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Assessment of MyChild Solution in The Gambia: Data quality, administrative time efficiency, operation costs, and users' experiences and perceptions.

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MAY 2018

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## **Acknowledgements**

Special thanks to our qualitative study respondents for their voluntary participation. We wish to thank the Ministry of Health & Social Welfare, the central level EPI Team in particular, Action Aid International The Gambia, and Shifo Foundation for their support and cooperation during the assessment period.

## Executive Summary

Health Management Information System (HMIS) is an important building block of any health system. Robust and efficient Health Management Information Systems that ensure good quality data are essential for sound decision making. Individualized electronic health records are becoming more and more common in Health Management Information Systems. A new HMIS, MyChild Solution, was recently introduced in 18 health service delivery points (of 4 health facilities): 4 fixed sites and 14 outreach sites for preventive child health services. As a pilot project, it was necessary to assess MyChild Solution. This assessment is as a result of that need. The goal of this assessment is to assess: 1) the data quality and verification time, 2) administrative time efficiency, 3) annual operating costs, and 4) users' experiences and perceptions associated with MyChild Solution so as to provide useful information in guiding decisions to scale up the intervention in The Gambia.

To examine the four components of this assessment, data was obtained from MyChild Solution, costs were identified, valued, and measured, interviews and observations were made during a field visit, and additional information required was obtained from the stakeholders. The data quality assessment covered a period of three months (October to December 2017). The WHO Data Quality Review Toolkit was used as a framework for the data quality assessment, a time-and-motion approach was used to estimate administrative time efficiency, and an incremental costing approach was used in comparing the costs of MyChild Solution to the Current HMIS in The Gambia. In addition to metrics in the WHO Data Quality Review Toolkit, incidences of recording errors were assessed. Verification time was calculated using verification time logs extracted from MyChild Solution for the months October to December 2017 whilst considering the number of health facilities for which data was verified per month. Interviews conducted were analyzed using thematic analysis.

MyChild Solution scores in all the WHO Data Quality Review Toolkit metrics measured were well within the recommended ranges. Incidences of recording errors were also low (from 0% in Sanyang and Gunjur to 1.5% in Sukuta). The annual average time expected to be spent on data verification nationally was about 2101 hours. MyChild Solution was more expensive than the Current HMIS (\$11,675.95 vs \$8,792.54) when MyChild Solution's administrative time saving was not considered in the costs, but MyChild Solution became cheaper than the current HMIS (\$3,944.10 vs \$8,792.54) when administrative time saving of MyChild Solution was considered. However, it is worth noting that administrative time saved does not mean the Ministry of Health and Social Welfare will save financial amounts equal to the time saved but it means that health workers would have more time to perform other tasks and quality improvement processes associated with their work. For each child fully immunized, given vitamin A, and de-wormed, MyChild Solution saved 60% of time spent on administrative tasks in comparison with the current HMIS. Generally, health workers expressed positive perceptions and experiences in using MyChild Solution. They also highlighted initial registration challenges during implementation because everyone receiving a vaccine dose, vitamin A, or de-worming had to be first registered.

MyChild Solution would produce high quality data when implemented nationally but would require time to perform needed data verification processes. The incremental annual operating cost of MyChild Solution compared with the current HMIS is reasonable though it should be noted that the costing approach used was incremental costing as per WHO requirements. MyChild Solution saved health workers a substantial amount of time spent on performing administrative tasks compared with the current HMIS. Health workers like MyChild Solution and associated it with a lot of benefits to their work. The initial registration of all beneficiaries when using MyChild Solution is a challenge.

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## **Acronyms**

AAITG – Action Aid International The Gambia

DHIS 2 – District Health Information Management System 2

DQR Toolkit – Data Quality Review Toolkit

EPI – Expanded Program on Immunization

GAVI – The Vaccine Alliance

HMIS – Health Management Information System

MCS – MyChild Solution

MoHSW – Ministry of Health and Social Welfare

PKS – Swedish Postcode Foundation

RHD – Regional Health Directorate

RPPHO – Regional Principal Public Health Officer

ROO - Regional Operations Officer

Shifo – Shifo Foundation

## **INTRODUCTION**

Health Management Information System (HMIS) is one of the building blocks of health systems. A HMIS has four important functions namely: data generation, compilation, analyses and synthesis, and communication and use (1). The importance of these functions in decision making cannot be over emphasized. Good quality data is a necessity for sound decision making. The challenge and need for establishing health information systems that ensure reliable immunization data especially in the African region has been highlighted (2).

In The Gambia, a new HIMS, MyChild Solution, has been piloted in 18 health service delivery points: 4 fixed sites and 14 outreach sites in Western Regions 1 and 2 for immunization, Vitamin A, and De-worming data management. The pilot health facilities are Serrekunda and Sukuta in Western Region 1 and Sanyang and Gunjur in Western Region 2. MyChild Solution is introduced in The Gambia through a project called Every Child Counts Gambia Project. The project aims to improve child health service delivery including increasing vaccination uptake in The Gambia. The key project stakeholders are the Ministry of Health and Social Welfare The Gambia (MoHSW), ActionAid International The Gambia (AAITG), The Vaccine Alliance (GAVI), IKARE, Swedish Postcode Foundation (PKS), Shifo Foundation (Shifo). As MyChild Solution is recently introduced in the country, stakeholders wished to ascertain the quality of the data produced using the intervention, its administrative time efficiency, its operational costs, and its user's perceptions and experiences. Information from this evaluation would be used to guide decisions to scale up the intervention.

### **Aim**

The overall aim of the assessment was to evaluate MyChild Solution's data quality and verification time, operating costs and user's experiences and perceptions. The assessment was broken down into four sections:

1. Data quality and verification time assessment
2. Administrative time efficiency assessment
3. Costs assessment
4. Users' perceptions and experiences (a qualitative study)

The evaluation questions of each section are indicated under it accordingly.

## **Description of the Current HMIS in The Gambia and MyChild Solution**

### **Data collection tools at the health facility**

#### ***Current HMIS***

The Current HMIS uses several paper-based forms to collect immunization and related services' data at the health facility level. These forms are also used during monitoring and evaluation. The following are the names of the Current HMIS forms and their descriptions.

1. Infant Welfare Cards are the home-based records in which all services received by a child at a health facility are recorded.

2. Immunization and Vitamin A and De-worming registers are used to register children and record vaccine, Vitamin A, and De-worming they received. These registers are also used to identify immunization defaulters and replace infant welfare cards when they are lost.
3. Daily tally sheets (tally book) are used to record immunization, vitamin A, and de-worming doses given in each immunization session. These sheets are used to aggregate the number of doses of each dose of vaccine, vitamin A, and/or de-worming tablets administered at the end of the month when preparing the monthly returns.
4. The monthly returns form is used to aggregate monthly data at the health facility. The form is later sent to the regional office for verification and entry into the DHIS 2.
5. Vaccine and Other supplies (dry stock) ledgers are used to manage vaccines, diluents, and other related supplies.
6. The Combined Requisition and Issue Note is used to requisite for vaccines and other supplies from the relevant level (regional or national).

### ***MyChild Solution***

MyChild Solution uses Smart Paper Forms for recording personal information and services received at the health facility. These forms are scanned to generate electronic records that can be integrated with national information systems such as the DHIS 2 and the Logistic Management and Information System (LMIS). After processing the Smart Paper Forms, HMIS reports, daily tally sheets, monthly summaries, Monitoring and Evaluation reports, and customized reports based on key program indicators are automatically generated by the system. An Immunization, Vitamin A and De-worming defaulters list is generated based on information captured in the electronic registers. The system also generates for each health facility a Vaccines and Supplies Management report that includes wastage rates and vaccines and supplies quantities required for the subsequent month. The following are the types of Smart Paper Forms used by MyChild Solution:

1. MyChild Birth Record is a form with unique pre-printed ID that is used to register personal information of newborns.
2. MyChild Birth Records Update is used to update electronic records of children when there is a change in information for example a change in address or telephone number.
3. MyChild Health Records is used to record all vaccines/services a child received during a visit.
4. MyChild Vaccine Management form - used by health workers to enter the amount of vaccines and other supplies received and balance at the end of every month.

