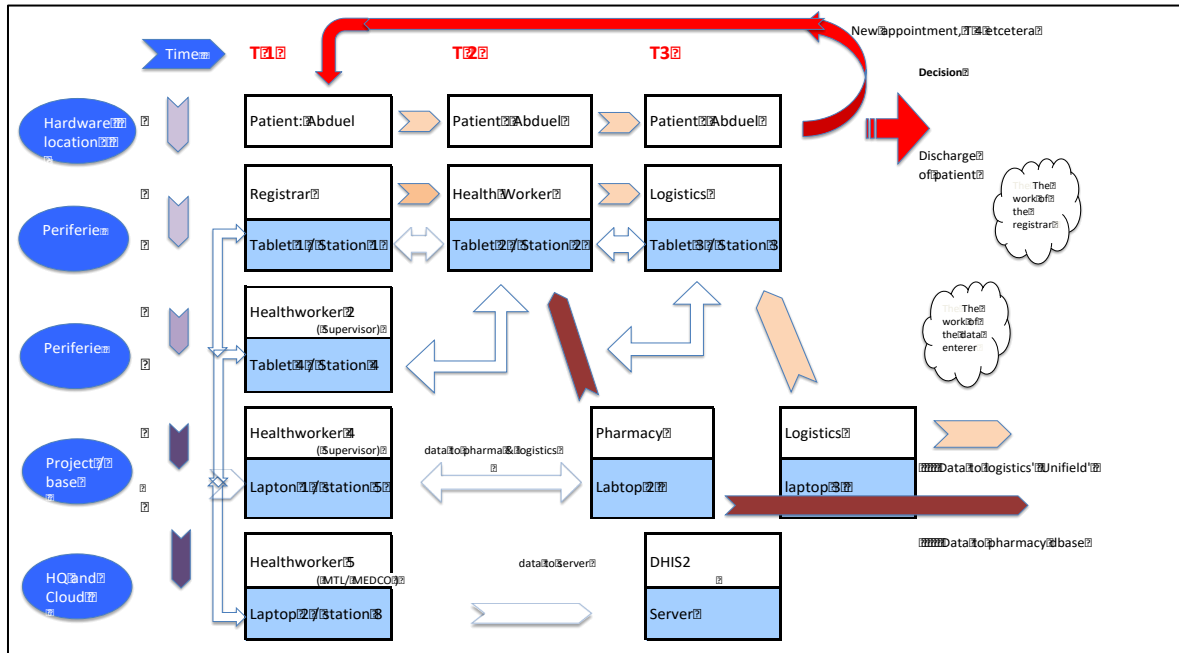
This ‘ outpatient ’ or ambulatory place sets the scope of this report. An ATFC is usually not located in a fixed health facility. It can be seen as any activity where a certain type of patients can be frequented easily.

Hence, the data, collected with an app must be collected in the periphery assuming that there will be no internet connectivity or local telecommunication network. After the data is collected in the periphery, the devices are brought back to the project and exported and aggregated on a desktop at the project base, where it can be screened and corrected if needed.

To make sure patients can be followed up, the data needs to be fed back for follow up and further data collection in an ATFC (such as new data on weight, oedema, distribution of RUTF and eventually the discharge data of the patient).

After a certain period, and after approval, the data will be exported to the MSF OCA HIS and ultimately via the HIS to DHIS2. Either our HIS or DHIS systems deliver reports.

Figure 1: Electronic data flow ATFC and scope of this research:-



The patient is the data holder and the registration officer (tablet or station 1) registers the first set of data: name, family, address and his siblings, nutritional and some medical data at admission.

During the next step (tablet or station 2) the patient is consulted by a health worker, weight, height and Mid Upper Arm Circumference (MUAC), and oedema is measured and at the following station is medical consultation where some data will be captured like malaria, TB and vaccination status.

At the following step (tablet or station 3) the patient receives medicines and ready-to-use therapeutic food (RUTF). A new appointment is made, data is synchronised and the cycle repeats itself until the moment the patient is discharged from the program. Some data will be recorded during the enrolment in the program, such as presence, and upon discharge such weight and date of discharge. When using paper and pen the data described are usually entered in the registration book (and from patient cards in the registration book), from where a data enterer will copy data in an excel sheet. The aim is that the new electronic recording system replaces the paper registration book and replaces the central data enterer.

### 1.3. Concepts

These data flows are not easy to explain using current terminology. Therefore, this section will introduce a new term for the method of collecting data, explain the difference between apps and platforms, and clarify the concept of Electronic Medical Record (EMR) using definitions developed by the WHO.

#### 1.3.1 Application and platform

- In this report, we define app and platform as follows: App: an app can be defined as a single application for a certain purpose medium to access an electronic platform. For example, the Buendia app was specifically built by MSF OCA as a medium to register, collect, aggregate and report data for in- and outpatient nutrition programs. An app can be adapted for use in other programs (eg. Ebola instead of nutrition).



- Platform: a platform is an electronic structure on which several apps can be build with similar underlying software and who potentially are able to complement each other. When the technical framework is updated , the app evolves automatically with that update. Several companies have developed mobile data platforms that offer the possibility to build app's.
- Although the software of an app can be adapted to make is suitable for other purposes, if it has not happen yet, we call it an app in this report; and a platform if there are currently several apps running on the same platform.

### **1.3.2 Electronic medical record (EMR) or a registration system**

According to the definitions for digital solutions<sup>1</sup> as developed by the WHO, digital tools for registration in the ATFC are in category 2: “digital health interventions” for “health care providers”. The following sub-categories apply: client registration (2.1) and client records (2.2), longitudinal tracking of patients (2.2.1) and routine health indicator collection and management (2.2.4).

Longitudinal tracking of patients has different forms. It can be extended, for example where a bedside EMR needs instant data entry to inform patient management, or it can be simple, where data is only entered at patient entry and exit. The latter is the current practice in the registration book of the ATFC's. An EMR system for patient management (including diagnostics, treatment and follow-up on daily basis) should have access to a large quantity of retrospective data, should include a system for data entry by several health providers, and should enable patient management to see all data by providing instant synchronisation and back up of data.

For the eATFC, longitudinal tracking of some data is important to support a good quality of care, such as weight change, presence and absence on appointments to identify defaulters, RUTF distribution. Synchronisation of this data between multiple mobile devices and users is an asset, enabling multiple registration points.

A system for capturing data that are required in an ATFC registration book is different from an electronic medical file (EMR) where all (medical activities) are entered continuously and the patient can be monitored over time on a daily basis or instantly (bedside like Buendia); this is not our scope.

Electronic registration in an ATFC can be seen as a light form of EMR as some data are tracked over time, but it is not comparable with a full bedside EMR. Therefore we call it “light-EMR”, as it still tracks some data over time.

Preferably it should enable several users (at different stations) to enter data, requiring only light local synchronisation of data with two or three registrars, and only full synchronisation with the main database when back at the base.

### **1.3.3 Mobile data collection (MDC)**

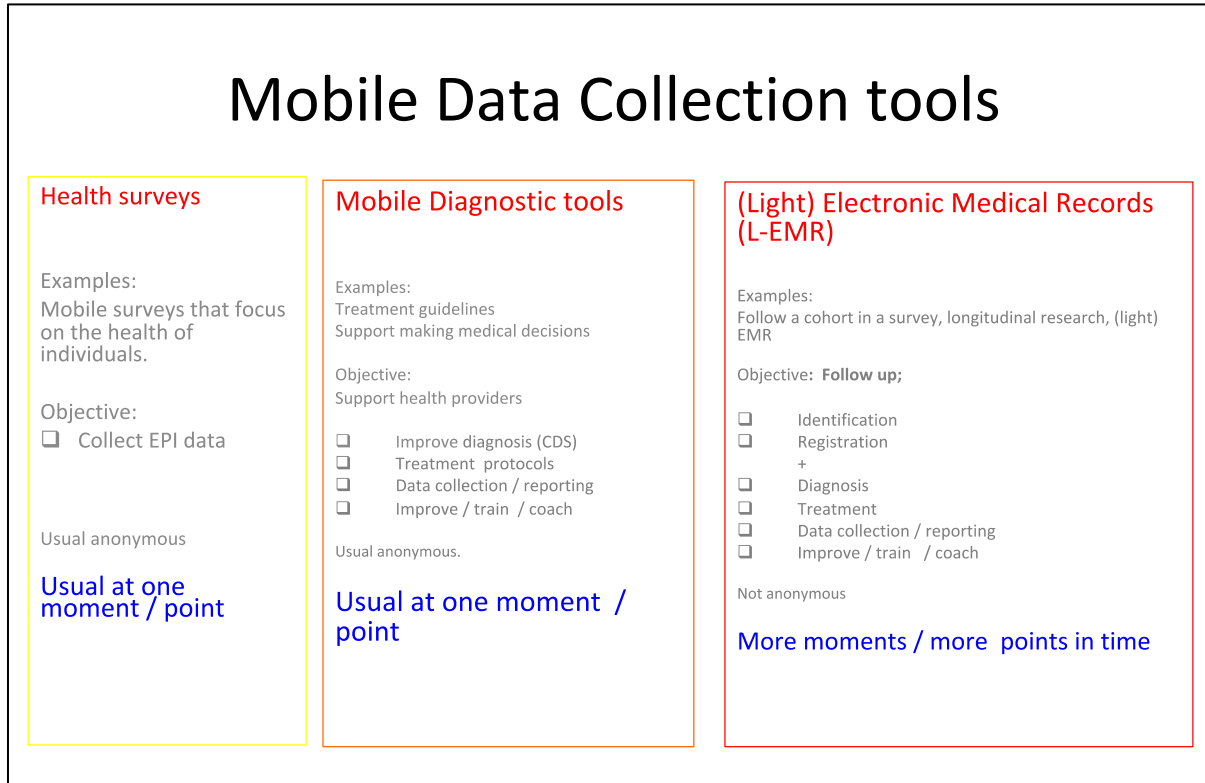
Data collection tools using mobile phones, tablets or PDAs for programming or data collection are called mobile data collection (MDC). MDC tools or apps can run on mobile devices (tablet or smartphone) and desktop computers. An intranet or internet connection (e.g. Wi-Fi, Meche network, intranet, or an individual patient data carrier<sup>2</sup>) is needed for the communication between mobile devices.

<sup>1</sup> WHO 2018; Classification of Digital Health Interventions v1.0; a shared language to describe the uses of digital technology for health.

<sup>2</sup> An individual patient data carrier in our workflow could be a NFC tag. On a NFC tag or wrist carrier data can be stored, read and restored.

Figure 2 shows an overview of the purposes for which MDC tools can be used. These purposes vary widely, from surveys to longitudinal follow-up of patients. The MDC tools and/or platforms for ATFC registration purposes need to support client registration, longitudinal tracking of patients, and routine health data collection and reporting (WHO data classifications 2.1, 2.2.1, and 2.2.4).

Figure 2: Mobile Data Collection Tools and their use



The evaluated MDC tools have been built for a specific purpose or scope eg to collect and research data over a long period of time, to capture data at one moment (survey) or to support field worker with the collection of data but also with decision-making process. This research has not focused on the original purpose of a tool but on how the tools are used today by actors.

Most MDC tools (2.3) can provide decision support to health care providers. When patient data are entered, the app gives guidance to follow a protocol and skips fields when a certain type of data is not relevant.

MSF Switzerland implemented a successful mobile e health application, running on the platform Mango Logic, the application supports health-workers with the diagnosis and clinical decisions.

A number of existing MDC tools included WHO categories 2.1 and 2.2 can track patients over time, which is required in electronic registration in and ATFC. They offer the features to track, amend and follow-up case or patient data over time.

## 2. Methods

The scoping research is divided into four phases:

1. Define requirements and functionalities (minimum requirements, optional requirements useful for program management and requirements for a full electronic medical record system) and rate these requirements according to relevance and importance.
2. Explore the market for existing applications and MDC tools. Explore the use of MDC tools by other NGO's.
3. Evaluate the selected apps and platforms with MDC tools against the needed requirements, expected functionalities; explore user experience and management considerations.
4. Propose to deploy an application or MDC tools and make a recommendation for management, based on the evaluation and user experiences.

Interviews were held with MSF staff (requirements), MDC tool providers (technical requirements and cost structure), and users (experience). Software was tested physically when possible.

### 2.1 Define data requirements and functionalities

A list of requirements and functionalities was derived from interviews with (medical) staff from the Emergency and Public Health department and the ICT department. Requirements and functionalities were also derived from the current workflows in TFC's, from the previous Buendia electronic patient file project, and from the scoping research of data platforms for surveys (Manson unit).

The requirements for automatic configuration and data transfer to the Health Information System (HIS) of OCA was received from OCA's HIS Project Lead team. A complete list of requirements and functionalities was made and rated by the scoping team according to the importance and relevance.

### 2.2 Explore the market for MDC tools

The market for apps and mobile platform was investigated by searching Internet and congresses, interviewing MSF innovation teams, interview with NGO's active in nutrition and through suggestions of interviewed users of platforms. The ICT department and the Manson Unit of OCA suggested also possible applications and platforms for patient registration.

