The Push of a Button: Evaluating the DOOR System

February 2022

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Acronyms

3PL	third-party logistics
ACT	artemisinin-based combination therapy
DOOR	Drugs Out Of Range
EQ	evaluation question
FP/RH	family planning/reproductive health
GHSC-PSM	Global Health Supply Chain-Procurement & Supply Management Program
GoA	Government of Angola
IoT	Internet of Things
IT	information technology
KEQ	key evaluation question
LMICs	lower- and middle-income countries
LMIS	logistics management information system
PSI	Population Services International
SDP	service delivery point

Executive Summary

The Drugs Out of Range (DOOR) system pilot was a novel intervention implemented under the Global Health Supply Chain-Procurement & Supply Management project through Task Order 3, Family Planning/Reproductive Health. Following Ministry of Health (MOH) approval, the team, in conjunction with MOH officials, installed Wi-Fi enabled Internet of Things buttons in select public-sector health service delivery points in Angola to increase visibility into the supply chain and ultimately reduce the incidence of stockouts.

The evaluation considered five key questions examining the effectiveness, viability, and acceptability of this novel intervention. Before and during the evaluation period, significant external events shaped and impacted the way the DOOR system could be implemented. The activity had to overcome challenges from a national contraceptive stock disruption in the pilot country as well as the impacts of the global COVID-19 pandemic.

Despite these sizable adverse events, the evaluation uncovered emerging evidence that the DOOR system does somewhat increase visibility into the inventory levels of SDPs in the supply chain, and to a much more limited extent, reduces the incidence of stockouts of contraceptive medicines. Highlights of that evidence include:

- In two dozen instances, supply chain managers had immediate visibility into an understocked alert or stockout alert that otherwise would have gone undetected for several weeks.
- Most (80 percent) of DOOR system alerts received a timely response from the municipal focal points.
- In two documented events, a DOOR system alert and its associated response averted a stockout of a contraceptive medicine in a health facility.
- DOOR system government staff participants were grateful for increased visibility they receive into the supply chain and the help it provides in supply chain management.

The positive impressions extended down to facility staff as well. The DOOR system increased health facility staff's perception that they are empowered to prevent stockouts of medicine in their own facility. This is encouraging evidence, as one of the important outcomes of interest

was to see participants feel more empowered to resolve their own stock management problems.

Outside of contextual factors, implementing the system presented technology-related challenges. Many of the facilities experienced frequent issues with inconsistent network signals for the device to connect to. Attempts were made to correct this, switching cell network providers when possible. The current technology stack employed has demonstrated consistent issues and requires re-examining the feasibility of using the currently deployed technology before any further expansion of the DOOR system can take place.

By resolving the technology issues and applying the lessons learned during the evaluation phase, the DOOR system has the potential to be used as an effective tool to increase visibility into health commodity supply chains in limited resource settings. Government staff participants in the system agree with this perspective but generally recommend that the technology challenges be resolved before any further implementations are considered.

Background

Introduction

In FY19, the Global Health Supply Chain-Procurement & Supply Management (GHSC-PSM) project was granted funds through Task Order 3, Family Planning/Reproductive Health (FP/RH), to implement a new pilot program. The new pilot activity is known as the Drugs Out of Range (DOOR) system.

This pilot program staff worked with MOH officials to install Wi-Fi enabled Internet of Things (IoT) buttons into public-sector health service delivery points (SDPs) in Angola (see Exhibit 1 for a picture of the device). A chronic problem for SDPs in lower- and middle-income countries (LMICs) is frequent stockouts of medicines that residents depend on for health needs. An often-cited problem driving this is a lack of real-time visibility into stock levels at facilities. This can be caused by a variety of factors, including delays in paper reporting systems, incomplete reporting by facilities, lack of clarity in reporting expectations, etc.