### **Daily processes at the health facility during and after delivering services**

#### ***Current HMIS***

During their first visit, children are registered and provided with an Infant Welfare Card (home-based record). When the child is due for Vitamin A supplementation, he/she is registered in the Vitamin A and De-worming register. Vaccines/services received by the child are recorded in both the Infant Welfare Card and relevant register each time vaccines/services are administered to him/her. Each vaccine dose, Vitamin A, or mebendazole (de-worming) given is also recorded in the daily tally sheets. Prior to the beginning of each clinic session, health workers are required to record the quantity of each vaccine/other supplies they took in the vaccine and other supplies ledgers. At the end of the immunization session, they are required to record the numbers

returned of each vaccine/supply. At the end of the month, they are also required to physically count their balances and update their vaccines and other supplies ledgers accordingly.

### ***MyChild Solution***

Children are registered using MyChild Birth Record with each entry connected to a unique ID. The unique ID is copied to the Child's Infant Welfare Card. When there is a need to update a child's information, a MyChild Birth Record Update form is used. Each time a child receives vaccines/services, it is recorded on both the home-based records (Infant Welfare Card) and MyChild Health Records. The home-based record is used to determine what vaccine doses/services a child needs during visits. Vaccines and other supplies ledgers are used the same way as in the Current HMIS. However, the paper-based registers and tally sheets are no longer used in health facilities implementing MyChild Solution. When the home-based record of a child is lost, health workers contact the data Verification Officer or someone at the Regional Health Directorate (RHD) to retrieve information for that child from the electronic register.

### **Monthly reporting processes at the health facility level**

#### ***Current HMIS***

At the end of the month, vaccine doses are aggregated using the daily tally sheets and this information is used to fill in the immunizations section of the monthly return. Vaccines and other supplies are physically counted, and totals are used to update the vaccines and other supplies ledgers. This information is also used to fill the vaccine management section of the monthly return. The monthly return is sent to the RHD for verification and entry into the DHIS 2. A copy of the monthly return is kept at the health facility.

#### ***MyChild Solution***

Health workers physically count vaccines and other supplies at the end of the month to fill the Vaccine Management and Data for Action Form. This form is then taken to the RHD for scanning after which a monthly return and vaccine and other supply requirements for next month are sent out via e-mail and WhatsApp on the 5<sup>th</sup> of every month. Additional performance related indicators are shared with health workers on monthly basis via SMS.

### **Monthly reporting processes at the regional level**

#### ***Current HMIS***

The Expanded Program on Immunization Regional Operation's Officer (EPI ROO) checks monthly returns from the health facilities for missingness of information and consistency. If they are satisfactory, he hands them to the regional data entry clerks for onward entry into the DHIS 2. Two copies of monthly returns are usually taken to the RHD. One copy is retained at the RHD and another is returned to the health facility after verification by the EPI ROO.

#### ***MyChild Solution***

The Scanning Coordinator (EPI ROO) and health workers that brought forms for scanning fill in a control sheet confirming that all forms have been delivered and received. The Scanning Coordinator checks the forms for missingness in administrative information and then scans them.

After scanning the forms, images of handwritten text and ticks are automatically converted into digitized text. When the system is unable to recognize text or a tick such as may be in the case of bad handwriting, poor marking, and/or damaged/data document images, it sends out such forms to a data Verification Officer for verification. The data Verification Officer is provided a data verification station that he uses to check data accuracy and verification. The data Verification Officer then checks the unrecognized data against original document images of the scanned forms and rectifies and/or inputs the actual data based on what is seen on the original document image. Scanned forms are archived at the RHD where they are expected to be kept for at least one year. No filled MyChild form is kept at the health facility level.

### **Performance monitoring and evaluation at the regional level**

#### ***Current HMIS***

Data completeness and consistency across different paper-based forms (immunization registers, daily tally sheets, and monthly returns) are periodically checked. Other performance related indicators in addition to data quality are also checked by the RHD and national EPI team periodically. Such Monitoring and Evaluation is time consuming and also requires more resources because one would be required to be physically present at the health facilities to be able to monitor a good number of the performance indicators.

#### ***MyChild Solution***

Data quality indicators on data completeness, timeliness, consistency, and incidence of data entry errors per health facility are automatically generated and displayed on the performance dashboard. This allows RHD and national EPI staff to provide timely feedback to health facilities about their performance and also minimizes the need to visit health centers to be able to monitor certain data quality indicators. Central level staff can also use the dashboard to monitor the performance of regions.

### **Paper form supply management**

#### ***Current HMIS***

The central level prints and distributes the forms to RHDs annually (or on a need basis). The RHDs store them and health facilities are supplied on a need basis.

#### ***MyChild Solution***

Shifo Foundation's project partner, Action Aid International The Gambia, currently prints and distributes the forms to the RHD but this responsibility will be passed on to the Ministry of Health and Social Welfare after the implementation phase. Forms are then collected from the RHD by the health facilities on a need basis.

## **DATA QUALITY AND VERIFICATION TIME ASSESSMENT**

### **Evaluation questions**

1. What is the level of data completeness of immunization sessions captured in electronic reports?
2. What is the level of timeliness for the submission of monthly HMIS reports?
3. What is the level of consistency between immunization indicators and between scanned smart paper forms and electronic data?
4. What is the level of consistency between data generated through MyChild Solution and external data sources?
5. What is the incidence of data recording errors in immunization data collected with MyChild Solution?
6. What are the data quality processes associated with MyChild Solution?
7. How much time should be spent on quality controls and required rectifications with MyChild Solution at a national scale?

## **Method**

### **Setting**

MyChild Solution is piloted in four health facilities (18 service delivery points) in two regions in The Gambia. Two of the implementing health facilities, Serrekunda and Sukuta health centers are in Western Region 1 and the other two, Gunjur and Sanyang, are in Western Region 2. The solution was implemented in Serrekunda in May 2017 and in August 2017 in Sukuta. It was implemented in Gunjur and Sanyang in December 2017. The Gambia's health system is three-tiered: primary (village health services), secondary (minor and major health centers), and tertiary (hospitals) (3). All the four health centers currently implementing MyChild Solution belong to the secondary level of the health system and are classified as minor health centers. Apart from Serrekunda which conducts only health center based (fixed) immunization sessions, all the other health centers conduct both health center based and outreach immunization sessions.

### **Evaluation design and framework**

The Data Quality Review (DQR) Toolkit developed by the World Health Organization (WHO), The Global Fund to Fight AIDS, Tuberculosis and Malaria (The Global Fund), the Vaccine Alliance (Gavi) and United States Agency for International Development (USAID)/MEASURE Evaluation (3) was used to assess the data quality of MyChild Solution in The Gambia. The toolkit provides a standard framework for data quality and information systems assessment. The data quality assessment covered data for a period of three months (October to December 2017). A total of 11,449 visits were made during that time. The toolkit proposes four dimensions of data quality with each dimension having one or more metrics that could be used to assess data quality.

Three dimensions of data quality and their selected metrics were evaluated. The fourth dimension, external comparison of population data, was not ideal to evaluate because health

facility targets in The Gambia are estimated based on catchment area populations whilst the national census results are aggregated at the district level. The different levels of population estimations made it impossible to make a comparison between the two. In addition to that, catchment areas are sensitive to population movements. For example, a child resident in one catchment area might attend immunization sessions in another catchment area due to one reason or other. It would therefore be better to assess external comparison to population data when the data quality evaluation includes regional level aggregation (after scaling up) since census data is aggregated at the local government area (similar to a region) level and also that regions are less sensitive to internal movements of people compared to health center catchment areas.

Data quality metrics of the three dimensions assessed requiring longer periods of data collection such as consistency of reporting completeness, presence of outliers, and consistency over time were also not assessed. It was thought inappropriate to assess them using data collected only over a three months period.

### **Dimension 1 – Completeness and timeliness**

Completeness of reporting measures the extent to which a unit reports to a higher unit it is expected to report to and timeliness measures if the frequency of such reporting is within the recommended reporting period. Completeness of health center reporting was measure by assessing the number of monthly returns sent to the regional health directorates against the number of reports expected from the selected health centers. Another completeness measure assessed was completeness of fixed and outreach immunization sessions captured by MyChild Solution. In assessing that, the number of immunization sessions scheduled and held as per the immunization session schedules of the respective health centers were checked against the number of sessions captured by MyChild Solution. Completeness of indicator data was assessed by asking responsible persons at the regional health directorates if all the information needed is included in returns generated from MyChild Solution. MyChild Solution logs the dates reports were sent from the system. These logs were retrieved from the system by Shifo and timeliness of health center reporting was measured by examining the dates monthly returns were sent from the system to the regional level. The agreed deadline between the Ministry of Health and Social Welfare and Shifo Foundation for submission of monthly returns is the 5<sup>th</sup> of the next month. Monthly returns for all the health facilities are sent the same day in MyChild Solution. The DQR recommended threshold for completeness or timeliness is 75%.