### 2.3 Evaluation of MDC tools

The selected apps and MDC tools were evaluated against the developed framework of data and functional requirements. This resulted in scores that represented the performance of a certain app/platform in a certain category.

Existing software was tested using demos of MDC applications or a we set-up a demo to test the capacities to register and follow patients in an outpatient therapeutic feeding centre. An IT system analyst supported us in this process.

Other NGO's were interviewed to integrate their user experiences in the evaluation of the MDC tools. Within MSF, the following sections shared their experiences and gave their feedback on the use of MDC tools: MSF Brussels (OCB), MSF Barcelona (OCBA), MSF Geneva (OCG), and the MSF Amsterdam (OCA) Manson Unit. Outside MSF, we interviewed the following NGO's: Action Contre Le Faim (ACF), International Committee Red Cross (ICRC), International Medical Corps (IMC), Open Development LCC, Oxfam GB, NOORA Health, Save the Children Fund UK (SCF), Terre des Hommes Switzerland (TdH), UNICEF, World Heart Federation, and World Vision International (WVI). The ICT

department of OCA supported this report and helped searching for possible applications and platforms for patient registration. Interview topics included the reasons for choosing certain MDC software, experience with using in a program, their plans, and challenges.

Several issues raised by MSF management were explored, e.g. necessary investments, running costs, provider service, and compliance with personal data protection regulations.

### 3. Development of data requirements and functionalities

#### 3.1 Interviews

In November 2017, approximately twenty open guided interviews were done with medical staff working in the Emergency and Public Health Department and staff returning from the field. Most interviewees recognised the dire need to innovate and improve ways of collecting and registering data. Office staff reported being amazed by the high workload to obtain accurate and reliable data. Members of the E desk reported that during the Ethiopian nutrition crisis in (2017) the data collection and registration of malnourished patients created over 6.000 paper patient records in six months. Instant monitoring of the numbers admitted was required in this emergency situation, but not always timely and accurate. Developing overviews also proved to be a monstrous task; after nine months, there was still no complete and correct registration of all patients.

The interviewees had many different expectations of the required functionalities, due to their different tasks and disciplines. Field staff reported a good application to collect rough data of boat refugees. However, this is not a registration tool, merely a tool to collect data. Many interviewees expressed the wish for electronic medical records (EMR), which offer functionalities beyond a patient registration book. While this scoping exercise keeps in mind the required data to register patients (registration book and MSF eATFC data collection requirements), it looks at the feasibility of light EMR instead of full.

#### 3.2 Data Requirements

The research team developed a list of data to enter in an app/process by a MDC, and a list of functionalities. During the scoping process, new information was retrieved from existing and previous apps, interviews, and software engineers, which yielded important functionalities for the evaluation of apps /platforms and MDC's.

All collected requirements and functionalities were gathered in a spreadsheet (data requirements separated from the functional requirements).

The data requirements have been rated on relevance and importance.

##### Minimum requirements are:

- Information normally collected in the registration book
- Information required in the HIS program
- Information needed to monitor progress of certain activities, mentioned in the MSF OCA strategic plan 2015-2019 (e.g. vaccination status)
- Information required by UNICEF

If a minimum requirement is not present and can't be added, the app/platform is not suited for OCA.

##### Optimal requirements are:

- Information on the wish list of future users and stakeholders
- Information that could be useful for other departments, e.g. the possibility to register RUTF distribution

Electronic Medical Record

- Data used for individual patient monitoring and management, but not necessarily used in the registration book

The rating was based on minimum requirements (1), optimal requirements (0,66) and those required in an electronic medical record (0,33).

In total 51 data requirements were collected and allocated into 4 categories:

- Patient Identification, 13 items (9 minimum, 4 optimal)
- Anthropometry (Admission Data), 11 items (6 optimal and 5 EMR)
- Medical Requirements, 20 items (9 minimum and 11 EMR)
- Program requirements, 6 items (3 minimum, 1 optimal and 2 extended)

*Table 1: Example of requirements and the rating of category data for patient identification*

Category	Description of requirements	Rating		
Patient Identification		1 minimum	2 optimal	3 EMR
	MSF ID health card	X		
	ID number / health number	X		
	Family name	X		
	First name	X		
	Age (months)	X		
	Gender	X		
	Name caretaker	X		
	Village	X		
	Address	X		
	Telephone number		X	
	Finger print / IRIS scan (embed grading )		X	
	Photo patient		X	
	Photo care taker		X	

In the above category, most requirements are minimal; telephone number, patient fingerprints, patient photo and caretaker photo are optimal requirements.

### 3.3 Functionalities

The interviews, Buendia app, and input from other scoping research contributed to a long list of required and preferred functionalities. The total list exceeded 100 functionalities. Similar to the data requirements, the functionalities were divided in categories:

1. The performance of the platform
2. The access and security of the platform
3. The possibility to scale and modify the platform
4. The possibilities to analyse and make overviews
5. The registration and use options
6. The possibilities to integrate and be compatible with other platforms or apps
7. The acceptance and user-friendliness
8. The expected support and future proof of the platform or app
9. The safety, back-up and synching of data
10. The future cost of using the app or platform in the field

As illustrated below, an MDC tool that has been deployed in the field and is able to register and follow-up the data of over 1.000 patients receives a rating of 1. MDC tools that are tested with 20.000 patients receive 2 more points. (Initially, a test on 50.000 patients was planned, but this proved unrealistic.)

**Table 2: Example of functionalities**

Number	Category	electronic register book in ATFC = Description of functionalities	Final Rating
1	Performance app	Capable of registering more than 1.000 patients	1
		Tested with 1.000 patients	1
		Tested with 20.000 patients	2
		Deployed and fully operational in the field (reference/recommended)	2
		Providing real-time aggregated data of number of admissions	2

The example below lists the functionalities that indicate how a tool/platform might perform and be sustained over time.

**Table 3: Example of future-proof rating**

Number	Category	electronic register book in ATFC = Description of functionalities	Final Rating
8	Future Proof	Non-vendor locking	2
		Owner of platform does not have ownership or access to the data	2
		Automatic updates by company that built the app	2
		Appropriate documentation developed to support trainings	2
		Online training to set up and adapt the platform	2

### 3.4 Other considerations

A digital tool to register patients in an ATFC electronically has other important features besides data and functional specifications. The information on data requirements and functionalities came predominantly from the app/platform providers; it is important how this is functioning in practice. We therefore have included the experiences of other users.

In addition, decision makers need additional information important for the management MSF; Therefore some key components were explored as. The costs, the service of the provider, and data protection regulations were examined.

## 4. Evaluation of existing software

Existing MDC platforms and apps were captured through MSF contacts, existing benchmark exercises, interviews with other NGO's known to be active in (e-)health (snowball effect) and a search on internet. OCBA and the Manson Unit reviewed mobile data collection platforms. The review of the Manson unit focused on the selection of electronic survey platforms that can be used in field surveys, resulting in the selection of the Dharma and Kobo/ODK platforms. OCBA focused on an easy-to-use MDC tool; case management was not a priority. The NGO's CartONG and Kopernik also performed an interesting benchmarking of MDC tools. Through these benchmarking exercises 29 MDC tools were identified; other searches added 2 applications to the list of potential application and platforms resulting in a total of 31 potential platforms/apps to be evaluated.

The criteria for extracting a shortlist of MDC tools to be evaluated in detail were: track record of MDC with medical NGO's, focus on longitudinal case management, and a working or functioning mobile application (See annex 7 for a full list and their compliance with these criteria).

As a result, the following six tools were selected for evaluation:

- 4.1 Survey CTO, a MDC platform
- 4.2 Commcare by Dimagi Inc., a MDC platform
- 4.3 Dharma by Dharma Platform Inc., a MDC platform
- 4.4 Mango Logic developed by Thing Prima GmbH, a MDC platform
- 4.5 Buendia, an app developed by MSF Amsterdam , potentially a platform
- 4.6 Easynut, an internet platform producing a single app developed by MSF Belgium
- 4.7 Scope Coda, a MDC tool, not technically evaluated

## 4.1 Description apps and platforms

### 4.1.1 Survey CTO platform

Survey CTO is an online Mobile Data Collection platform based on Open Data Kit (ODK ). Survey CTO has added features to ODK that can help the user manage individual cases and/or patients. Users have to pay for the Survey CTO platform. Survey CTO supports users to capture, transport, and process data collected during personal interviews (Computer Assisted Personal Interviews, or CAPI). The MDC tools of Survey CTO are deployed in 130 countries. Datasets can be made in Excel and in Google Sheet. The developing language is Javascript. Dobility Inc. is the company behind Survey CTO.

### 4.1.2 Commcare platform by Dimagi Inc.

Commcare, is an open source platform where developers can build apps or forms to collect and register data. The source code is available but not very user-friendly for developers and not much help from the company behind it is available. However it's source code remains available. Open source means that the software can be installed anywhere, complying with security / ethics / legislation requirements.

If an organization or a developer does not have the knowledge or qualification to develop a tool, the company Dimagi Inc. offers services to develop an app. Dimagi Inc. can offer service and a support in Asia and Africa where it has a large user base in Africa and Asia. Tools built on this platform are used in over 150 countries. Apps built on the Commcare platform have proven to work well in the low-resource settings of our scope.

Commcare is based on Open Data Kit (ODK) and Commcare designs smart interfaces to help users collect data. It uses Xforms and the JavaScript language.

### 4.1.3 Dharma Platform by Dharma Inc.

Dharma Platform can manage different data collection projects within one platform. It provides an application with collection, management, analysis, and visualization features, which can be used real-time in health, logistic, and research sectors. Several NGO's working in crises and development context use the Dharma platform to collect data. Dharma is committed to empower organizations to solve complex data challenges in difficult environments. MSF is using the Dharma platform for surveys and other data that are usually are collected with tally sheets. Dharma enables non-programmers to configure, maintain and validate data challenges.



#### **4.1.4 Mango Logic platform developed by Things Prime GmbH**

Mangologic is a platform that facilitates the development of mobile decision-support and data collection systems. Things Prime GmbH, a Swiss private limited company, has developed the software. D tree International, the service provider, leverages technology to build digital solutions that supports other NGO's to strengthen their health systems. D three deployed the application of Mangologic in 9 countries in Sub-Saharan Africa and in India, Bangladesh and Myanmar.

Mangologic is also used in MSF OCG's eCARE project, Electronic algorithms to support diagnoses and treatment in Integrated Management of Childhood Illnesses (IMCI) programs; it is being rolled out in several African countries. MSF OCG has also used Mangologic successfully in a vaccination campaign in Central African Republic. Mango-logic MDC tools are deployed in Maternal Health programs in Tanzania and in Zanzibar for follow-up of the pregnant women.

Mangologic permits non-programmers to configure, maintain and validate even complex decision logic. The registration and longitudinal tracking of clients is a standard functionality of this software.

#### **4.1.5 Buendia app by MSF OCA**

The Ebola outbreak in 2016 highlighted the need for paperless, electronic patient files. The app Buendia was designed to manage patients admitted to TFC's and to manage the electronic medical records more efficiently. The app was tested in the field, but further development was halted [due to difficulties synchronising the comprehensive data of multiple simultaneous users](#). MSF OCA has prioritised the development of a health information system based on DHIS2. Buendia was built on OpenMRS and ODK using Java. The server side is built on OpenMRS and the client (mobile device) app is built on ODK. Although the decision was taken to stop any further development we have evaluated the application.

#### **4.1.6 Easynut app by MSF Belgium**

EasyNut is a web app and should be installed in a server. This server can be in the field without any internet connection. The server running the application [creates](#) a local hub or intranet. The web app is developed by MSF Belgium. Easynut, is a strong example of how the data requirements of a Therapeutic Feeding Unit have been translated into an application to collect patient data electronically.

The application is a tool that helps register, record and follow up patients over time. All the standard and non-standard data requirements are integrated. MSF Belgium [started to develop the app several years ago and follows a cohort of Nutritional Patients over the course of 2 years](#). The disadvantage of this app is that it will not work without a local server.

The goal of Easynut was to get away from more heavy and complex platforms (OpenMRS, OpenEMR) and to offer something more limited and simpler to configure. The app has been made in Python 2.7 using the Django framework.

Easynut has been deployed in the ITFC/health centre of Fori (Maiduguri, Nigeria) with 25 users and 5.000 patients. It is not an MDC tool, as it cannot function without a local server. Although the software is operational in the field and works as a proof of concept, it has been decided to halt the further development of the application. MSF Belgium has prioritised the development of DHIS2 and Bahmni. ([Bahmni is a platform but not a MDC and therefore it is beyond the scope of this research.](#))



### 4.1.7 Summary description

The following table summarises the design structure of the tools:

**Table 4: Data analysis and overview**

MDC platform/app	Survey CTO	Comm care	Dharma	Mangologic	Easynut	Buendia
Based on	ODK	ODK	Own framework	Own framework	Django	ODK, OpenMRS
Type of forms	XLS, Google Sheets	Xforms	Own form	Own form	HTML form	Xforms
Main development language(s)	Javascript	Javascript	Python & Java script	Java	Python	Java
Client Android	YES	YES	YES	YES	YES	YES
Client IOS	NO	NO	YES	NO	YES	NO
Client Windows	YES	YES	YES	YES	YES	YES
Hosting	Amazon web Services	Commcare	Dharma (Google Cloud?)	Mangologic (Google Cloud?)	Easynut	Buendia
Database Management Software	MySQL/postgreSQL	MySQL	unknown	MySQL/Firebase	MySQL	SQLite

Survey CTO and Commcare were founded on the open source Open Data Tool Kit. Both platforms use XLS / X forms to start an application.