### **Dimension 2 – Internal Consistency**

Data consistency refers to coherence of data. Two metrics, consistency between reported data and original records and consistency between indicators, were assessed. In assessing consistency between reported data and original records, a sample of digitized data was checked against original document images filled by health workers. In order to determine the number of visits to be examined, an online sample size calculator was used (4). MyChild Solution visit forms are scanned in batches with each batch assigned a unique ID. Each visit form in a batch is assigned a

unique document ID. The document ID is a combination of the batch ID and the document number. A list of 58 document IDs was randomly generated from all the visits in the four health centers within the data assessment time frame. The randomly generated forms contained information for 2,133 visits representing 18.6% of all the visits (11,449) made October to December 2017. The parameters used in determining the sample size were a margin of error of 0.45%, a confidence level of 95%, and a response distribution (accuracy) of 99%. The accuracy rate selected was based on an earlier study by Shifo (5). The second metric evaluated was consistency between indicators. For this metric, October to December 2017 Penta 1 and Penta 3 coverage were compared. In a normal situation, Penta 1 coverage is expected to be higher than Penta 3 coverage due to dropout. This metric was only assessed for Serrekunda and Sukuta because MyChild Solution was implemented in Gunjur and Sanyang in the last month of the assessment period.

### **Dimension 3 – External consistency**

External consistency measures the coherence between separate data sources measuring the same indicator. It was measured by comparing Penta 3 coverage of each health center retrieved from MyChild Solution with the Demographic and Health Survey 2013 (6) Penta 3 coverage of the region in which that health center is found. This comparison was only made for Serrekunda and Sukuta because MyChild Solution was introduced in Sanyang and Gunjur in December 2017 (only one month of the evaluation time frame). The recommended threshold for this metric is 33%.

### **Incidences of recording errors**

Incidence of data recording errors is not an explicit dimension or metric in the DQR Toolkit. However, the existence of traceable individual level data in MyChild Solution motivated the assessment of two types of errors.

- 1) Same vaccine dose being marked as administered in two different visits to the same child. This error could be due to a vaccinator administering the same vaccine dose in different visits or recording a vaccine dose as administered when it was not. The proportion of single-dose Bacillus Calmette-Guérin (BCG) administered to the same child twice was estimated for each health center and across all four health centers. The rationale for choosing BCG is that it leaves a noticeable scar on arm when administered thereby reducing the chance of administering it again to the same person during subsequent visits.
- 2) Two different doses of the same vaccine being recorded as administered to the same child during the same visit. This is more likely to be a recording error than actually administering the two doses to the same person. All multidose vaccines were included in estimating the frequency of this error.

### **MyChild Solution’s data quality assurance processes**

For any Health Management Information System (HMIS) system to produce good quality data, adequate quality assurance processes must be specified and implemented accordingly. The assessors observed some verification processes while in the field and requested Shifo Foundation to provide information about validation rules and verification processes associated with MyChild

Solution. Validation rules are automated processes performed by the system and verification processes are procedures manually implemented by a data Verification Officer.

### **Verification time required when MyChild Solution is scaled nationally**

MyChild Solution logs time spent on data verification processes. Verification times for October to December 2017 for the four health centers were retrieved from the system and analyzed. Weighted average monthly verification time was calculated and then projected to a national scale considering the number of health facilities and 2017 EPI target.

## **Results**

### **Dimension 1 – Completeness and timeliness**

#### **Timeliness and completeness of health facility reporting**

Table 1 below shows the timeliness and completeness of submitted monthly returns. It indicates that all monthly returns from the health centers implementing MyChild Solution were sent by the agreed deadline. Hence, both timeliness and completeness of health facility reporting were 100%. MyChild Solution monthly returns are automatically generated and contain all data elements required in the monthly return form. Responsible persons at the Regional Health Directorates confirmed that all required information is provided in the returns obtained from MyChild Solution. Therefore, completeness of indicator data is considered 100%.

*Table 1: Timeliness and completeness of health center reporting*

<b>Month</b>	<b>Deadline</b>	<b>Sent</b>	<b>Timely</b>	<b>Complete</b>
October	5th November 2017	3rd November 2017	Yes	Yes
November	5th December 2017	5th December 2017	Yes	Yes
December	5th January 2018	5th January 2018	Yes	Yes
<b>Percentage (timeliness and completeness)</b>			<b>100%</b>	<b>100%</b>

#### **Completeness of immunization sessions captured**

From table 2 on the next page, it has been shown that information for all held immunization clinic sessions was captured by the system. While reviewing immunization session dashboards for the four health centers in MyChild Solution and immunization session schedules of the health facilities, it was observed that not only held immunization sessions were captured but reasons for cancellation of immunization sessions were also recorded. Health facility immunization session plans extracted from MyChild Solution and given to the evaluators were verified in the field and found to be consistent with those at the implementing health facilities.

Table 2: Completeness of held immunization sessions captured by MyChild Solution

Health Facility name	Session type	Scheduled	Held	Cancelled	Captured	Completeness
Serrekunda	Base	78	76	2	76	100%
Sukuta	Base	36	34	2	34	100%
	Outreach	9	9	0	9	100%
Sanyang	Base	3	3	0	3	100%
	Outreach	6	6	0	6	100%
Gunjur	Base	4	3	1	3	100%
	Outreach	7	7	0	7	100%

## Dimension 2 – Internal consistency

### Consistency between indicators

Penta 1 and Penta 3 coverages were 79.8% and 75.6% in Serrekunda and 83.4% and 82.1% in Sukuta respectively. From the perspective of an expected relationship between Penta 1 and Penta 2, the coverages reported are consistent with what was expected. The coverages also indicate that Penta 1 – Penta 3 dropout rates were well within the recommended dropout range (10%) during the time reviewed.

### Consistency between reported data and original records

Of the 2,133 visits reviewed, information for 2,132 visits, representing 99.95% of the original records was correctly recognized. Only one visit in the scans of the visit forms had a tick that was not recognized by the system and therefore not digitized. The proportion of original records correctly digitized highlights a very high consistency between original records and digitized data.

## Dimension 3 – External consistency

Penta 3 coverage was 75.6% in Serrekunda and 82.7% in Kanifing the local government area in which Serrekunda Health Center is located showing a difference of 7.1 percentage points. This difference is very consistent based on the DQR Toolkit recommendation of a difference of not more than 33%. In Sukuta, Penta 3 coverage was 82.1% and it was 85.7% in Brikama, the local government area in which Sukuta is found. The difference (3.6 percentage points) in Penta 3 coverage between MyChild Solution and DHS is also consistent in Sukuta.

## Incidence of recording errors

### Proportion of children recorded as to have received BCG during two different visits

The average proportion of children who were recorded as having received BCG twice in different visits within individual health centers was 0.7% considering all four health facilities. In Serrekunda health center it was 1.5%, in Sukuta health center it was 0.1%, and it was 0% in both Gunjur and Sanyang health center. When the proportion of children recorded as to have received BCG during

two visits was checked both within and between health centers, the proportion increased to 1.1%. The 0.4 percentage points increase was due to the unique child IDs recorded as to have received BCG in at least two health centers.

**Proportion of children recorded as having received two doses of a multidose vaccine during the same visit.**

Taking all the health centers together, the proportion of children recorded as having received two doses of the same vaccine (multidose vaccine) during the same visit was 0.4%. For individual health centers, it was 0.3% in Serrekunda, 0.5% in Sukuta, 0.1% in Gunjur, and 0% in Sanyang.

**MyChild Solution data quality assurance processes**

MyChild Solution has two types of data quality assurance processes (7). One type is comprised of automated processes carried out by the system and it is called validation rules and the second one is composed of manual processes called data verification.

**Validation rules**

*Table 3: Cases that may result in invalid data and their validation rules*

No	Cases that may result in invalid data	Validation rules
1	Multiple scanning of the same form which could result in duplication of data.	System uses immunization session date, site name (base/outreach) and visit information to identify multiple scans of the same form. Information from the last form is considered.
2	Health worker recording in the form that the same vaccine dose was administered multiple times to a child in one day (visit / session)	System considers only unique vaccine doses administered to a child in a day.
3	Health worker records that the same vaccine dose was administered multiple times to a- child at different dates (sessions / visits)	No validation rules are applied in the aggregate data and all administered doses are reported. However, in the electronic immunization register (individual records of the child) last date of administered dose is shown.
4	Health worker does not record child's date of birth in the registration form.	Child's date of birth is estimated based on the vaccine doses received and the recommended age for the received vaccines. This is used to generate aggregate data stratified by age groups. All estimated dates of birth in register are marked as "estimated".
5	Health worker does not register a child's gender in the registration form.	Cases of unknown gender are randomly assigned to one of the gender groups. This is done to allow stratification of aggregate data by gender.

6	Mistake is made while recording the child’s ID number in MyChild Health Record.	<p>Incorrect IDs are identified and corrected based on inbuilt algorithms that analyze registered children who match those with incorrect ID numbers based on:</p> <ul style="list-style-type: none"> <li>a. Register ID numbers that differ by 1 digit.</li> <li>b. Registered ID numbers that differ by 2 digits that differ by 2 digits that have been switched around.</li> <li>c. History of vaccines and other services provided.</li> <li>d. Date of birth.</li> </ul>
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**Data verification**

When MyChild Solution detects bad handwriting, poor marking, and/or damaged/dirty document images, it flags such errors and sends them to the data Verification Officer. The Verification Officer then checks all discrepancies and corrects all flagged fields and cases where the digitized data is incorrectly recognized by comparing the electronic data with what is written or marked on the scanned Smart Paper Forms. The Verification Officer rectifies and/or inputs actual data seen in the original document image.

The system also flags possible discrepancies/incomplete data for the Verification Officer to review and compared with the original document image. The Verification Officer reviews and rectifies incorrectly recognized data based on information in the original document image filled in by the health workers. The discrepancies flagged for verification by the system are listed below:

- 1) Date of birth of the child is not recorded in the registration form.
- 2) Recorded date of birth is in the future or more than five years in the past.
- 3) Phone number does not adhere to the country-specific format.
- 4) Gender of the child is not recorded in the registration form.
- 5) Same vaccines but different doses administered during the same visit (e.g. OPV 1 and OPV 2).
- 6) Not all vaccines that a child is expected to receive are administered (ticked in the form) during a particular visit.
- 7) No vaccines or other services provided during a visit.
- 8) Incorrect IDs.
- 9) There are four types of smart paper forms (MyChild Birth Record, MyChild Health Record, MyChild Birth Record Update, MyChild Monthly Return). The type of form is recognized by the system from the barcode on the forms. If the barcode was not printed properly system might fail to identify the type of the form and send a task to Verification Officer to manually include the form type.

- 10) Session date is in the future or more than two months in the past.
- 11) If wrong health facility name/code that does not exist in the database is entered.

### Time to be spent on verification

Using the average verification time per visit based on verification times of implementing health facilities and the average monthly visits of Western Regions 1 and 2, the expected national average monthly verification time is 175 hours 6 minutes and the average expected yearly verification time is 2,101 hours 12 minutes as shown in table 4 below.

*Table 4: Expected national verification time based on average visit of pilot regions and average time per visit in implementing health center*

Average verification time (in sec) per visit <sup>1</sup>	Average visits per health facility per month <sup>2</sup>	Number of Health facilities offering EPI services <sup>3</sup>	Estimated verification time nationally	
			Monthly	Annually
7	1122	76	175 hrs 6 mins	2101 hrs 12 mins

In table 5 below, the average verification time per month per health facility is presented. This is another way of showing the average time expected to be spent on verification per health facility per month when rolled out nationally. Assuming that average verification time would be similar for all health facilities in the country, the average monthly verification time expected nationally is 2 hours 36 minutes per health facility per month.

*Table 5: Expected average verification time per health facility per month based on the average of current implementing health facilities*

Month	Number of health facilities <sup>4</sup>	Time spent on verification	
		Seconds	Hours & minutes
October	2	39863	
November	2	20200	
December	4	19827	
<b>Average per month</b>		<b>24929<sup>5</sup></b>	<b>6 hrs 54 mins</b>
<b>Average per health facility per month</b>		<b>9348</b>	<b>2 hrs 36 mins</b>

<sup>1</sup> This time was calculated using weighted averages of the number of the total monthly visits and verification times.

<sup>2</sup> This figure is an average of the monthly visits of all the health facilities in the Western regions 1 and 2.

<sup>3</sup> This is the number of health facilities providing immunization services in The Gambia (Source: National EPI).

<sup>4</sup> Refers to the number of health facilities implementing MyChild Solution during the assessment period.

<sup>5</sup> This average was weighted by the number of health facilities per month.

## Discussion

This assessment examined the quality of data generated through MyChild Solution in The Gambia using data from the four implementing health centers, described the data quality processes associated with MyChild Solution, and estimated the average time expected to be spent on verification on a national scale. Findings indicated that MyChild Solution's data quality assurance processes are robust and guarantee high quality immunization data as evidenced by the system's high scores under each of the DQR Toolkit metrics assessed and the incidence of recording errors evaluated.

Data generated through MyChild Solution was found to be well within the recommended thresholds for each of the DQR Toolkit metrics examined. Also, the proportions of recording errors found were very small. The high quality of data generated using MyChild Solution may be credited to the well thought out validation rules, verification procedures, training of the people involved in data collection at the health facility level, and the continuous optimization of the system and data collection tools.

In assessing the incidence of recording errors, we found that a small number of children was recorded as to have received BCG vaccine in two health facilities. The error occurred in immunization sessions that were within a range of 3 days. We explored reasons that might explain it and found that it was a printing error. Information gathered from the field visit and Shifo Foundation has it that the contracted printing company mistakenly duplicated MyChild Birth Records while printing and that consequently resulting in a duplication of IDs. So, it was not that the same children received BCG from two health centers. Shifo Foundation mentioned that download links to the forms have now been programmed to expire after a single download. That way, the printing company will not print the same form twice. The children that are affected by that error are now uniquely identified by the addition of the letters "a" or "b" after the last digits of their IDs according to Shifo.

This evaluation has some limitations the assessors would like to highlight. The average time estimated to be spent on verification when MyChild Solution is scaled up nationally might have been over or underestimated because the average number of visits used is based on average visits of the two health regions implementing MyChild Solution and not all regions in the country. Based on national population estimates, these two regions account for more than half of the national population (7). However, the ratio of number of health facilities delivering immunization services to the population per region varies across regions. For example, figures obtained from the national Expanded Program on Immunization Office show that Western Region 2 (one of the implementing regions) had an annual live births target of 14,256 in 2017 and Central River Region had 12,996 but Central River Region had 1 health facility offering immunization services more than Western Region 2 (9 Vs 8 health facilities).

Looking at the monthly verification times from October to December 2017, it is obvious that the verification time decreased in each of the last two months of the period evaluated compared to the previous month (even in the last month when two health facilities were added leading to an increase in the number of visits). There may be many possible explanations to that observation. One is that perhaps the data Verification Officers become more familiar with the process over time and as a result become more efficient. A second possibility is that health workers in the first two health facilities have learnt ideal ways of filling and taking care of the forms overtime. So, less forms were sent out for verification by the system. Since MyChild Solution has been implemented in Serrekunda and Sukuta at least four months prior to its implementation in Sanyang and Gunjur, it could also be that MyChild Solution staff have learnt the mistakes commonly made by health workers in the first two implementing and health facilities and emphasized on such mistakes when orienting health workers in Sanyang and Gunjur. Another possible explanation is the continuous development and optimization of MyChild Solution. It is also possible that all the possibilities mentioned worked complementarity in reducing the verification time.

Going by the decrease in verification time observed, one would tend to think that a similar trend would be observed when the solution is rolled out nationally. For example, the time spent on verifying data for October when there were two health facilities was twice the time spent for December when the number of health facilities was four. This suggests that verification time per month might be high and differ significantly between early months of implementation but then reduce and become shorter and similar after sometime into implementation if all other conditions remain constant (e.g. health workers). However, to test that line of reasoning, verification logs of a longer data verification period and a larger sample of health facilities would be required.

## **ADMINISTRATIVE TIME EFFICIENCY**

### **Evaluation question**

What is MyChild Solution's administrative time efficiency in comparison to the current HMIS?