Dharma and Mangologic made stand-alone digital tools where users directly compose or write your application on the platform. EasyNut is a web app and runs on a local server.

Both Dharma and Mangologic use of Google for hosting the platform. Google focuses its developments in the growing field of Artificial Intelligence (AI). *Anybody can follow Google A.I. developments closely and integrate to develop smarter algorithms in their MDC tools. As the AI technology is only available in Google servers, therefore platforms move their tools into Google hosting.*

Easynut and Buendia are apps (at the moment) and both require a server for functioning. With the help of a local portable server modus the apps can be run on tablets and telephones. This server can be in the field without any internet connection. The strong part of Easynut is that it is an online web-application with all its managerial benefits of the net. Its disadvantage is that it should be installed on a local server that creates the interconnectivity.

Also Buendia needs a server to run the software and to create a local network. Buendia was built on OpenMRS and ODK using Java. The server side is built on OpenMRS and the client (mobile device) app is built on ODK. The open MRS makes the application very heavy and this might be a reason for difficulties during synchronisation. Buendia built an app that could be used in an inpatient and outpatient setting in an integrated way, supporting also patients medical data (EMR)

## 4.2 Benchmarking the apps and platforms

To support the registration and case management of nutritional patients in outpatient therapeutic feeding centres we have defined 51 data requirements. These 51 data requirements were divided in 4 categories:

1. Patient Identification; standard and extended
2. Anthropometry; standard, extra and extended
3. Medical; extra and extended
4. Program; standard, extra and extended

### 4.2.1 Patient Identification

**Table 5: Standard patient identification**

Patient ID		Max rate	Survey CTO	Comm care	Dharma	Mangologic	Easynut	Buendia
standard	MSF ID health card	1	1	1	1	1	1	1
	Patient number	1	1	1	1	1	1	1
	Family name patient	1	1	1	1	1	1	1
	First name patient	1	1	1	1	1	1	1
	Age patient (months)	1	1	1	1	1	1	1
	Gender	1	1	1	1	1	1	1
	Name caretaker (father, mother)	1	1	1	1	1	1	1
	Village	1	1	1	1	1	1	1
	Address	1	1	1	1	1	1	1
Total	9	9	9	9	9	9	9	

All evaluated MDC tools are able to register the standard patient identification data.

**Table 6: Extended patient identification**

Patient ID extended		Max rate	Survey CTO	Commcare	Dharma	Mangologic	Easynut	Buendia
	Telephone number	1	1	1	1	1	1	1
	Biometric ID (FP, iris)	0.33	0	0	0.16	0.33	0	0
	Photo patient	0.33	0.33	0.33	0.33	0.2	0	0
	Photo caretaker	0.33	0.33	0.33	0.33	0.2	0	0
	Total	1.99	1.66	1.66	1.82	1.73	1	1

Not all evaluated MDC tools are able to collect extended identification data (fingerprints and photos). With Survey CTO Collect, Commcare, Dharma, and Mangologic, it is possible to add the photo of a patient and of their caretaker(s). Mangologic also offers the feature to add fingerprints to the identification process. Dharma does not offer this feature yet, but is investigating the option with its engineers.

### 4.2.2 Anthropometry

**Table 7: Standard anthropometry**

Anthropometry standard		Max rate	Survey CTO	Commcare	Dharma	Mangologic	Easynut	Buendia
	Weight	1	1	1	1	1	1	1
	Height / Length	1	1	1	1	1	1	1
	Weight/Weight Z-score (manual)	1	1	1	1	1	1	1
	MUAC	1	1	1	1	1	1	1
	Oedema	1	1	1	1	1	1	1
	Discharge weight	1	1	1	1	1	1	1
	Total	6	6	6	6	6	6	6

All evaluated MDC tools are able to register and manage a patient's standard anthropometry over time.

**Table 8: Non-standard anthropometry**

Anthropometry		Max rate	Survey CTO	Comm care	Dharma	Mangologic	Easynut	Buendia
Extra	Admission criteria	1	1	1	1	1	1	1
Extended	Weight/Weight Z-score (automatic)	1	1	1	1	1	1	1
	Oedema (0, 1+, 2+, 3+)	1	1	1	1	1	1	1
	Discharge MUAC	1	1	1	1	1	1	1
	Discharge Length/Height	1	1	1	1	1	1	1
Total	6	6	6	6	6	6	6	

All evaluated MDC tools are able to register and manage the patient's non-standard anthropometry over time.

### 4.2.3 Medical

**Table 9: Standard medical treatment**

Medical treatment standard		Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easy nut	Buendia
Extra	Malaria test	1	1	1	1	1	1	1
	Outcome malaria test	1	1	1	1	1	1	1
	TB test	1	1	1	1	1	1	1
	TB status	1	1	1	1	1	1	1
	HIV test	1	1	1	1	1	1	1
	HIV status	1	1	1	1	1	1	1
	Vaccinations given (list in HIS)	0.66	0.66	0.66	0.66	0.66	0.66	0.66
	Vaccination status on exit (complete, partial, none)	1	1	1	1	1	1	1
	Vaccinated for measles	1	1	1	1	1	1	1
Total		8.66	8.66	8.66	8.66	8.66	8.66	8.66

In an outpatient nutritional feeding centre, the current MSF OCA strategy is to test patients for malaria, TB, and HIV. The patient's vaccination status upon admission and discharge are also assessed. All evaluated MDC tools are able to monitor these results.

**Table 10: Medical state at admission**

Medical state at admission		Max rate	Survey CTO	Comm care	Dharma	Mangologic	Easynut	Buendia
Extended	Temperature	0.66	0.66	0.66	0.66	0.66	0.66	0.66
	Malaria	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	Previously in OPD/IPD	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Breast feeding status	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Consciousness	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	Pulse & heart rate	0.66	0.66	0.66	0.66	0.66	0.66	0.66
	Respiratory rate	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Medication	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	General condition	0.66	0.66	0.66	0.66	0.66	0.66	0.66
	Appetite test	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	Vital signs	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Total		4.43	4.43	4.43	4.43	4.43	4.43	4.43

The above-mentioned extended medical conditions are usually not captured in the reporting of an outpatient nutritional facility. However, when patients require daily care, these conditions are monitored electronically, i.e. an EMR. All evaluated MDC tools are able to record the data.

### 4.2.4 Program data

**Table 11: Monitor program functioning**

Program functioning		Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easy nut	Buendia
standard	Date of admission	1	1	1	1	1	1	1
	Referral from	1	1	1	1	1	1	1
	Date of exit	1	1	1	1	1	1	1
	Type of exit (cured, defaulter, death, etc.)	1	1	1	1	1	1	1
	Type of admission (new, relapse, etc.)	1	1	1	1	1	1	1
	Extra information, e.g. receiving food aid	1	1	1	1	1	1	1
	Number of RUTF given	0.66	0.66	0.66	0.66	0.66	0.66	0.66
	Total		6.66	6.66	6.66	6.66	6.66	6.66

All necessary data to manage the nutritional program is integrated or can be integrated into the evaluated MDC tools. In the Easynut application, the distribution of RUTF is recorded and the data are exported/shared with the logistics department to support stock management. In all other MDC tools, this can potentially be incorporated.

#### 4.2.5 Conclusion Data Requirements

All evaluated MDC tools have integrated or can integrate the data requirements of an outpatient nutritional centre.

**Table 12: Summary data requirements**

		Survey CTO	Comm care	Dharma	Mangologic	Easynut	Buendia
Patient Identification	Standard	9	9	9	9	9	9
Patient Identification	Extended	1.7	1.7	1.8	1.7	1	1
Anthropometry	Standard	6	6	6	6	6	6
Anthropometry	Extended	4.3	4.3	4.3	4.3	4.3	4.3
Medical	Extra	8.7	8.7	8.7	8.7	8.7	8.7
Medical	Extended	4.4	4.4	4.4	4.4	4.4	4.4
Program data	all	0.7	0.7	0.7	0.7	0.7	0.7

As the categories of data requirements are not weighted, the rating of the different aspects cannot be summed up to construct one single total score. The MDC tools have score similar ratings, with the exception of added patient identification features. Mangologic has experience with adding biometrics to patient identification processes. They also have experience in circumventing biometrics by giving a patient an electronic token/card with their data.

### 4.3 Functionalities

The Easynut and Buendia are applications that run on a local server that serves as a hub. These apps are only suited in an outpatient nutritional centre, when a local mobile server or hub can be installed quickly. Easynut is used in a fixed - not mobile or outpatient- therapeutic centre and Buendia used it for in- and out-patient settings but had syncing problems when using a relative small mobile server. In this chapter, the functionalities of all six data collection tools will be evaluated.

The functionalities were categorised into nine subgroups. In the following paragraphs, the results of benchmarking MDC tools are presented.

#### 4.3.1 Performances of the MDC tools

**Table 13: Technical performance**

Technical performance	Max rate	Survey CTO	Comm care	Dharma	Mangologic	Easynut	Buendia
Capable of processing > 1.000 complete records	1	1	1	1	1	1	
Tested with 1.000 patients/records	1	1	1	1	1	1	
Tested with 20.000 patients/records	2	2	2	2	2	1	
Tested and proved to be accurate by client	1	1	1	1	1	1	
Real-time/timely, providing total number admissions	2	1,5	1,5	2	2	2	
<b>Total</b>	<b>7</b>	<b>6,5</b>	<b>6,5</b>	<b>7</b>	<b>7</b>	<b>6</b>	

The MDC tools Survey CTO, Dharma, Mangologic all are capable to collect more than 1000 records. The scores of Commcare were slightly lower, Easynut was rated as medium, and Buendia concept was not fully tested. Survey CTO, Commcare, Dharma and Mangologic all function in offline /off-grid contexts, while Easynut and Buendia [require a connection to a local server/network](#).

#### 4.3.2 Access and security

**Table 14: Technical management**

Technical management	Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
User log on required (automatic log off)	1	1	1	1	1	1	1
MDC tools PIN-protected on mobile and desktop	1	1	1	1	1	1	1
Secure password for Wi-Fi	1	1	1	1	1	1	1
Role-based, user rights can be limited	2	2	1.5	2	2	2	2
Data sharing and export /import encryption	2	2	2	2	2	2	2
Software and data can be hosted on own server	3	1	1	1	1	3	3
Total	10	8	7.5	8	8	10	10

Survey CTO, Commcare, Dharma, and Mangologic work well with multiple users user log on, security and roles can be all well organized. EasyNut takes it a bit further by specifying roles between the data collectors: for example the pharmacist not being able to access the same data as the nurse. [Buendia makes a substantial difference in specifying roles as it follows the OpenMRS software that is specialized in the differentiations of functions and responsibilities.](#)

Data can be shared and export and imports can be encrypted. They also all offer the possibility to host software and data on a client server but so far, only International Committee of the Red Cross (ICRC) accomplished to host the software and the collected data on its own servers. [By hosting the software and data on its own servers is complies with it's ethical and legal requirements.](#)

All the evaluated MDC platforms offer the possibility of encrypted data sharing-

The data structure of Survey CTO and Commcare has not been designed for local or remote data sharing between users. Data needs to be updated and synchronised via a central server before data can be added by other users or stations. Therefore, Survey CTO and Commcare can only function optimally when the workflow in the ATFC is adapted to the use of one tablet or station per centre.

Dharma and Mangologic offer abilities to share data between users/stations in an off-line context (See the illustrated workflow of our ATFC in Figure 1.) Within Mango Logic data between users can be shared in an off line context via NFC chips or patient card. Within Dharma a 'mesh' network is being under investigation.

[Easynut and Buendia offer these abilities with a local server or network.](#)

#### 4.3.3 Flexible, scalable and easy to modify

**Table 15: Simplicity programming**

Simplicity programming	Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
Flexible, scalable, easy to maintain	2	2	1	2	2	1	0
MDC solution can be amended by capital and HQ	1	1	1	1	1	1	0
Can modify all data entry variables on user desktop	2	2	1	2	2	2	2
Can integrate with e-ITFC app or other apps	2	2	1	2	2	2	2
Can export data to EMR	2	2	1	2	2	2	2
Can upload from registration book/patient cards	2	2	1	2	2	2	2
Can delete/edit offline and real-time by supervisor	2	1	1	2	2	2	1
Total	13	12	7	13	13	12	9

Dharma and Mangologic users reported the best option when it comes to amending and scaling the application. A new line of information in a query or a different data entering form will not have big impact on the data exportation to another data tool (e.g. DHIS2). The NGO's we have spoken to expressed difficulties in amending Commcare's tools and exporting the data. Survey CTO, Dharma and Mangologic have shown better functionalities to export data. Dharma and Mangologic MDC tools are by users seen as the most flexible, scalable and easiest to maintain. The Easynut offers also these possibilities however the management of MSF Belgium has decided not to further invest / scale the tool. Buendia's app was piloted (proof of concept) but it was not deployed in the field.