### **Method**

#### **Design and data collection**

One of the Results Framework for Every Child Counts The Gambia Project is *reduction in time spent on data collection, aggregation and reporting by frontline health workers*. Having that in mind, a pre- and post-intervention quantitative study to measure changes in administrative time has been part of the project since its inception. This assessment is based on data collected by the project team in collaboration with Tallinn University for an earlier pre- and post-introduction of MyChild Solution efficiency study (8). The study was informed by a time-and-motion study approach. A time-and-motion study involves breaking down processes into their constituent

tasks and observing and recording the time of each task repeatedly (see Baysari MT et al 2015) (9).

Pretest, pre-intervention, and post intervention data were collected in September 2016, May 2017, and December 2017 respectively. Pretest data was collected in two health facilities in Central River Region while pre-intervention and post-intervention data were collected in two health facilities in Western Region 1. Researchers used stopwatches to time each task associated with immunization service delivery at the health facility level. The duration of each task was recorded on a sheet of paper. This process continued until either all children were observed for that immunization session or saturation (observations recorded become consistent and repetitive over multiple child visits for that session) was reached. Four observation sheets were used to record observations:

Observation 1: Time spent on children making their first visit to the clinic

Observation 2: Time spent on children making a follow-up visit to the clinic

Observation 3: Time spent on daily administration tasks

Observation 4: Time spent on monthly administration tasks

Due to time limitations, post-intervention data collection in Western Region 1 was only three days. In addition to using the pretesting observations to test data collection tools, some pretest data was also included in estimating MyChild Solution's administrative efficiency. Such data was registration of children and filling in the vitamin A/de-worming register for first visits and follow-up visits and filling in the immunization register (for follow-ups) because those tasks were not done in in the health facilities where observations were made in Western Region 1.

## Results

The results show that there is a reduction in administration time across all the measured tasks. The administration time savings per child fully vaccinated and received all the required vitamin A and de-worming doses is 16 minutes 37 seconds representing a 60% decrease from 27 minutes 42 seconds to 10 minutes 57 seconds. If only vaccinations are considered, administration time was reduced from 12 minutes 34 seconds to 5 minutes 37 seconds showing a decrease of 55%. For vitamin A and de-worming, an administration time of 64% (9 minutes 40 seconds) was saved. The highest administration time saved per task was in monthly reporting. It was reduced by 97%. The lowest administration time (26%) savings was in administration at the end of the day.

Table 6: Time saved per child (only administration time considered) in hours, minutes, and seconds

Processes	Pre-intervention Observation Activity  Result (average time spent)	Post-intervention Observation Activity  Result (average time spent)	Time saved	Time saved in percentage
Vaccinations for newborns/first visits	0:04:10	0:02:25	0:01:45 per child	42%
Follow-up vaccinations	0:01:24	0:00:32	0:00:52 per child	62%
Vitamin A and deworming first visit	0:02:24	0:00:32	0:01:52 per child	78%
Vitamin A and deworming Follow-up visit	0:01:24	0:00:32	0:00:52 per child	62%
Administration at the end of the day	0:04:44	0:03:30	0:01:14 per child	26%
Reporting at the end of the month	2:21:52	0:04:02	2:17:50 per month	97%
Time spent to fully immunize a child (7 visits)	0:12:34	0:05:37	0:06:57 per child	55%
Time spent to fully provide vitamin A/deworming to a child (10 visits)	0:15:00	0:05:20	0:09:40 per child	64%
<b>Time spent to fully provide vitamin A, deworming, and vaccination per child</b>	<b>0:27:34</b>	<b>0:10:57</b>	<b>0:16:37 per child</b>	<b>60%</b>

## **Discussion**

This study assessed administration time savings associated with MyChild Solution in comparison with the Current HMIS in The Gambia. Findings have shown that there was a reduction in administrative time in all the tasks assessed. This means that health workers would have more time to perform other tasks and quality improvement processes. MyChild Solution has the potential to in fact save more time with it is continuous improvement. For example, the system automatically generates a defaulters list for follow-up but generating such a list in the Current HMIS involves physically searching for defaulters from one page to the other in the immunization or vitamin A/de-worming registers which is time consuming.

This assessment has some limitations the assessors would like to point out. It was assumed that all required tasks for each process associated with vaccination and vitamin A and mebendazole administration during clinic sessions. However, it was noticed that some tasks such as updating the immunization registers were not consistently performed. It is also noteworthy that this assessment was made based on post-intervention observations made in only two health facilities. Therefore, although the results are very encouraging and strongly suggest that MyChild Solution is highly administrative time efficient when compared with the Current HMIS, our results are not conclusive. The administrative time saving would be more generalizable when assessed after MyChild Solution has been implemented in more health facilities in The Gambia.

## **OPERATION COSTS**

What are the annual operating costs of MyChild Solution per child fully immunized compared to the current HMIS?

## **Methods**

### **Costing approach**

The costing process used was guided by the WHO guide for standardization of economic evaluations of immunization programmes (10). An incremental costing approach was used in the costing (10) and costs were viewed from the healthcare (Ministry of Health and Social Welfare's) perspective (11). Using incremental costing means that only additional resources required to implement MyChild Solution were included. Existing structures in the health system that would be used by the solution were not costed. In comparing the operation costs of MyChild Solution with the Current HMIS, items/resources that differ between the two were costed. Existing structures and resources that are utilized by both systems such as computers and internet connectivity at the regional level, transportation of forms from the health facilities to the regional level for inputting/scanning, vaccine and dry stock ledgers, et cetera were excluded. An "ingredients" approach to costing was also used wherein the total quantities of inputs were multiplied by their unit costs. Such separation of prices from quantities enhances transparent representation of costs (10). All market prices were reported in US dollars. Conversions from local

market prices to US dollars were made using the average conversion rates of March 2017 to March 2018 from OANDA (12). The following steps were followed in the costing process.

1. Identification of all relevant costs for MyChild Solution and the Current HMIS
2. Measurement of all costs with relevant physical units
3. Valuation of costs
4. Identification of relevant data sources

### **Data (costs) sources**

Financial costs of MyChild Solution were extracted from project accounts provided by Shifo Foundation. Invoices for materials/items obtained from The Gambia were verified during the field visit. Similarly, the costs of materials/items were requested from a printing company that was suggested by the MoHSW. The sources and quantification of each included operation cost is described below. Quantities used in the estimations were obtained from the MoHSW.

### **Printing costs**

Printing costs for the two alternatives were obtained from the same printing company to minimize the chance of price variations that could arise from obtaining costs from different printing companies. Fortunately, the company that provided the quotations also prints Current HMIS and MyChild Solution forms. Current HMIS printing costs are borne by donor organizations. Costs for the Current HMIS were estimated considering the number of health facilities delivering preventive child health services nationally to be 76 and the annual live births target to be 88,968.

### **Equipment costs**

Since an incremental costing approach was used, only costs that are not common to the two systems were included. Therefore, common equipment such as computers at the regional level, electricity, and internet were excluded in the costing. Since health workers receive monthly reports and SMS on their personal mobile phones, monthly mobile phone and internet costs were thought to be negligible and therefore also excluded. Based on the current implementation strategy of MyChild Solution, only one additional equipment, a scanner, is needed in each of the seven health regions of The Gambia. Costs of scanners purchased for the two implementing regions were used to estimate equipment costs. In line with WHO recommendations, import tariffs were not included in calculating the cost of scanners (10). The useful life of each scanner is estimated to be 7 years. The straight-line depreciation method was used to calculate annual depreciation over the useful life of the scanner with the expected value at the end of the 7 years assumed to be 0.

### **Costs of other services**

Smart Paper Technology engine operations and continuous development costs were included in the cost calculations. This is a fix cost of 0.1 USD per child fully immunized that is applied in all the countries implementing MyChild Solution. SMS costs were computed using price from the service provider.

### **Verification time costs**

The expected time to be spent on verification when MyChild Solution is scaled up nationally was valued in monetary terms using the salary scale of data entry clerks at the regional level. Data entry clerks at Regional Health Directorates are on grade 6 pay scale of the government pay scale ranging from grade 6.0 to grade 6.8 depending on the data entry clerk's length of service. The average salary of data entry clerks at the regional level is 2,558.38. Using the average grade 6 monthly salary of data entry clerks, an hourly rate was calculated. Then the hourly rate was multiplied by the number of hours expected to be spent on verification. For details about how average national verification time was estimated please refer to pages 8 (*"Verification time required when MyChild Solution is scaled nationally"*) and 12 (*"Time to be spent on verification"*) of this report.

### **Cost savings due to reduction in time spent on administrative tasks at the health facility**

The expected time savings due to reduction in time to be spent on administrative tasks at the health center level was valued using the average monthly salary of Public Health Officers (they responsible for preventive child health) in The Gambia. Public Health Officers at the health center level are on grade 7 of the government pay scale. After employment, 0.1 points is added to one's pay scale each year and the limit for this addition is grade 7.8. Since Public Health Officers at health center level in The Gambia are at different points of the grade 7 salary scale and the distribution of such in the country was not known to facilitate the calculation of weighted averages, an unweighted average grade 7 salary of 3112.75 Dalasi was used to calculate an hourly wage. This hourly wage was used to estimate the costs of administrative time that would be saved when MyChild Solution is implemented across all health centers in The Gambia. For a detailed explanation of how cost savings due to reduction in time to be spent on administrative tasks at the health facility level was calculated please refer to the section, "ADMINISTRATIVE TIME EFFICIENCY" (pages 14 – 15 of this report).

### **Assumptions**

In calculating the costs for both arms, it was assumed that similar services and process will have the same costs. The costs that were assumed to be the same for both arms are specifically:

1. Delivering forms/reports from facility to RHD
2. Storing paper forms in RHD and facility
3. Procurement and distribution processes of the paper forms
4. Electricity, computer/laptop and internet access at RHD
5. Data storage costs
6. DHIS2 maintenance

Also, in calculating the administrative time efficiency of MyChild Solution, which was used in calculating the cost of administrative time savings, the assumption was that immunization service providers in different regions would complete similar procedures in about the same time durations. This means that observed Public Health Officers in health facilities implementing MyChild Solution would use about the same time to complete similar administrative tasks as

those in non-implementing health facilities in Central River Region that were used as a comparison in some instances. Another assumption was that time spent on manually validating and inputting immunization data into the DHIS 2 is insignificant and therefore negligible.

One of the WHO recommended sensitivity analyses approaches, a multi-way sensitivity analyses (10), was used to evaluate how MyChild Solution costs would change if the costs of the scanners and Smart Paper Technology Engine operations and continuous development increase by 1%, 5%, and 10% respectively.

## Results

Table 6 presents a comparison of the annual operation costs of the Current HMIS and MyChild Solution in The Gambia. The estimated annual operation cost for the Current HMIS was \$8,792.54 and that of MyChild Solution was \$11,675.95. It points that the annual operation cost of MyChild Solution is higher than that of the Current HMIS. The difference between the two systems suggests that an additional 33% of the Current HMIS costs would be incurred when the country decides to move from the Current HMIS to MyChild Solution. Immunization and Vitamin A and Deworming registers account for the largest cost proportions in the Current HMIS whilst Smart Paper Technology Engine operations and continuous development was associated with the highest proportion MyChild Solution costs.

The costs presented only included costs for required items for both systems and the salary for data verification in MyChild Solution. Cost for time savings from reduction in administrative time of health workers at the health facility level was not included.

Table 7: A comparison of the operating costs of the Current HMIS and MyChild Solution

Item	Quantity /year	Unit Cost	Annual costs of the Current HMIS	Annual costs of MyChild Solution	Comments
Immunization registers	283	\$ 13.925	\$ 3,940.87	\$ -	Health centers were supplied at least twice their annual needs. Therefore, half of the supply was considered.
Immunization tally book	76	\$ 8.229	\$ 625.37	\$ -	1 for each of the 76 health facilities.
Vitamin A and deworming register	283	\$ 13.925	\$ 3,940.87	\$ -	Expected to be similar to the number of immunization registers.
Monthly return book	76	\$ 3.756	\$ 285.43	\$ -	Health facility monthly returns books contains 11 pages and 3 of them are used for immunization data. Hence 27% of the cost is used.
MyChild birth records	5,931	\$ 0.038	\$ -	\$ 225.26	Quantity per year considers annual 88,968 new births and each form capable of registering 15 children used.
MyChild health record	35,568	\$ 0.017	\$ -	\$ 600.36	Quantity considers 39 forms (based on pilot sites) used on average per month in 76 health facilities.
MyChild monthly return	912	\$ 0.011	\$ -	\$ 9.62	Monthly return is filled once per month
MyChild birth records update	7,296	\$ 0.017	\$ -	\$ 123.15	8 forms (based on pilot sites) per health facility per month
Maintenance of scanners	7	\$ 50.000	\$ -	\$ 350.00	Quantity considers 1 scanning station would be placed in each region. Rollers are recommended for change annually by the manufacturer.
Smart Paper Technology Engine operations and continuous development	88,968	\$ 0.100	\$ -	\$ 8,896.80	2017 Live births target used to determine quantity
Scanners	7	\$ 107.625	\$ -	\$ 753.38	Scanners considered to last for 7 years
SMS	1,824	\$ 0.016	\$ -	\$ 29.18	2 health workers per facility per month
Time to be spent on verification	2,024	\$ 0.340	\$ -	\$ 688.19	Salary (hourly rate) for data entry clerks at RHD used
<b>Total</b>			<b>\$ 8,792.54</b>	<b>\$ 11,675.95</b>	

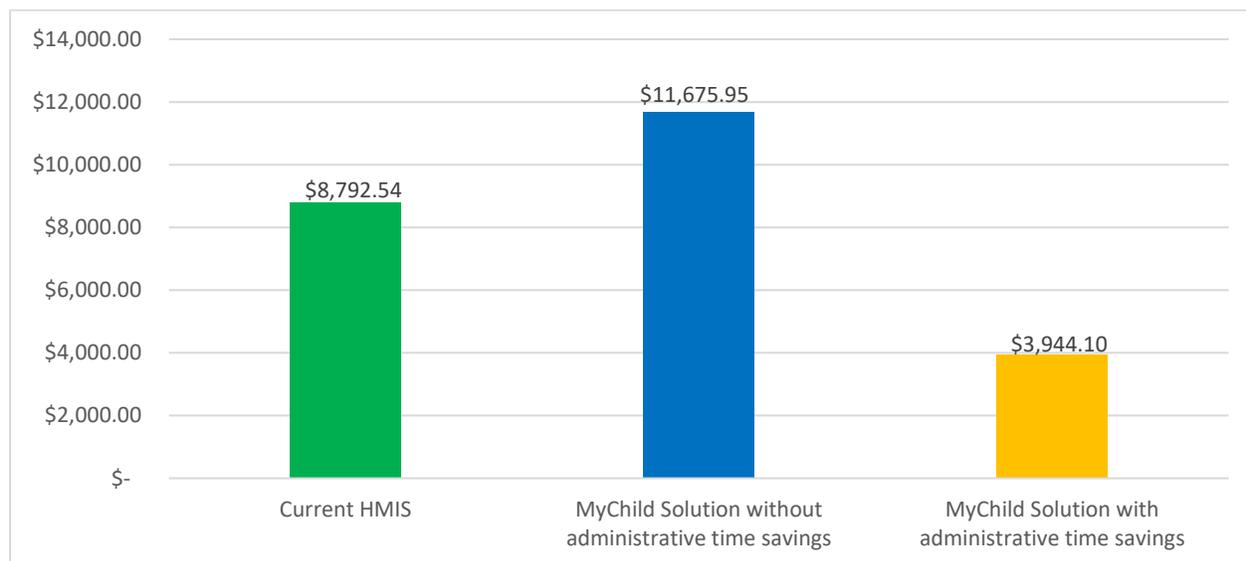
In table 7 below, it is shown that MyChild Solution has the potential to save administrative time at the health facility level worth \$7,731.85 per year when implemented in all 76 health facilities offering immunization services in the country.

*Table 8: Cost saving due to reduction of time spent on administrative tasks at facility level.*

Visit	Current HMIS	MyChild Solution	Time saved	Average annual visits in 76 health facilities <sup>1</sup>	Time saved	Costs saved
First	0:06:34	0:02:57	0:03:37	88968	5362h 47m	\$ 2,198.74
Follow up	0:01:24	0:00:32	0:00:52	934296	13495h 23m	\$ 5,533.11
<b>Total</b>					<b>18858h 10m</b>	<b>\$ 7,731.85</b>

Costs comparison between the Current HMIS, MyChild Solution without administrative time savings, and MyChild Solution with administrative time savings is presented in figure 1 below. Without considering administrative time savings, the current HMIS was cheaper than MyChild Solution but when administrative time was considered, MyChild Solution became cheaper. However, it is worth noting that the administrative time saved, may not mean employment of less Public Health Officers in The MOHSW but it could mean that Public Health Officers would have more time to perform other tasks and improve the quality of their work.