#### 4.3.4 Capacity to make analyses and overviews

Table 16: Data analysis and overview

Data analysis and overview	Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
Provides statistics relating to activity data enterers	2	2	2	2	2	2	1
Automatically calculates average length of stay (ALS)	1	1	1	1	1	1	1
Automatically calculates average weight gain (AWG)	1	1	1	1	1	1	1
Gives number admitted /day/week/month	1	1	1	1	1	1	1
Gives number exited by period and mode	1	1	1	1	1	1	1
Automatically calculates W/H z-score and BMI	1	1	0	1	1	1	1
Gives overview absentees	2	1	1	2	2	2	1
Shows nutritional progress per patient	2	1	1	2	2	2	1
Frequent use of visuals/dynamic interface	2	2	1	2	2	2	2
Alarm when observations are outside normal range	2	2	1	2	2	2	2
Gives overview/summary of data	3	2	1	3	3	3	3
Total	18	15	11	18	18	18	15

We have seen that Easynut is a good practical example how an app can support a nutritional centre and scores full on capacity to make analyses and overviews. Dharma and Mangologic offer also nice functionality to make instant summaries or overviews of collected data. Survey CTO and Commcare are robust tools to enter data, but fail to make these quick and simple analyses or overviews before the file has been transmitted or uploaded to a desktop or a server.

#### 4.3.5 Capacity to make registration book, patient card, and use of data points

Table 17: Practical features

Interface	Max rate	Survey CTO	Comm care	Dharma	Mango Logic	Easynut	Buendia
Can generate print of register book	1	1	1	1	1	1	1
App can generate patient number and card	1	1	1	1	1	1	1
NFC bootstrapping mechanisms for data transfer over Bluetooth or Wi-Fi Direct	2	2	2	2	2	2	2
Multiple users can use app offline	3	2	2	3	3	3	3
Persistent fields (pre-filled form) possible	2	2	2	2	2	2	2
Free text responses possible	1	1	1	1	1	1	1
Multi-lingual : English, French, Swahili and Arabic	1	1	1	1	1	1	0
Use cursor position right or left (European/Arabic)	3	3	3	3	3	0	1
Can search on fingerprint	2	0	0	1	2	0	0
Total	16	13	13	15	16	11	11

The MDC applications were evaluated on practical and helpful features in a remote setting. One example is that users indicated the importance of being able to print out a patient's complete file. It is also an advantage when data can be shared in an offline mode.

All MDC tools offer the possibilities to print patient files, and search for patients with various tools and wildcards. All tools are able to design custom user roles with their own permissions to access forms, datasets, and functions.

Dharma and Mangologic are able to work in an offline mode and update data using near field communication (NFC), which was tested by uploading a complete form (our 51 questions) of approximately 1,5 Kbits via NFC. Please note that data size increases significantly when a patient fingerprint or photo is added. If the form becomes too large or the distance between users/stations exceeds 10 meters, a personal patient data carrier can improve the connection.

Mangologic offers the functionality to search a patient with a fingerprint. Mangologic also has proven experience to connect the digital tool to other digital applications.

#### 4.3.6 Software compatibility and data sharing

**Table 18: Data sharing and compatibility**

Data sharing and compatibility	Max rate	Survey CTO	Comm care	Dharma	Mango Logic	Easynut	Buendia
Runs on tablets and smart phones with Android V6 or higher	2	2	2	2	2	2	2
Runs on tablets and smart phones with iOS V10 or higher	1	0	0	1	0	2	0
Export data via CSV to a HMIS system like OpenMRS/Open EMR, HIS, and DHIS2	2	2	2	2	2	2	2
Automatic upload to server when device connects to Wi-Fi/3G	2	2	2	2	2	2	2
App can be easily set up in the field (download)	2	2	2	2	2	2	1
Standard format data exports Excel, PDF, XML, CSV	1	1	1	1	1	1	1
Automatic updates	2	2	2	2	2	1	0
Sharing or sync of data via local server	2	0	0	2	2	2	2
Sharing data via NFC chip or carrier	1	0	0	0	1	0	0
<b>Total</b>	<b>15</b>	<b>11</b>	<b>11</b>	<b>14</b>	<b>14</b>	<b>14</b>	<b>10</b>

All MDC tools run on Android, which is the most used operating system in Africa and Asia. The Dharma platform also runs on iOS. All evaluated MDC tools can export the collected data to desktop and, after completing and approval, export the data in csv format to hospital management and information systems and databases, e.g. the MSF HIS system. Next, the MSF HIS exports data to DHIS2.

Dharma and Mangologic have demonstrated user-friendly ways to share data between users in the field. For example, if three people work in a remote ATFC, with separate stations and not connectivity, they can share and update their data via NFC or a NFC chip.

Mango Logic advised not to share data via NFC (WiFi-direct or Bluetooth) as it would mean that a health worker would need to walk to an other health worker to share the data collected. Mango Logic advised to use a NFC chip or data carrier, which should be carried and kept by the patients. The NFC chip will function as a unique identifier and can pass data between stations.

If a small picture would be stored it would give us direct support in recognizing a patients and his records. Other MDC tools have not advised on this domain. We have inserted an extra line in Table 18 and granted an extra score of 1 point.

Figure 3; An example of a NFC chip or token as unique data carrier.



Easynut and Buendia offer this interconnectivity between users or devices via a local intranet network. Prior for usage this local network should be activated. In Nigeria this local network is functioning properly in a TFC but not in usage for outreach areas. Buendia is also developed to function on a local network for use during in and out-patient consultations.

#### 4.3.7 Acceptance and user-friendliness of MDC tool

Table 19: Reported acceptance and user-friendliness

User-friendliness	Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
Accepted and found user-friendly by field staff	1	1	0	1	1	1	1
Accepted by patients and caretakers	1	1	1	1	1	1	1
Intuitive interface for program users	2	1	1	2	2	2	1
Simple visuals can be used	1	1	1	1	1	1	1
Search on patient ID including wild card	1	1	1	1	1	1	1
Saves time in data entry and aggregation	1	1	1	1	1	1	1
Simultaneous multi-user possible	3	2	2	3	3	2	1
Total	10	8	7	10	10	9	7

Users reported that MDC tools are accepted in most countries by patients and their caretakers. In most countries, a health worker seen with a MDC device is taken more seriously than one without. However in other countries MDC are not trusted (e.g. Lebanon). The MDC tools of Survey CTO and Commcare are experienced as less user-friendly than Dharma and Mangologic. Both Dharma and Mangologic can give various summaries of the collected data. Also, data collected in the past can be retrieved. Another advantage of Dharma and Mangologic is the ease to work with multiple users addressing various roles. Buendia evaluation was derived from the test version, as field experiences where not available.

#### 4.3.8 Safety, backup and synchronisation ease

Table 20: Safety, backup and synchronization

Safe synchronisation	Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
Password-protected backup on USB	1	1	1	1	1	1	1
Automated backup with timer function	2	2	2	2	2	2	2
All data have timestamp of last user	1	1	1	1	1	1	1
Encrypted data traffic between users-server, user-user	2	2	2	2	2	2	2
Data-sharing between users in the field via NFC	2	1	1	2	2	0	0
Synchronisation with field server within 5 minutes	2	2	2	2	2	2	2
Total	10	9	9	10	10	8	8

All evaluated MDC tools offer thorough safety and backup functionalities.



### 4.3.9 Support, training, and future-proof features

**Table 21: Support by provider**

Support by provider	Max rate	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
Can be supported at field level by senior user	1	1	1	1	1	1	1
Minimal on-site technical support	2	1	1	2	2	1	1
Based on standard modern frameworks and techniques	2	2	2	2	2	1	1
Service layered architecture and API's	1	1	1	1	1	0	1
Platform provider 'promises' not have access to data	2	2	2	2	2	2	2
Automatic update by platform/app provider	2	2	2	2	2	2	2
Appropriate documentation to support training	3	3	3	3	3	1	1
Training to set up/adapt app available/online	2	2	2	2	2	1	0
Tech support is available from provider	2	2	1.5	2	2	1	1
<b>Total</b>	<b>19</b>	<b>18</b>	<b>16.5</b>	<b>19</b>	<b>19</b>	<b>12</b>	<b>12</b>

The introduction and sustainability of a new and innovative working tool in our outpatient nutritional facilities needs the support of the innovation department, the IT department, nutritional advisors, medco's and MTL. An MDC tool that is easy to understand, offers plug and play logic and demands minimal onsite technical supports this dynamic.

Mangologic and Dharma are MDC tools that are easy to understand, do not need specific programming knowledge, offer wider functionalities, and hence can be deployed and scaled up more easily. Users and supporting departments are likely to understand easily both applications; hence, reliance on support of the tool provider is limited. Commcare and Survey CTO are more complex platforms and users would need more support from the providers.

All evaluated MDC tools offer in-house training, online documentation and technical support.

### 4.3.10 Summary performance functionalities

**Table 22: Summary performance functionalities**

Summary performance functionalities	Survey CTO	Comm care	Dharma	Mango logic	Easynut	Buendia
Technical performance	C	C	A	A	E	
Technical management	A	D	A	A	E	E
Simple programming	C	F	A	A	D	E
Data analysis	C	F	A	A	C	C
Practical features/interface	C	C	B	A	E	E
Data sharing compatibility	C	C	A	B	E	E
User-friendliness	D	E	A	A	C	E
Synchronisation and safety	C	C	A	A	E	E
Support	C	D	A	A	E	E

The total rating of the different functional categories cannot simply be added up as the categories are not weighed. To visualise the differences, the ratings are ranked by assigning a letter (A, B, C, D, E, F); A for the highest rate, B for the next, etcetera. If tools had the same rate, they received the same letter, but a letter was skipped for the next tool, e.g. tool 1 and 2 both received an A and tool 3 received a C. This resulted in a clear picture of the rankings.

The table above highlights that Dharma and Mangologic got the best scores on performance functionalities, followed by Survey CTO. Remarkable is that Commcare, the most widely distributed MDC platform, ranks lower than Dharma, Mangologic and Survey CTO in our evaluation of mobile data tools where data-sharing between users in offline mode is essential. In addition, Commcare is perceived more complex to program. Commcare explained that their design principles, based on the ODK toolkit and their interfaces are not developed with the intention to manage cases in an offline context between various users or stations.

## 4.4 Evaluation of the Mobile Data Collection tools by their users

During the survey, we interviewed a large number of NGO staff working with electronic registration tools and mainly in the domain of nutrition. All NGO's collaborated and shared their experiences with the MDC they have deployed in the field. We asked questions about performances, functionalities and challenges of the MDC application used. We also asked some participants about their rationale to choosing a certain tool. We learned that very few organisations have changed their MDC provider after a first experience. Easynut has a small user base and its development has been stopped; Buendia is not operational. Therefore these tools are not investigated further.

### 4.4.1 Survey CTO

Survey CTO has a very large user base all over the world. The platform is used in 130 countries. Most of its applications are used in academic studies, research, and surveys. Among others, Noora Health and Oxfam GB have deployed Survey CTO in the field, to improve the health outcomes of groups of patients.

Noora Health is an NGO that gives training to relatives of patients in hospitals, so the relatives can provide better care and fewer people have to be readmitted to hospital. Noora Health uses the Survey CTO platform to evaluate the quality of the trainings and to follow the post-discharge health outcomes of the patients. Participants are contacted by telephone at regular intervals and the outcomes are assessed. For example, In India, over 90.000 family members have been trained, resulting in a 25% reduction of readmitted patients.

Noora Health (NGO) is satisfied with the platform for these phone-based surveys but doubts if the platform, as in our case, functions properly when it is used simultaneously by multiple users in an offline context.

Oxfam has implemented MDC tools based on Survey CTO for survey's and assessments in 50 to 60 countries and OXFAM staff like the flexibility of the tool. Oxfam also uses electronic case management tools to monitor, evaluate, account and learn from the direct feedback from the community. These tools have been deployed in Tanzania, Ethiopia, Myanmar and Iraq. Oxfam uses also other MDC tools to collect data.

The vision of the Oxfam team is that MDC tools is in important element for organization growth "it is faster, the data is more accurate, reliable and of a better quality, the novelty factor, trust and possibilities to faster interact with communities will have the desired effect on our organization".

Oxfam is deploying MDC tools since 8 years and is steadily scaling up the use, over the years they gathered an enormous experience and knowledge. The Oxfam innovation team works with 8 people for countries that demand support. The innovation department OXFAM did deliberately choose for platforms as opposed to specific apps: "developing an app yourself, in-house, that is an absolute stop as these are not scalable and not sustainable".

### 4.4.2 Commcare

The Commcare platform has the largest user base in Africa and Asia. Most NGO's we contacted have experience with Commcare, including International Committee of the Red Cross (ICRC), Save the Children, World Vision, Terre des Hommes, and World Heart Foundation. Action Contre la Faim plans to deploy a Commcare application for nutrition in collaboration with World Vision and Terre des Hommes.