*Table 9: Comparison of annual operation costs of the Current HMIS and MyChild Solution (without and with time savings).*



<sup>1</sup> Annual average visits was estimated based on average monthly visits per health facility in Western Region. Of the average annual visits, the live births target (88,968) was taken as the first visits and the rest as follow-up visits.

In table 8 below, another possible way of calculating the annual operation costs is shown. Here, costs were calculated per child. Again, the Current HMIS is cheaper than MyChild Solution when costs savings due to reduction in administrative time at the health facilities were excluded but the Current HMIS became more expensive when cost savings were included.

*Table 10: Annual cost per child comparison of the Current HMIS and MyChild Solution (Without and with cost savings)*

System		Annual operation cost	Annual cost per child
Current HMIS		\$ 8,792.54	\$ 0.10
MyChild Solution	Excluding cost savings	\$ 11,675.95	\$ 0.13
	Including cost savings	\$ 3,944.10	\$ 0.04

A multi-way sensitivity analyses of the annual operation cost and annual cost per child of MyChild Solution (excluding cost savings) is presented in table 9 below. The cost of scanners and Smart Paper Technology Engine operations and continuous development were varied together by 1%, 5%, and 10% to give an idea of how such changes might influence the costing. The reason for choosing these two costs is that they are the two major contributors to the cost of MyChild solution and that printing costs are expected to increase similarly. Hence there is no need to include the cost of MyChild solution forms. The results indicate that up to a 10% increase in the costs of the items included does not make the total cost exorbitantly high.

*Table 11: Annual operating costs and costs per child of MyChild Solution should the cost of scanners and Smart Paper Technology Engine operations and continuous development increase by 1%, 5%, and 10%.*

Increment rate	Annual operation cost	Annual cost per child
1%	\$ 11,956.07	\$ 0.13
5%	\$ 12,349.34	\$ 0.14
10%	\$ 12,840.94	\$ 0.14

## Discussion

This study used an incremental costing approach to compare the annual operation costs of MyChild Solution with the Current HMIS in The Gambia. Its findings indicate that the annual operation costs of MyChild Solution are reasonable in comparison with the Current HMIS in The Gambia. The findings further suggest that for The Gambia to move from the Current HMIS to MyChild Solution, an incremental cost of about 33% of the Current HMIS would be incurred if the cost of potential administrative time savings at the health center level is not considered. However, MyChild Solution would cost less than the Current HMIS to implement if administrative time efficiencies are taken into account. In India, an evaluation of a point-of-care electronic register estimated an annual cost per beneficiary of \$4.79 (12). This cost is higher than that of

MyChild Solution with (\$0.13) or without (\$0.04) considering administration time efficiency gains. Another advantage of MyChild Solution over point-of-care electronic registers is that registration equipment such as a laptop or some other electronic device (plus power and internet connectivity) are usually required at the service delivery point whilst that is not required with MyChild Solution.

In addition to administrative time efficiency at the health facility level, MyChild Solution would bring along other important benefits to preventive child health services. From the data quality evaluation, it is evident that MyChild Solution has the potential to enhance immunization data quality. At the regional and national levels, MyChild Solution's EPI performance dashboard would ease supervision and monitoring of performance of lower levels.

There are limitations to the costing approach used that are worth keeping in mind while interpreting the results of this study. It was not a full costing that was conducted. Since an incremental costing approach was used, only costs that are thought to differ between the two systems were included. It is possible that implementation and adaptation costs may be higher for MyChild Solution than the Current HMIS. Implementation and adaptation costs would be better measured when the solution is implemented at least regionally. Administration time efficiency gains at the health facility level may not mean a direct reduction in government expenditure on salary of service providers at the health facility level. But it could directly mean that service providers at the health facility level would have more time to carry out their job more effectively resulting in a more general preventive health system improvement. It is important to note that potential administrative time efficiencies (supervision frequencies, data analysis etc.) that may be gained when MyChild Solution is implemented nationwide were not included in the costing. Verification and manual entry of immunization data from the Current HMIS monthly return into the DHIS 2 was thought to be negligible and therefore not included. Similarly, time spent on scanning MyChild Solution was also thought to be negligible. There is a possibility of feeding data from MyChild Solution directly into the DHIS 2 platform. When that is done, it would further improve data quality and eliminate time spent on manually entering data into the DHIS 2. It is also worth noting that average annual visits were estimated using data from the implementing regions (Western regions 1 and 2). It is possible that the average annual visits were under or over estimated.

## **USERS' PERCEPTIONS AND EXPERIENCES**

### **Evaluation question**

What are the perceptions of health facility workers and regional health directorate staff about the benefits and challenges associated MyChild Solution?

### **Method**

#### **Study setting**

Western Regions 1 and 2 of the Gambia.

#### **Study design**

A qualitative approach was used in this study, and thematic analysis as the analytical approach. To collect the data, semi-structured interview was used.

#### **Study participants**

To be eligible for this study, participants should have been engaged in routine immunization in the Gambia for at least three months and had contact with MyChild Solution during that time. Seven respondents were purposively invited to join this study and confirmed their availability. The participants were in the middle age groups, and four of them were women. They consisted of four Public Health officers, one Regional Principal Public Health Officer (RPPHO), one EPI Regional Operations Officer (EPI ROO) and one central level EPI Staff.

#### **Data collection**

A semi-structured interview guide with open-ended questions was used. The researcher developed three topics in the interview guide based on their experiences in EPI, which are 1) Health workers' opinions and experiences in using MyChild Solution, 2) Benefits and challenges of using MyChild Solutions, and 3) Major differences between MyChild Solution and HMIS. The interviews were conducted on the 16<sup>th</sup> – 20<sup>th</sup> April 2018 and at the respondents' workplaces. Interviews were conducted in English. The average interview duration was 12 minutes with the longest interview lasting 16 minutes. All interviews were recorded. The researcher also used a notebook to write down his observations, additional information provided by the participants, memos, and comments during data collection.

#### **Data analysis**

The researchers transcribed all the interviews verbatim and conducted a line by line coding with the use of emergent codes. The next step was to identify the codes with similar patterns that lead to grouping these codes under several themes. There were five initial themes developed that were relevant to addressing the research question.

Table 12: Sample of coding process

Text	Codes	Themes
<p><i>“The new format (MyChild Solution) has definitely reduces the workload in the public health services and it has also made follow up ease on their own, on their part”</i> (Participant 4)</p>	<p>Reducing health worker workload</p> <p>Easier to follow up</p>	<p>“I like MyChild Solution”</p>
<p><i>“With this is a, this is very user friendly, very easy to use, no complication, very easy. “</i> (Participant 1)</p>	<p>User friendly</p>	

### Ethical consideration

Prior to the interviews, the researcher explained the objectives of the study to the respondents. He informed them that participation in this study was voluntary. They were also assured that they had the right to withdraw or refuse to answer questions at any stage of the interview and without a need to give any explanation. Afterwards, the respondents who agreed to participate, read and signed the informed consent. In analyzing and presenting the findings, the researchers assured the respondents that the data will be treated carefully to ensure confidentiality. The transcribed data was protected and could only be accessed by the researcher. In an effort to achieve anonymity in presenting the result, the respondents were referred to using numbers assigned to them. Names, addresses, and other identification that could lead to recognition of the respondents were removed.