Both Terre des Hommes and ICRC expanded the use of Commcare digital tools beyond nutrition and use the platform to support health workers with clinical decisions and reporting. Terre des Hommes works together with Dimagi to develop and optimize their MDC tool. In Burkina Faso, Terre des Hommes supports over 600 health centres that use Commcare as part of the Integrated Management of Childhood Illnesses (IMCI) program, processing 200.000 children per month. This is possibly one of the largest caseload on which an MDC tool is deployed. In the 600 clinics, 75% of the consultations are supported by a mobile applications but not all consultations as not all staff is qualified to use tablets ( data 2018) .

The Ministry of Health (MoH) of Burkina Faso is very positive about the program as it helps to deliver timely reports to the international donors.

Over the past eight years, Terre des Hommes have invested up to \$1.000.000,- in Mobile Data Collection tools and staff training. On average, every new version costs \$100.000,- to develop and update. The first versions were more expensive than their most recent updates.

ICRC has developed an app on the Commcare platform called Almanac and deployed it in Nigeria. ICRC has trained staff that is qualified to modify the application. ICRC is the only organization we spoke to that stores the collected data on their own servers, enabling them to remain in full control of access to the data.

Several NGO's have reported successful deployment of Commcare applications to improve the care to nutritional patients. However, over the course of this research, it became clear that most organisations had to reduce the implementations due to funding difficulties. Currently only Save the Children and World Vision register malnourished children in an outpatient nutrition program.

Neither World Vision or Save the Children has in-house specialists who are able to manage the data aggregation and flows, and who have experience in adapting the Commcare apps (e.g. data entry fields). Consequently, they are dependent on services and expertise provided by Commcare, which brings additional costs.

The applications developed by Dimagi Inc. for World Vision and Save the Children do not represent the workflow and use of MSF. We are looking for a tool to replace the register book and the follow-up of patients in an ATFC in a remote setting. The developed application for World Vision is designed for data collection by one health worker/station, one patient at a time. Dimagi Inc. informed us that the forms used in the MDC cannot be shared with another user/station in an offline or remote mode.

#### ***4.4.3 Dharma Platform***

The Dharma platform was developed for longitudinal survey purposes, but it can also be used to single surveys. Dharma was used in 2018 by the OCA Manson unit to collect data in surveys. In 2018 we experienced a trend to collect data in ODK. One of the reason is that the people in the public health have more experience with ODK then with Dharma.

In Syria, in the Busra Hospital, the Dharma platform is used to collect and aggregate the statistics of all departments. It does not use Dharma to follow up patients. However, there are plans to pilot Dharma for the follow-up of patients in selected cohort programs.

The International Medical Corps (IMC) intends to use Dharma as a survey tool and as an EMR in medical facilities. IMC has tested Dharma in a remote mode in the USA. They have not deployed a digital tool to manage patient files in the field. They have chosen to use Dharma as it offers the ability to go back to an old record or data point in the collected data.

No NGO that took part in this survey has deployed Dharma for registration and follow-up of patients in the field. [OCBA is making plans but has not deployed yet \(2019\)](#).

#### **4.4.4 Mangologic**

Mangologic is a platform developer, but collaborates closely with D-tree to build digital health systems. D-tree is an international NGO that supports other NGO's in strengthening health systems with digital solutions. It has been active for the past 15 years in many countries in Sub-Saharan Africa and Asia. D-tree was an early user of Commcare, but shifted to Mangologic because Mangologic offered more accurate and scalable software.

MSF OCG has developed a mobile health application with Mangologic. This app supports health workers in their diagnostic judgement and clinical decisions for children aged < 5 years. One of the outcomes is a reduced use of antibiotics, from 87% to 54%. The application is operational in 3 countries. MSF OCBA is planning to deploy the tool in Mali.

The digital health advisor of OCG has previous experience with ODK and Commcare. She decided to switch to Mangologic as the digital platform was more innovative, more accurate, and easier to create, program and adapt forms. OCG developed an app to support diagnosis and treatment, called eCare ([link](#)). Mangologic and D tree can assist with the creation of forms but a health advisor or a program manager with some will can adapt the forms.

Mangologic is also used as a mobile assistant to support health-related decision-making in a maternal health program in Zanzibar. The project started in 2011 and has a positive impact on the safety of deliveries. In Liberia, a similar project is piloted by the NGO Open Development LLC to improve the delivery of essential obstetric care (EOC), e.g. from ANC to delivery and from delivery to post- natal care.

All levels and roles of health care provision are included, i.e. health centres, hospitals, clinics, and midwives. The tool tracks regular check-up of mothers and newborns, e.g. to follow the pregnancy and to plan vaccinations. The set-up of the application is similar to the requirements for an app for nutritional programs. The deployed tool is smart and user-friendly.

Open Development LLC explained that the prototype 1 is currently being tested with 50 users. They are using NFC tokens or data carriers to store the patients' data. It works accurately. They also use fingerprinting tools to identify the patient.

Open Development LLC is very positive about Mangologic and D Tree, due to their extensive knowledge and experience in health. They expressed that the organisation is creative and can come up with out-of-the-box solutions. The data platform of Mangologic is easy to use and end users can make small adaptations (when allowed). New functionalities can be incorporated easily.

[The ambition is to deploy a tool of Mango logic with the use NFC card in refugee camps at the Thai border in 2019.](#)

#### **4.4.5 Scope coda**

[Scope Coda is not tested and rated like the other tools we have evaluated, as the existence of the tool came to light after the finalisation to this report. Therefore, in this second and last version of the](#)

report, we limit to a description of the tool that includes users experience, but lacks technical testing and evaluation.

WFP (the lead developer) and UNICEF developed and implemented the SCOPE CODA patient registration tool for outpatient feeding programs. The project is funded by DFID (UK).

In health centres, types II and III the tool is being tested for supporting outreach therapeutic centres (OTC/ATFC) and community-based supplementary programs (CB-SFP) for supporting moderately malnourished (MAM) patients.

The mobile tool 'Scope Coda' makes uses of biometric registration and mobile devices to register and follow up patients. The tool incorporates an NFC chip. The patients receive this NFC-chip to identify and to function as a network key and /or data transporter. Scope Coda uses a dashboard supported by Tableau Data is synchronised at a centralised office with internet connectivity

At this moment, 4 departments in a feeding program are using in the tool in parallel following the patient flow:

1. Triage (no user)
2. Anthropometry (user)
3. Data entry / registers (user)
4. Medical (user)
5. Assistance (user)

The 'Scope Coda' digital tool for electronic case management of Moderate Acute Malnourished (MAM) and Severe Acute Malnutrition (SAM) patients is piloted at several locations, including the Moroto district of Karamoja, Uganda.

At the end of October 2018<sup>9</sup> the pilot in Moroto covered 6 aTFC sites, 53 severely acute malnourished (SAM) patients, 21 Beneficiaries in CB-SFP and 369 Pregnant & Lactating Women (PLW).

The MoH in Karamoja has the ambition to develop a single registry for health, meaning that all personal health data are accessible in one data base (Ugandan EMR) and the health facility data are collected in one tool; the DHS2.

The health workers were very satisfied with the use of the tool. They reported that patients and caretakers like the tool as it was fast and secure. And it helped with identification and follow-up of patients (relapse, defaulters double, registration).

#### ***4.4.6 Conclusion user experience***

The platforms of Survey CTO, Commcare, Dharma and Mangologic all have a solid user base. Although Commcare is the most widely used and based on open source software, it is not perceived as a very service-friendly organisation. The Commcare digital tool is more complex to develop (a technician of Commcare needs to help designing and adapting the application, which makes it more expensive). The tool doesn't give the possibility to share data when being off line i.e. it does not meet the full minimum requirements to replace a register book.

Survey CTO, Dharma and Mangologic provide applications that are perceived more easy to develop. All companies have consultants that can support the deployments of these applications.

Survey CTO is an MDC application used in large scientific surveys. However, the tool has not been used for registration and follow-up of patients. Its users are very positive about the accuracy of the tool and the supporting organization.

Dharma is a user-friendly tool to program applications. Their user base in patient management is still small. IMC has tested Dharma for the follow-up of patients and MSF is planning to use it in managing a cohort of patients in the Busra Hospital, Syria.

Mangologic is an MDC platform that has been deployed by a large number of smaller NGO's, who have accomplished satisfactory results in designing applications suitable for maternal health and nutritional programs. This makes Mangologic the only platform with satisfactory experience. MSF OCG has started using Mangologic as it is more accurate, is easy to alter, and gives better results than other digital tools.

#### 4.5 Considerations for MSF

If MSF wants to deploy MDC tools, there are important management issues to consider, such as costs, data protection and organisational support.

##### 4.5.1 Data Protection

MSF must adhere to data protection regulations, e.g. General Data Protection Regulation (GDPR) of the EU and MSF Health Data Protection Policy (HDPP). [MSF must also adhere to data protection policies of the countries where we are operational.](#)

The GDPR regulates personal data protection standards, provides methodology to assess all possible risks of privacy breaches in the process of collecting, analysing, reporting, and transferring data, and gives guidelines to prevent privacy breaches. The GDPR applies when electronic personal data is managed or stored in the EU and/or when data is transferred across the EU border. All the Personally Identifiable Information (PII) should be removed. Only aggregated data can be transferred across borders, from the project to Norway (DHIS2), to HQ (Amsterdam, Berlin) and back to the project.

There are various actors and national stakeholders in the process of data collection, each with different obligations: Data controller: the natural or legal person, public authority, agency or other body which, alone or jointly with others, determines the purposes and means of processing personal data. This is MSF's responsibility as pointed out in MSF's Health Data Protection Policy (HDPP).

Data processors: the digital tools that collect, analyse, provide feedback, and often provide standard reporting. In this case there are two data processors: the MDC tool provider and the DHIS2 teams.

Also MSF is implementing a part of the data processing: our staff is collecting, consenting, entering data of the patient (e.g. quantity, accuracy, privacy), monitoring the patient and analysing data, reporting etc. This part of data processing is not discussed here, as it is not dependent on the MDC tool, but more on the rules (access and data transfer), regulations and behaviour of MSF staff (e.g. consenting) and what MSF exactly demands the software providers to do (e.g. concerning retaining information).

This report will only discuss MDC tools in relation to electronic registration in ATFC's (eATFC). The responsibilities of MSF are not discussed, as this is not specific to eATFC but to any and all data tools used. The checklist used here is based on the summary the complete checklist of GDPR compliance by La Commission National de l'Informatique et des Libertés ([link](#), updated February 2018).

The GDPR rules that are important for the MDC tools are:

1. privacy and depersonalisation of data, limitation of access
  2. safety of data flows
  3. the patient’s rights to see personal data, to have it removed, and to transfer it to another entity (portability, either electronic or on paper).
1. When a tool is said to be GDPR compliant, it usually means that the tool does not store personally identifiable data, e.g. images and names, on devices or servers but that data are de-personalised as much as possible. In an eATFC, some personal data needs to be available so health workers can pay home visits (if necessary). A solution is to register names and addresses on paper and link this to an ID number used in the electronic tool. Another option is to enter the personally identifiable data in the MDC tool and keep these data in the project, i.e. it will not be exported anywhere else. This data needs to be deleted when the patient exits (ID numbers can be kept). Both solutions are possible with the current MDC tools
  2. However, MDC tools and providers have responsibilities beyond the depersonalisation of data. MSF needs to ensure that MDC tools are fully GDPR compliant. MDC providers need to have provisions to protect data from privacy breaches, e.g. by offering data encryption, password systems, and server management.
  3. Additionally, the tool should be able to provide the patient with their full data-set and it should be possible to delete a patient’s data. Provisions should be made that an individual patient’s data can be given back to the patient either by an electronic device or on paper. An NFC token or wrist data carrier could be a good choice for a personal health record.

**Table 23: Compliance with privacy standards**

Compliance with privacy standards	Survey CTO	Commcare	Dharma	Mangologic
EU General Data Protection Policy (GDPR)	In progress	Yes	Yes	Yes
HIPAA (Patient Record Standard)	Optional	Yes	Yes	Yes
Hosted in Europe	In Europe	In USA	In USA	In Europe
Hosted on a server controlled by MSF	Possible	Not likely	Not likely	Possible

\* Possible\*, but point needs further investigation

MDC providers were asked about their compliance to GDPR (as far as the software can facilitate) and to the patient record standards (HIPAA).

The HDPP by MSF and country where MSF operates determine the data ownership, a role equivalent to data controller. This means that MSF should have made agreements over the control over access (and the level of access) to data. To ensure our responsibility MSF should have ultimate control over the server where data is processed and stored, and that limited, MSF-only staff have full access to data. Therefore MSF should be the owner of the server and adhere to the national regulations. The MDC providers usually host the server capacity, e.g. Commcare and Dharma in the USA, but all MDC providers see our rationale to facilitate hosting on MSF’s own servers in Europe. [How this will work out in future is unclear and is related to the costs.](#)

As shown in tables 14 and 20, all evaluated MDC tools are able to create backups, provide password protection, install automated backup, encrypt data on servers and during transfer, provide logging on after a time period, and host software and data on own server. Table 15 shows that all MDC tools provide editing and deletion of data to a certain extent and table 17 shows that all MDC tools can make at least a print of the register book and can generate a patient card.