### Findings

There were five themes revealed from the data

#### “I like MyChild Solution”

- Easy, user friendly and reduces workload

*“Ya, anyway MyChild Health solution is not difficult, this thing system. The way I see it, it is very user friendly and it reduces the workload off.. off..”* (Participant 1)

*“Am a.. the major differences is the new format has definitely is the workload in the public health services and it has also made follow up ease on their own, on their part.”*  
(Participant 4)

*“First, it reduces the workload as regional .... (ROO) and even at the facility level because sometimes it takes you two or three days before some PHOs would finish their monthly returns. And now they don’t have that burden on them” (Participant 6)*

- Save time

*“You just write the number, tally the immunizations the child needs to have. It saves time compared to the other (old system) immunization schedule that we were using.” (Participant 2)*

- Improve data quality

*“What you vaccinated, that’s what you would recorded there. So, you can not minus it, you can not plus it” (Participant 5)*

- Wishes to maintain MCS and to scale this up

*“Yeah MyChild, MyChild solution I think it is great innovation and maybe in the near future, if this, can be scale up to the whole country, I think it will help a lot.” (Participant 3)*

### **MyChild Solution system facilitates data analysis**

- Generate and update monthly returns

*“The system is preparing them (monthly returns) for us and you know how crazy it is to prepare a monthly return at the end of a month but with this MyChild Health Solution system, the system is just providing us with our monthly returns” (Participant 2)*

- Generate and update vaccine requisition

*“Ya, they also generated the..requisition notes. Like the..the amount of vaccine that you will need for the following months..ya” (Participant 3)*

- Providing defaulters list

*“For this system, because it helps us a lot, we know the the defaulters, we do contact tracing” (Participant 1)*

### **Practical benefits for mothers**

*“MyChild Solution is is great. Because it has turn down the..the waiting time of the mother during our clinics..” (Participant 3)*

*“This MyChild Health Solution is really helping us because when mothers get this SMS alert” (Participant 2)*

*“Within 5 minutes, xxx was able to trace a child (who lost the card), and give me all the detail about, a child. The child address, the telephone number, the vaccine, what the child was immunized..” (Participant 5)*

### **Initial registration of target children was challenging**

- Took high amount of time to register all targeted children

*“The registration, at the start. It was very tough, it was because to give a child a number, it was very very hectic.” (Participant 1)*

- Incorrectly registered non-target children

*“It was very difficult for us, before we understood it. So, for the first go we just went and start registering everybody, as far as you came for the clinic, whether you have immunization or you don’t have immunization” (Participant 5)*

***“ The desire to correct and rectify data at the health facility level”***

*“If there are issues as well, the service provider would not be in a position to do any rectifications. They would have to communicate to the next higher level for them to make any adjustments which to me is really a challenge.” (Participant 7)*

*“I think facility level should also be in person to know what is been input-ed. Whether they’ve realized any mistake before somebody else pointing out to the them.” (Participant 4)*

## **Discussion**

One of the frameworks that can be utilized to analyse the integration of targeted health intervention into health system is Atun’s conceptual framework (13). It consists of five interlinked components which are the problem, the intervention, the adoption process, the health system characteristics, and the broad context. In this study, the data showed a clear pattern of characteristic of the health intervention, namely MyChild solution, that promotes the integration process into the health system where the project is implemented. The first, second, and third themes represented three perceived attributes of the intervention that will be discussed below.

As a pilot project in two regions in the Gambia, MyChild Solution (MCS) initiated positive insights and experiences as described by most of the respondents. It relates to several perceived attributes of health innovation that health workers developed after using MCS. The first attribute was “low complexity”, which refers to the degree of innovation perceived relatively simple to understand and apply (14). The operationalization of MCS, described as easy and user friendly by health workers, promotes higher adoption into the health system.

The second identified attribute was “observability”, that is visibility of benefits of the intervention to the users that will lead to higher acceptance of the innovation (15). MCS’s ability to reduce health workers’ work load and save working time were perceived as advantages and encouraged health workers to continue to utilize it. Moreover, they believed that these benefits should also be experienced by other health workers across the country. All participants also viewed SMS reminders, quick child identification when the card is lost, and reduction of waiting time as benefits of MCS to the mothers. These observabilities created better chance of integration of MCS into the health system.

The third perceived attributes presented was “task issues”. Task issues refer to the intended user’s performance whether it is relevant and improves their performances. If these conditions are applied, the user is motivated to adopt the intervention. Participants of this study described that MCS assisted them to improve data quality and it facilitated data analysis. It implies an

increasing performance in managing and analyzing immunization data at health facility level. Therefore, MCS served its purposes to improve data recording, reporting and analysis and it was easily adopted by the health workers at this stage.

However, these positive experiences were built in an ideal situation, as a pilot project usually does, where a lot of resources were allocated including close monitoring and supervision by Action Aid in the field. One needs to consider this as lessons on what works and what needs to be revised to show similar results in a non-ideal situation. One challenge raised was related to registration of target children at the initial phase, as shown in the fourth theme. This registration is an important step to establishing reliable individual data. To overcome this challenge, stakeholders should calculate the time, human resources, and logistics required based on previous experiences and incorporate it in the microplanning process.

The fifth theme posed a different view in one aspect of data management which was rectifying the data at the health facility level. Although they expressed the advantage of improving data quality because the filled form is sent to the regional office for scanning. They also requested a rectification mechanism at the health facility. These contradictory perceptions showed disagreement between the first and fifth themes on the role of health workers in data rectification in MCS. It is suggested to engage all stakeholders to reach a consensus on each level's roles in data management in MCS. Facilitation of this process should be taken by a party who is seen as neutral and committed to improve the EPI program for all parties involved.

One of the key strengths of this study is that qualitative studies provide an opportunity to explore experiences and perceptions of individuals as in the aim of this study. To increase credibility, this study performed triangulation of data sources and prolonged engagement by one of the researchers. It is worth noting that although a very similar pattern was observed in all the interviews and we think that it is very likely that we reached theoretical saturation, we cannot be sure due to the short timeframe of the assessment.

## CONCLUSIONS

MyChild Solution generates high quality data as measured by the WHO DQR Toolkit. The high scores of MyChild Solution in all the data quality metrics assessed are attributable to the robust validation rules that are automatically implemented by the system, data verification processes in place, and orientation of health workers about the system prior to implementing the system in the health facilities. Findings of this study strongly suggest that MyChild Solution would enhance immunization data quality when implemented in all health facilities in The Gambia. The expected time to be spent on data verification after national implementation is reasonable.

MyChild Solution would save at least half the time required to perform administrative tasks when implemented nationally compared with the current HMIS. The administrative time saved could be used to perform other tasks such as improving the quality of services associated with preventive child care in The Gambia.

The operation cost of MyChild Solution per child fully immunized is reasonable compared with the Current HMIS in The Gambia. The solution would also save a significant amount of administrative time health workers spend on data collection and analyses.

The positive perceptions and experiences of health workers and managers were captured through three themes which were “I like MyChild solution”, MyChild solution facilitates data analysis, and practical benefits for mothers. Several advantages of utilizing MyChild solution (e.g. user friendly, easy, save time) are leveraging these positive experiences. The challenge during initial stage of registering target children was expressed in the fourth theme. Another point for follow up discovered and presented in the fifth theme was the desire to rectify the data at health facility level. These last two themes should be put into consideration in future developments of the project.

## RECOMMENDATIONS

Based on our findings, we hereby make the following the recommendations.

1. Expanding the validation rules of checking duplication of information within health facilities to also check for duplication of information between health.
2. Although respondents expressed the desire to be able to rectify data at the health facility level, it was not clear from the interviews what type (individual or aggregate data) of rectification they were referring to. However, as a precaution to avoid compromising data quality, we recommend that a child’s electronic records are only rectified/corrected during service delivery (when the child is present) and there is a justified reason to rectify/correct his/her records. If a child’s records need to be rectified/corrected, the MyChild Birth Records Update form should be used. Any adjustment to aggregate level data generated from the system would negatively influence data quality and to prevent such serious data quality issues, we recommend that no adjustments are made to aggregate level data.

3. We recommend MyChild Health forms to be returned to the health facilities after scanning. That will allow health workers have access to raw data generated by them and enable them to perform some monitoring checks they might want to. For example, they can aggregate the total doses administered for a particular vaccine dose over a one-month period and see how it compares with what is reported using MyChild Solution. That way, health workers would have the chance to help monitor the performance of MyChild Solution and possibly feel more ownership of the system.
4. We recommend that MoHSW staff are more involved in data verification processes because data verification would ultimately be performed by the MoHSW staff in the long run if the intervention is to be adopted nationally. There is also a need to specially train national and regional level EPI staff on MyChild Solution to ensure a full understanding of the system and full exploration of what it has to offer.
5. As the initial registration of beneficiaries in MyChild Solution could be time consuming because everyone receiving vaccination, vitamin A supplementation, or de-worming must be registered, it is recommended to plan for initial registration of beneficiaries including estimation of time and human resources needed to perform initial registration.
6. In an ideal (adequate resources) situation like the current one, scaling up MyChild Solution would be beneficial, and we recommend it.

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