Overall, the respondents in our survey and our own meetings with private MDC providers gave us the feedback that Dharma and Mangologic meets our current requirement and expectation best,



followed by Commcare and Survey CTO.

Commcare is an open source technology, and this attractive for organisations that want to develop and manage their own tools. However, open source means that the basic software language is available, but beyond this quite some development work should be done and the organisation should have continuously a team available to update the tool. In this report we discuss apps that has been built by Commcare and is based on their open source software.

#### 4.5.2 Expected costs

In addition to technical specifications, we requested estimated prices for a hypothetical case: a pilot to register 12.000 patients over the course of 1-2 years, starting in one project location and adding two more project sites later on. Most providers gave a rough estimate; as Commcare could not offer all requested functionalities (data sharing in offline mode), they did not give a financial estimate. A data collection tool can be developed if the workflow is adapted to one workstation/tablet to complete a data entry form. The cost estimation for using Commcare was not derived from a formal offer, but from their website and interviews with current users, and keeping the development of a limited application in mind.

It is estimated that there will be five users per ATFC (see also table 1). Health workers (users 1-3).

The cost estimate is not complete and it should be noted that this is a rough and temporary overview. New developments, negotiations and possible changes in pricing strategy all play a role in the final price for a real project.

**Table 24: Cost estimate (\$) for pilot: 175 data points/1.2000 patients/1 year**

		Survey CTO	Commcare	Dharma	Mangologic
<b>Initial cost</b>	Creation MDC tool	13.000	25.000	6.000	40.000
<b>Initial cost</b>	Integration with DHIS2	Not specified	Not specified	Not specified	included
<b>Training based on 14 days, excluding travel/stay</b>	HQ and/or field	29.500	29.500	11.200	10.000
	<b>Subtotal initial cost, minimum</b>	<b>42.500</b>	<b>54.500</b>	<b>17.200</b>	<b>50.000</b>
<b>Recurring costs/year</b>	Software/platform licence	18.000	24.000	35.000	No cost
<b>Recurring costs/year</b>	Maintenance software (e.g. on servers)	included	Included	included	7.200
	<b>Subtotal annual costs, minimum</b>	<b>18.000</b>	<b>24.000</b>	<b>35.000</b>	<b>7.200</b>

Technical support is estimated at 125 per hour for all MDC providers. Devices and (renting) server space were excluded from this cost estimate.

In this cost estimate we have not include the cost of one NFC card per patient. As one NFC card cost approx. \$ 2,- . This would add \$ 24.000 to the initial costs.

The pricing strategies of the various MDC providers differ greatly:

- Survey CTO's initial costs are below average (2), their recurring costs are below average (2).
- Commcare's initial costs are highest (4), their recurring costs are above average (3).
- Dharma's initial costs are lowest (1), their recurring costs are highest (4).
- Mangologic's initial costs are above average (3), their recurring costs are lowest (1).



Based on the initial costs (excluding training) plus the recurring costs for the first year with 7 users/stations and 12.000 patients, the average cost per patient varies between € 2,58 (Survey CTO ) and € 4,08 (Commcare).

Dharma charges a relatively high annual fee and states it can justify this price by offering a superior platform. If a project is scaled up, Dharma will be more expensive than any other MDC tool. However, the lower set-up costs of Dharma are profitable when the number of patients is low, e.g. in a pilot.

Dharma offers an enterprise model or yearly licence, limited at € 100.000 per year. If MSF exclusively uses Dharma for all surveys and electronic tools, the price per patient will drop. Using Dharma across all programs and sections (e.g. nutrition, mental health, maternal health, and vaccination) seems tempting, it is not a likely scenario given the independence of the sections and the dynamic market.

The Mangologic platform is built on Google's AI technology. Mango Logic doesn't charge expenses for using the platform/software, only recurring expenses are made for maintaining and storing the software on a (client) server. However, Mangologic charges more for building an MDC tool but are the only MDC provider who can make tool completely adapted to our workflow. They justify this price by focusing on the added value of their technical and health consultants. Mangologic has low running costs and when a project is scaled up, it becomes more profitable.

Commcare charges the highest price for a tool and an above average price for the platform. The technology used is more complex, which might justify the resources needed to develop an application.

Survey CTO's pricing set-up is reasonable but cannot offer the functionality to share data between users / stations when being offline.

It seems that Mangologic is the best option, from a workflow or field users perspective. On the long run is financially most interesting

Sustainable funding of electronic tools is essential, as two MSF initiatives and several NGO's had to stop development due to management and funding issues. One-off funding to start deployment is usually not the biggest challenge, but the continuation is. Therefore, as the annual running costs are reasonable, Mangologic is an attractive option.

#### ***4.5.3 Organisational support***

Another important aspect to consider is the available support (see also table 21).

Training of users (online and documentation), technical support (on-site or remote, helpdesk, self-service, and consultants) and automatic updates are assets that limit financial risk and enable a pleasant and efficient workflow.

In this survey Dharma and Mangologic score best and are seen as the most customer-friendly and service-oriented firms, delivering regular updates and good technical support. D-tree, the app builder and distributor using Mangologic, has several offices and is able to promptly deliver support, if required on the spot.

To receive support from Survey CTO and Commcare is a bit more complicated (unclear on updates, individual advice, general technical support). Despite being the market leader, Commcare does not have a very positive reputation. Dharma and Survey CTO are more centralised and their potential service level in the field is difficult to assess.

Technical possibilities develop quickly, but the needs of MSF can also change very quickly, e.g. reporting requirements, legal developments, patient loads, staff level, and adding more variables. It seems wise to deploy a flexible system. As shown in paragraph 5.2.2 (table 14), Dharma and Mangologic are the most suitable for scaling up, maintenance and updating of the system, changing variables, integration of ITFC 's, integration of other apps (e.g. for vaccination programs), and the possibility to develop a full EMR.

This survey focused on a unique independent project, an eATFC. For this Mangologic seems to be the cheaper solution.

## 5. Discussion, conclusions and recommendations

This project, the electronic registration of patients in an ATFC, aims to identify an electronic registration tool for outpatient feeding centres (Ambulatory Therapeutic Feeding Centre, ATFC) only. The objective of this electronic tool is to eliminate the use of pen and paper in the registration process, to increase efficiency and accuracy of registration, to enable instant data delivery to management to facilitate decision-making, and to feed directly and instantly into the HIS.

### 5.1. Discussion

MSF is continuously improving patient care by medical innovation and new models of care and with the deployment of the new HIS also data and reporting tools are on a higher level. However to improve the entire data chain, quality data collection in the projects needs to be further developed. Electronic data collection could play an important role in this process.

MDC tools have reportedly improved the quality of data, the accuracy, reliability, and timeliness of data collection, aggregation, analysis and reporting. High quality data is the basis to improve operations, to strengthen accountability, improve quality of care and steer innovation. MDC tools can be used for registration, data collection and reporting, but also for diagnosis and treatment support, identification, and instant patient care.

The sapling nursery of MSF OCA gave the opportunity to investigate digital tools for registration and limited follow-up of patients in outpatient settings. This is an important step towards more efficient use of digital solutions. Digital support aims to increase efficiency and guide program management with high quality data and prompt overviews and less manual work, ultimately leading to improved quality of care. High quality data increase monitoring of programs and guides strategies and the challenge is to meet all technical and managerial requirements, and to combine data collections to develop an efficient, informative system that respects the principles of health data protection and humanitarian values<sup>3</sup>.

#### 5.1.1 Apps and platforms

This search focussed on an electronic tool to capture patient registration in outpatient services with some patient follow-up. The electronic tool should make use of mobile devices (tablet, smartphone) and function properly without a constant internet connection, called a Mobile Data Collection (MDC) tool.

This research was searching apps for use in the periphery (MDC apps), but soon became clear that that a general platform on which several apps can be developed has many advantages over a single isolated app developed for MSF only. The advantage is that a platform's technical performance is continuously updated, a service level is provided and the platform is not influenced by changes of various individual apps. In addition, certain features are standard available and can be adapted according to needs such as automatic upload to DHIS2 and to the HIS.

On an up-to-date MDC platform, many apps for outpatient health programs can be designed and built and maintained e.g. TB, reproductive health, mental health and nutrition; only the fields for

---

<sup>3</sup> Oxfam (Tomkys-Valteri E; 2017) [reported](#) on their advancements (august 2017) in combining data silos in a workable data collection and analysis system

data entering needs to be different, the underlying software remains the same. An MDC platform can also be used for apps developed for diagnostic and treatment support, e.g. eCare by MSF OCG. Ultimately, data of apps within one MDC platform can be combined and connected, e.g. an app for registration could be integrated with an eCare app to support diagnosis or with a drugs and food ordering system.

Apps on existing MDC platforms are easier to scale up and it provides advantageous economy of scale compared to specific apps developed for a specific purpose only. The development of an app in-house is not an optimal option as these are not scalable and not sustainable<sup>4</sup>. This is illustrated by the two attractive nutrition apps of MSF, Buendia and Easynut, of which the development is stopped due to funding and/or operational challenges. Restarting the development of these two apps would be challenging as the technical developments have moved too quickly.

All MSF programs follow patients over time, even though this follow-up is very limited (e.g. presence and discharge). Therefore, the MDC tool needed to replace a registration book is classified in the category EMR (Electronic Medical Record). This terminology might be misinterpreted as a heavy system demanding extensive patient data for instant care. Actually, an EMR can be used in a range of activities from bedside instant patient care to admission and outcome data, a light form of EMR (EMR-light).

Although a large number of MDC tools are available that can collect data in a remote or offline environment, most of these tools are developed and used for surveys (one point in time) and not for multiple entries and feedback over time. A small number of electronic tools have been deployed and proven to be suitable to register and follow patients over time. Just one MDC (Mangologic) has demonstrated capacity to share data between users when being offline.

### ***5.1.2 Workflow and instant connectivity***

The current paper based data flow is a cumbersome process. Some data are directly entered in the registration book and some data are copied from the patient card in the registration book at the end of the day. Days later data from the registration book and other data collection sheets are manually entered in the master software (the HIS).

As the registration book contains data of different workstations, the MDC should facilitate this process by allowing several users working sharing data following the workflow.

This would imply that all the different health care providers should enter data directly in a mobile device that feeds automatically into the register app, e.g. at reception, at the weighing and measuring stations, at the nursing station.

This implies that some communication between the mobile devices is needed in an offline setting. Near Field Communication (NFC) is possible but not practical, as the devices (tablets/telephones) have to be close to each other. A unique portable identifier like a patient owned NFC token (e.g. chipcard) is the most promising option to share and update data in the same workflow. This can be combined with a unique identifier e.g. by a patient number, fingerprint or with a photo image. In this way the patients literally owns their medical data. Mangologic is most advanced by offering these features and integrate them in the data flow.

### ***5.1.3 The evaluated MDC tools***

In this research, we have evaluated apps that were designed or can be used to support the workflow in nutritional programs and to follow up patients.

---

<sup>4</sup> ‘ Develop an app yourself, that is an absolute stop’ , statement of Oxfam Innovation Team

The list of criteria for evaluation were developed by interviewing potential users, reviewing past experiences (e.g. Buendia) and consulting software specialists. The benchmarking entailed interviews with the software providers, physical testing of the software, and collecting user experiences. In addition, implications for the organisation of MSF were explored.

All tools met the medical data requirements for an ATFC. Reportedly, it is relatively easy to collect or adapt the required patient data for other medical programs. Therefore, this research is not only applicable for nutrition programs, it also applies to tools that track ambulant patients, e.g. in HIV, TB, SBV, ANC, PNC, IMC, Mental Health and vaccination programs.

Differences between the tools surfaced when the technical functionalities were investigated. The two tools developed by MSF, Easynut (MSF B) and Buendia (MSF OCA), [scored in some cases sufficient on the functional demands, explained by that the further development of these own apps was halted by MSF.](#)

Of the four MDC platforms, Mangologic and Dharma rated the best on functionalities, closely followed by Survey CTO and finally Commcare. This is related to the basic technical software framework used; Commcare and Survey CTO use ODK and Javascript, [while Dharma and Mangologic make use of their own developed forms and software.](#)

Discussions with users and developers highlighted that Commcare is the most widely used tool in remote settings. NGO's that do not have their own experts to develop an app can use the services of Dimagi. These NGO's expressed to us that the organization is not perceived as flexible and provides unsatisfactory support. If an organization is willing to set up it's own development team, there are chances to scale and develop apps faster. However we the app misses functionality to serve a in a remote workflow with more then one user.

The Survey CTO tools are of a high quality, [mostly used for studies and research and not often used for longitudinal care of patients.](#)

The Dharma platform is mostly used to collect data of field operations (surveys and program data), but it has sofar limited operational experience in following patients over time.

Mangologic has deployed apps that enables the follow-up of patients over time in health programs. It also has experience in integrating biometric tools and sharing data using NFC chips.

Mangologic offers a package that matches the requirements of outpatient health programs .

MSF OCG already uses Mangologic for patient management decisions and found it easy to program, smart and accurate. This mobile tool to support clinical decisions (eCare) is being scaled up.

#### ***5.1.4 Organisational considerations***

##### **Data protection**

Some important aspects of organisational support were explored. Data protection regulations (GDPR and MSF Health Data Protection Policy) address the entire data flow of which MSF is responsible.

Most of these regulations are related to MSF's staff behaviour and contractual demands. MSF is responsible for following national laws and ensuring that MDC providers are in compliance with these regulations. Therefore, MSF should make sure all requirements for data protection are listed in it's e health policy and in the contract with the MDC provider, e.g. de-personification rules, passwords rules, access rules, and server strategy. All providers can deliver these requirements, except for Commcare, that still has to do some work to reconfigure their apps.

## Costs

The other strategic aspect for the deployment of electronic tools is the financial component. A hypothetical use case (virtual project) was given to the tool providers to estimate costs. These are the minimum estimated costs; additional costs might be necessary, pricing strategies may change, but prices may also be lowered as a result of negotiations. Nevertheless, this exercise gives an idea of cost structures and strategies. The initial costs to develop a digital tool exactly matching the workflow in an ATFC is a serious investment. In addition, the app/platform and database need to be maintained every year, adding to annual recurring costs.

Annual costs and costs for additional requirements can be a problem; For example, World Vision, Save the Children and the World Heart Federation have reduced or halted the deployment of MDC tools (Commcare) due to continuous funding difficulties.

Dharma has the lowest initial development costs (estimated about \$ 17.200) and Mangologic has the lowest recurrent annual costs (estimated about Mangologic \$7.200 versus Dharma \$35.000). The initial costs of Mango Logic are higher (estimated about \$ 40.000 ) because they have integrated the features to facilitate the complete workflow in an outpatient facility, e.g. incorporating possibilities for unique patient identifiers. Dharma doesn't offer this features and is hence simpler and less expensive.

When the annual recurrent costs are added to the initial costs, the total cost for using Mangologic is higher costs compared to Dharma when calculated over the first year, but on the long run the investments in Mango Logic will pay out as the software licence is free.

[There is no information on Scope Coda, that was developed within WFP, but has the ambition to serve NGO's](#)

In the cost estimate, hardware and training are not taken into account. Hardware (tablets, smartphones, desktop computers) and adaptations, legal advice, and guidance will increase the initial cost with \$ 20.000-30.000 and the annual cost will increase with a percentage of these hardware costs depending on the depreciation time of the hardware.

We estimate that the investments in electronic tools balance out in roughly two years, after which the tool will save time and money and it will support accurate and prompt data management. A more conservative estimation is three years.

## Service

Lastly, the level of support provided is important. Mangologic has a good service record, in part thanks to their cooperation with D-tree who is able to promptly deliver support (on-site if necessary). As an example of a prompt reaction, D-tree offers a package for data collection in outpatient health programs that follows the specifications and terminology of this research, even before the dissemination of this report. Dharma and Survey CTO are more centralised and their service level is more difficult to access. Generally, Commcare does not have a very good reputation concerning their service delivery.

## In-house development or commercial partner

[The choice for in-house or commercial platform is a corporate strategic decision, as it has far reaching consequences for many years. It touches values of the organisation, it influences the core business of MSF and it will define the software for several decennia.](#)

[The advantage of the development of a platform in-house is that MSF feels totally in control of the software and data entered and MSF defines the rules of engagement \(eg ownership and hosting of data\). However, the disadvantages are larger. The development of a platform in-house requires a considerable investment in development of the software \(even when it is based on open source](#)

software) and it requires continuous IT support to keep the apps updated and to support and train staff.

To be cost effective it is recommendable that all apps should be developed on the same in-house developed platform, which decreases flexibility and loses the benefits of healthy competition. Besides, the centralisation of software in house is vulnerable for hiccups in this system (managerial, or software) affecting all apps at once. Cost effectiveness might improve if all OC's join in this project; however, inter OC dynamics makes it quite difficult to centralise software development.

Cost effectiveness, scalability and sustainability has to be seen and is likely better with a commercial partner as one can profit from their economy of scale and expertise (serving several parties). Support functions and training is the responsibility of the partners which gives the highest flexibility for the lowest price, and keeps HQ smaller, as was also concluded by OXFAM.

In addition, the benefits of in-house developed platforms of control over software and data, can be also managed with a commercial partner.

An alternative could be that several options are chosen and the development is spread over MSF OC's eg: One MSF OC focuses on the power of open source (Commcare) and one other OC on DHIS2 or Bahmni. Currently various OC's focus on the developments in Bahmni and DHIS2. Which is of course not cost effective.

#### **Open source and/or commercial partner**

An Open Source the source-code (a basis to build applications) software is owned by a community of developers. It is free for public use and often a community of volunteers develop the software further (eg. Open street maps).

The software can also be used by organisations who can develop the application for their specific needs either to use it themselves or to sell it (e.g. Commcare).

Of the software reviewed here ODK is a open source application that has been developed further by Commcare, Side Coda and Survey CTO in their own direction. The leverage between users is dispersed. Example , Dimigio elaborates on a Commcare application for nutritional programs. Their adapted product, is commercially sold to other parties.

In MSF, there is a strong wish to engage with an open source applications because of the principle that MSF can profit from other people their work and others can profit from MSF's work. In addition, when MSF develops their own software (including based on open source) MSF is completely controlling how this will be developed and managed.

MSF does profit from the work of others community members. Successful examples from open source application are open street maps or the statistical software R.

However, further development of open source software specific by MSF for complex MSF needs, and controlled by MSF does not mean automatically that his will be taken up by other organisations with other needs.

Also, it is not evident that MSF can rely on the open source community unless MSF contributes substantially to his community. If MSF decides to use Open Source software they should become very active and dedicated in this open source community. The dedication demands resources and a lot of often time.

The alternative is to develop the open source further independently of the community, which would mean splitting the original applications in many versions.



Hence, open software as a basis or straight a commercial product makes no difference in ownership, control, and cost effectiveness. To make an informed decision, any decision about the use of software, based on open source or commercially available, should weigh initial investments, cost effectiveness, scalability, sustainability and whether it fits into the original expectations.

### **Flexibility**

Instead taking a principled stand of using software based on open source, or house versus commercial partner, the engagement could also weigh the choice on case by case basis. This will result in a software collection that is a mix of open software and commercially available software. A choice per application would enhance flexibility, that reflects the fast changing software market, and also the fast changing MSF demands. A mixed approach is a reality tight now: one hand R for statistics and Microsoft for word processing, spreadsheets, presentations, communication and storage of data. Flexibility in software and reacting on needs and opportunities is common in MSF; for statistics MSF switched in 25 years to the following software HP, Epistat, Epiinfo, SPSS, to STATA, and now open source R.

Whatever strategy is chosen, a framework for software that clarifies the minimum requirements of software is urgently needed. With a framework, any software is eligible open source or not as long as they meet the criteria of the framework. Also for electronic registration and follow up of patients, this framework should be developed sooner than later.

### **5.1.5 Way forward**

Many platforms are developed for different purposes and for various and varying needs while also the technical features are rapidly advancing. Given the complexity of MSF's programming, the related needs, and the rapid change of needs warrants a flexible system. Although it feels convenient to use one particular platform, this might not be the best solution.

CartONG states that the benefits of using one platform, such as in-house expertise, and compliance with organisational standards, the disadvantages of a single platform outweigh these benefits. The use of one platform inevitably leads to organisational inertia, limited flexibility, difficulties to adapt to new developments and needs, and ultimately to frustration of staff (specifically with electronic literate young staff). Cart ONG suggests the deployment of a pool of 3-4 solutions to account for different requirements. ([CartONG 2017](#)).

This basic idea is also applied by Oxfam, who works with a variety of MDC tools (Survey CTO and Mobenzi) and used a variety of analysis tools. ([Tomkys-Valteri E. 2017](#))

Similarly, one can envisage that MSF can deploy different tools for use in hospitals, surveys and offline outpatient purposes.

Also in MSF the complexity and variability of programs, flexibility supporting systems (tools) is a requirement to adapt to fast changing needs. This pleads for the use of several electronic tools/platforms. In MSF this would mean that the platforms and tools should be able to connect with one core health platform such as the HIS. As many electronic tools that are interesting for MSF should offers automatic updates, extensive support and training in-house, inhouse IT expertise of each tool is not necessary. Also in this way MSF can profit from economy of scale and swift incorporation of IT developments. Therefore, it is best not to use one single MDC tool and opt for several tools/platforms.



In order to manage a wealth of possible apps and platforms, MSF should develop a framework in which minimum requirements are described, such as technical compliance to connect with the data hub (HIS) and the required support level and training provided.

Despite all possibilities of mobile electronic data tools, it is too early to conclude how these technologies will and can be used in MSF. There is no good insight to weigh the needs and benefits with obstacles, risks, safety and ethical concerns in typical MSF contexts. The expectations of an electronic registration should be evaluated. Does it improve patient care? Does it save time and money? Is it faster, does it give timely overviews, is it more accurate, is it accepted by staff and patients? Can the hardware used for MDC be maintained and can de data be stored and retrieved.

The way forward to develop expertise is to design a pilot including the necessary evaluation indicators to test theory and to inform strategy and policy concerning electronic data collection.

A pilot of a MDC tool should go beyond the minimum of a registration book but cover the entire workflow in order to be effective and prevent copying from paper in the tool. Therefore, the piloted platform should incorporate elements of local connectivity, patient identification, and multiple users in outpatient facilities.

The pilot should also develop, test and fine-tune systems of data protection, safety and acceptability. Requirements related to data protection for the MDC platform should be in a contract with the producers (templates are available) to ensure incorporation in the software. However, a major part of data protection is related to human behaviour and additional measures in the workflow (e.g. consent). Rules of behaviour and additional tools are being developed in MSF, but the feasibility and the practicalities in the field need to be tested and rules need to be adapted accordingly.

While many outpatient programs would qualify (e.g. mental health, reproductive health), a pilot in nutrition has the advantage that the patient flow is quite predictable and described, the number of patients is rather clear and the nutrition advisor is aware of technological developments.

A pilot with on the Mangologic platform is now the best choice as they have already deployed such apps, and therefore Mangologic is simply a step ahead other platforms concerning MDC tools for outpatient health programs. However, fast technical developments go and negotiations with the producer can change the cost benefit balance.

We searched for MDC tools with EMR-light through our networks and internet. Nevertheless, there might be existing MDC EMR-light tools but not currently known by our networks. To enable a proper judgement of current and future platforms, a framework for platforms should be developed including the following elements:

- Supports mobile data collection (MDC)
- Enables longitudinal follow up (light EMR)
- Functions in remote settings with limited connectivity
- Enables several data users simultaneously
- Supports several types of use e.g. registration, EMR and diagnostic and treatment support
- Possibility to link with an unique identifier system (eg chip, finger print)
- Supports automatic feed in the HIS.
- Supports technical requirements for medical data protection
- Possibility to scale and adapt to other projects, other countries.
- Has a sustainable service approach
- [Enables the development of other apps](#)

## 5.2. Conclusion

To follow patients in an outpatient nutritional program, MSF needs a flexible, user-friendly, and scalable MDC platform that complies with GDPR and HDPP and does not have high set-up and recurring costs. Apps designed for a specific use do not meet all the requirements.

Platforms provide an electronic structure that forms a foundation for apps. All platforms support changes of the data fields of the app, which makes it an interesting solution for many programs beyond nutrition, e.g. mental health and TB. Of the evaluated platforms, Mangologic and Dharma received the best evaluation concerning functionalities, flexibility, and costs. Mangologic has the advantage of having experience in limited follow-up of patients in outpatient settings. The service provided by Mangologic is more flexible, possibly due to the service stations in several regions. The financial difference between Dharma and Mangologic depends on the intended use and the negotiations of MSF with these platform providers.

For now, at this moment of exploration, Mangologic fits best the needs of an outpatient health program. Dharma follows but doesn't offer now, but can develop the functionalities related to the follow up of patients.

This ranking is a snapshot at this moment as requirements (e.g. MSF data management), innovations and updates change continuously and rapidly. Therefore, MSF should closely follow the market on several key benchmarks, e.g. functionalities and pricing. MSF should design a framework for identification of suitable platforms in future.

A pilot of an app on a platform would inform MSF's strategy concerning benefits and limitations of electronic data collection, including local data exchange, data protection and feasibility. An app on Mangologic platform would be suitable as Mangologic has deployed electronic data collection apps for outpatient health programs with other organisations and thus Mangologic is a step ahead other platforms.

Also Scope Coda is promising, as they have built already the platform and app for the precise use case for registration and follow up in the ATFC.

## 5.3 Recommendations

### **5.3.1 Develop framework for selection of MDC in outpatient health programs**

Although it is practical to stick to one specific platform for apps, MSF is very divers, supports a lot of initiatives thus probably various data collection tools (apps) and other health systems will be piloted and adopted. In addition, as this field is changing fast, in future various MDC platforms can and will support the MSF in collecting and registering data. This diversity and flexibility should be channelled by the development of a framework with minimum requirements for these electronic initiatives. These should include requirements of a platform, rules for health data protection, steps for introduction of the app etc.

### **5.3.2 Pilot an app**

To advance the subject of electronic registration in outpatient settings, to inform the eHealth strategy in general, to test tools and support MDC framework development it is necessary to run a pilot with the tools currently developed to apply theory in practice, to learn and adapt when necessary.

The pilot should evaluate functional features such as described in a framework for MDC tools, and the pilot should include process and impact features such as:

- Feasibility
- Acceptability, including authorities, staff and patients
- Costs and benefit balance (e.g. time saved)
- Impact on patient care
- Data protection issues (contract, rules of behaviour)

Currently Mangologic is the best fit for platform that can support apps that follows patients in a remote and off line environment as they already have deployed such systems, [although Scope Coda should be explored](#). This does not mean the MSF should stick to Mangologic, but it seems reasonable to limit risks of bugs and learn as much as in a pilot. Later, when MSF's framework for MDC tools in outpatient settings is clear, similar pilots can be run with other platforms (for instance with Dharma).

## 6. References

CNIL; **CNIL's PIA method updated and adapted to the GDPR**; February 2018  
<https://www.cnil.fr/en/cnil-publishes-update-its-pia-guides>

CartONG; **Benchmarking of Mobile Data Collection Solutions, What aspects to consider choosing a tool/platform**; June 2017  
[http://blog.cartong.org/wordpress/wp-content/uploads/2017/08/Benchmarking\\_MDC\\_2017\\_CartONG\\_2.pdf](http://blog.cartong.org/wordpress/wp-content/uploads/2017/08/Benchmarking_MDC_2017_CartONG_2.pdf)

Dam J; Musuku J; Zuhlke LJ et al. **An open-access, mobile compatible, electronic patient register for rheumatic heart disease ('eRegister') based on the World Heart Federation's framework for patient registers**. Cardiovasc J Afr 2015; 26: 227–233

Frank T, Rosnick N, Keane E, Emary C; **A mobile app to manage acute malnutrition**. Transform nutrition. WVI, SCF; March 2017.  
<https://www.eldis.org/document/A101641>

Frank T; **A mobile health application to manage acute malnutrition: lessons from developing and piloting the app in five countries**. Working paper WVI/SCF, Transform nutrition; March 2017  
<https://www.eldis.org/document/A101635>

Kopernik; **Introduction to impact tracker technologies, Digital Data Collection Apps**; Oktober 2014  
<http://impacttrackertech.kopernik.info/digital-data-collection-apps>

MSF Barcelona; **Mobile Data Collection Tools, 2017**  
<https://displacementunit.msf.es>

NXP; **NXP Expands IoT with real-time NFC Authentication and Sensing Across Secure Healthcare and Retail** March, 2017  
<https://www.nxp.com/docs/en/supporting-information/NFC-NTAG-PRESS-RELEASE.pdf>

Ollis S; **Use of Innovative Information and Communication Technology (ICT) in Nutrition Service Delivery**; CMAM Forum Technical Brief; November 2014  
<http://hesp-news.org/2015/01/11/use-of-innovative-information-and-communication-technology-ict-in-nutrition-service-delivery/>

Staiger C; Ait-Bouziad I; Southgate R; **Report on the OCA Survey Platform Benchmarking Project**; MSF November, 2017  
<https://innovation.lakareutangranser.se/cases2/2018/3/5/digital-survey>

Tomkys E; Lombardini S; **Going Digital - Using Digital Technology to Conduct Oxfam's Effectiveness Reviews**, Oxfam GB, September 2015  
<http://oxfamilibrary.openrepository.com/oxfam/bitstream/10546/578816/4/cs-going-digital-effectiveness-reviews-290915-en.pdf>,

Tomkys-Valteri E; **Being data driven... can it be more than an utopia?** Merltech.org; Nov 2017  
<http://merltech.org/tag/emily-tomkys-valteri/>

**WHO; Classification of digital health interventions v1.0; A shared language to describe the uses of digital technology for health**; 2018  
<http://www.who.int/reproductivehealth/publications/mhealth/classification-digital-health-interventions/en/>

Ghee A.E; Pajela R; Uysal J; **Mhealth Global report**; World Vision, November 2015  
[https://www.researchgate.net/publication/308103390\\_Global\\_mHealth\\_Report](https://www.researchgate.net/publication/308103390_Global_mHealth_Report)

## 7. Annexes.

## 7.1. Platforms and tools considered for evaluation

Platforms	Website	Benchmark exercise					Other sources	Track record with medical NGO's	Focus on longitudinal / case management	Users	Short listed	Comments
		Kopenik	CartONG	OCBA	Manson Unit							
Acqee	<a href="http://acqee.com">http://acqee.com</a>				X		Yes	no		no	survey oriented	
Akvo Flow	<a href="http://akvo.org">http://akvo.org</a>	X	X				No	no		no		
Buendia	Stopped development					X	Yes,	yes	MSF OCA	yes	EMR developed by MSF OCA for nutrition programs	
Commcare	<a href="http://www.dimagi.com">http://www.dimagi.com</a>	X	X	X	X		Yes	yes	Save the Children, World Vision, World Health Federation, Terre des Hommes	yes		
Datawinners	<a href="https://www.datawinners.com">https://www.datawinners.com</a>	X					No	no		no		
DeviceMagic	<a href="https://www.devicemagic.com">https://www.devicemagic.com</a>		X				No	no		no		
Dharma	<a href="http://dharmaplatform.com/">http://dharmaplatform.com/</a>		X	X	X		Yes	yes	MSF OCA - Manson unit, OCBA	yes		
DHIS2	<a href="https://www.dhis2.org">https://www.dhis2.org</a>			X	X		Yes	no		no	focus on aggregation and visualization	
Easynut	Stopped development					X	Yes	yes	MSF Belgium	yes	light EMR developed by MSF B for nutrition programs	
EpiCollect5	<a href="https://five.epicollect.net">https://five.epicollect.net</a>	X	X		X		Yes	no		no	survey oriented	
Formitize	<a href="http://formitize.com/en/">http://formitize.com/en/</a>		X				No	no		no		
Fulcrum	<a href="http://www.fulcrumapp.com">http://www.fulcrumapp.com</a>		X	X			No	no		no	focus on location leverage	
GoFormz	<a href="https://www.goformz.com">https://www.goformz.com</a>		X				No	no		no		
iFormbuilder	<a href="https://www.zerionsoftware.com">https://www.zerionsoftware.com</a>	X	X		X		Yes	no		no		

Electronic Registration Outpatient Feeding Programs

KoboToolbox	<a href="http://www.kobotoolbox.org">http://www.kobotoolbox.org</a>	X	X	X	X		Yes	no		no	
Magpi	<a href="https://magpi.com">https://magpi.com</a>	X	X		X		Yes	no		no	
Mango Logic / D tree	<a href="https://www.mangologic.com">https://www.mangologic.com</a>			X			Yes	yes	MSF Geneva, OCBA, Open Development, MoH Zanzibar,	yes	
Medic Mobile	<a href="https://medicmobile.org">https://medicmobile.org</a>			X	X		Yes	yes	Usaid, Rhites, Intrahealth	No	not selected: test crashed ; lack of information.
Mobenzi Researcher	<a href="http://www.mobenzi.com">http://www.mobenzi.com</a>		X				Yes	no		No	survey oriented
mWater	<a href="http://www.mwater.com">http://www.mwater.com</a>		X	X			No	no		No	wash specific
ODK with Aggregate	<a href="https://opendatakit.org">https://opendatakit.org</a>	X	X	X	X		Yes	no		No	
ONA	<a href="https://ona.io">https://ona.io</a>		X	X	X		Yes	no		No	
Poimapper	<a href="http://www.poimapper.com">http://www.poimapper.com</a>		X	X	X		No	no		No	focus on mapping
Pushforms	<a href="http://www.getpushforms.com/">http://www.getpushforms.com/</a>		X				No	no		No	
RapidPro	<a href="https://community.rapidpro.io">https://community.rapidpro.io</a>			X			Yes	no		No	community survey oriented
Socialcops Collect	<a href="https://socialcops.com/collect/">https://socialcops.com/collect/</a>	X	X				No	no		No	only used in limited context so far.
Survey123	<a href="https://survey123.arcgis.com">https://survey123.arcgis.com</a>		X		X		Yes	no		No	focus on mapping
SurveyBe	<a href="http://surveybe.com">http://surveybe.com</a>		X				No	no		No	no considerable track record with humanitarian orgs
SurveyCTO	<a href="http://www.surveycto.com">http://www.surveycto.com</a>	X	X				Yes	yes	Oxfam,	yes	
Viewworld	<a href="https://viewworld.net">https://viewworld.net</a>	X					Yes	no		No	focus on mapping
VitalHealth	<a href="https://www.vitalhealthsoftware.com">https://www.vitalhealthsoftware.com</a>					X	No	no	Diacare, Mediq	No	interesting focus on applications in our 'modern' world

## 7.2. Acknowledgements

With special thanks to the people who contributed to this research.

### ***International NGO's***

Action Contre la Faim (ACF): Caroline Antoine, Karine le Roch  
International Committee of the Red Cross: Stéphane Du Mortier, Alexandre Vanobberghen  
International Medical Corps: John Balsler  
Save the Children: Emily Keane  
Terre des Hommes: Thierry Agagliate, Guillaume Foutry and Riccardo Lampariello  
Noora Health: Sehj Kashyap  
Open Data Development LLC: Sarah Sheening  
Oxfam UK, Emily Tonkys Valteri  
Unicef: Josephine Ippe  
World Heart Foundation: Joris van Dam  
World Vision: Miriam Chang, Colleen Emary  
[Andre Foods International \(AFI\)](#). [Betty Wamala](#)  
[WFP](#): [Brian Wamubeyi](#)

### ***Providers of MDC tools***

Survey CTO: Audra Blanchfield  
Commcare: Ryan Hartford  
Dharma Platform: Luke Barton, Idriss Ait Bouziad, Andre Heller and Glen Schulenberg  
Mangologic: Thomas Routen  
D-tree: Erica Layer  
Easynut: Francois Xavier Dosonge, Edouard Lavaud  
Buendia: Ivan Gayton, Ka Ping Yee  
[Scope coda](#), [WFP](#): [Craig M Arnold](#); [Federico Naccarato Sartori](#)

### ***Other advisors / consultants***

Editor: Kelly Meulenberg  
GDPR Consultant: Jennifer Perkins  
Legal Consultant: Marcel Vermolen  
Developers, IT experts & system analyst: Jeroen Buis, Einhard Engelbrecht (SC Synergie),

### ***Within MSF***

MSF Amsterdam: Sarah Bellamy, Jacob Goldberg, Kartini Kadroen, Jaap Karsten, Niels van Opzeeland, Harriet Roggeveen, Karin Roodnat, Duco Roolvink Silvia van der Weert, Ellen van der Velden  
MSF Brussels: Francois Xavier Dosonge, Edouard Lavaud  
MSF Barcelona: Ghassan Aziz, Connor Prenderville,  
MSF OCG: Clotilde Rambaud  
The Manson Unit: Raphael Brechard, Jane Greig, Theo Krommydakias, Pete Masters and Rosamund Southgate

### 7.3. Conflict of interest statement

None of two authors and direct collaborators have any affiliation or financial or non-financial interest with a provider of mobile data collection tools that were listed and/or evaluated in this research.

### 7.4. Disclaimer

This Report (the “Report”), its content, evaluation, conclusions and recommendations have been compiled by Médecines Sans Frontières Operational Centre Amsterdam (MSF OCA) and SC SYNERGIE B.V. based on information provided by several providers of mobile data collection tools and NGO’s using these tools (the “Survey”).

This Report will be supplied to all the sections of Médecines Sans Frontières and the NGO’s that participated in the Survey. The Report and all other information supplied to the readers are provided under the express condition that the information is used to support an upcoming decision process within MSF OCA. On their request it can be shared, for information purposes only, with other NGO’s.

Each Recipient of the Report must form its own opinion and assess the content of the Report. MSF OCA and SC Synergie B.V. shall not have any liability (whether for negligence or otherwise) to any of the recipients of the Report or to any other person in connection with or arising in any way from the material and information contained in the Report.

Certain statements, conclusions and recommendations with respect to use of electronic registrations in the ATFC’s are included in the Report. All these reflect assumptions, which may or may not prove to be correct. Actual performance may be affected by material changes in circumstances, which cannot be foreseen at the time of preparing this Report, and actual results may vary from those reported. The recipient of this information undertakes not to copy, reproduce or distribute this Report or any other information related to the Report to a third party without prior written approval from MSF OCA and SC Synergie B.V..

MSF OCA and SC Synergie B.V. make no representations, warranties, opinions or undertakings (express or implied) nor accept any responsibility or liability (whether for negligence or otherwise) as to the accuracy or completeness of the Report, the Survey or any supplement thereto and it should not be assumed that the material and information contained in the Report or the Survey will remain unchanged after the date hereof or that any update of any part of the Report will be prepared or made available.

MSF OCA and SC Synergie B.V. have no obligation to provide the recipient with any additional information, to update the Report or any additional information, or to correct any inaccuracies in the Report or any additional information that may become apparent.