Exhibit 1. A DOOR system button

The DOOR system's goal is to increase visibility into stock levels at SDPs by reducing the time lag to alert supply chain managers of critical stock events, eliminate the burden of reporting, and eventually reduce the prevalence of stockouts in facilities that use the DOOR system. These buttons, when pressed, would immediately alert the appropriate supply chain manager of a low-stock or stockout event at a facility and enable the manager to respond.

As part of the funding agreement, an evaluation was to be conducted of the activity, examining various aspects of implementation of the DOOR system and its associated intended outcomes. This report details the context, approach, and findings of the evaluation.

The DOOR system evaluation is formative, using a mixed-method approach with a focus on the effectiveness of the system, the viability of its implementation, and the acceptability of such a system with pharmacy managers in the SDPs. Each of these dimensions—effectiveness, viability, and acceptability—is framed by an evaluation question(s) to reflect the specific evaluative interests of the stakeholders involved. The key evaluation questions (EQs) are:

EQ1: Is the DOOR system effective in increasing the visibility of stock levels at SDPs?

EQ2: Is the DOOR system effective at reducing stockouts of health commodities?

EQ3: Is the implementation approach of the DOOR system effective in generating compliance by participants in the response to stock alerts?

EQ4: Is the DOOR system practical, cost effective, and replicable in other environments?

EQ5: Does the DOOR system increase users' sense of empowerment and satisfaction with stock management and reporting?

The methodology for answering the various questions and their associated results is examined further within the report.

Country Context

When the DOOR team was deciding on a pilot location, a specific set of requirements was identified to guide the decision-making process. The pilot country needed to:

- Be receiving USAID funding for FP/RH supply chain activities under the GHSC-PSM project
- Have stable cell network providers operating in the country
- Have serious data visibility challenges in last-mile commodity availability
- Not currently be implementing any new pilot activities for last-mile commodity visibility

The starting list of countries included all countries currently receiving technical assistance under the GHSC-PSM project. As the different criteria were applied, the list became shorter and shorter. The deciding factor to implement in Angola (apart from simply meeting all of the criteria) focused on the severity of the data visibility problems. In Angola, the FP/RH stock reporting is an entirely paper-based system. The paper reports are then physically collected and manually collated at two administrative levels before they are shared with supply chain managers. This can result in up to a six-week delay of notification of a stockout, meaning an even longer period before the stockout can be corrected. The DOOR team felt that such a dearth of real-time data availability made for a compelling case to pilot the system in Angola.

Timeline

To aid in understanding the evolution of, and the context surrounding, the DOOR system pilot, a brief timeline is presented below:

FY19 (October 2018–September 2019)

In the first year of implementation the focus was primarily on generating proof of concept for the proposed IoT devices and on laying the groundwork for piloting the project within a country context. Using an external technology consultant, a prototype was developed and tested. Once the proof of concept was constructed and tested, a small production batch of 120 buttons was commissioned. At the same time, Angola was determined to be a suitable pilot country within the countries where the GHSC-PSM project has a local presence and would benefit from such an innovation within its supply chain (primarily driven by inadequate visibility into stock levels and frequent stockouts across the system). The DOOR system team experienced significant administrative and procedural hurdles exporting lithium from the United States. Regulations surrounding the exportation of lithium-ion batteries out of the U.S. are stringent, and specific documentation, pre-approvals, and licenses are needed. Due to the devices containing the lithium-ion battery, they are classified as UN3481. This classification must be shipped in compliance with Section II of PI967, a regulatory document maintained by the International Air Transport Association. UN3481 is a label assigned to lithium-ion batteries as designated by the United Nations Committee of Experts on the Transport of Dangerous Goods. These requirements were fully complied with and the products were cleared

successfully. The devices were successfully installed in 22 health facilities located in Luanda Province, Angola, in September 2019. Two of the original 22 facilities were eventually removed from the trial as the team was unable to secure approval from facility leadership to participate.

FY20 (October 2019–September 2020)

As the pilot was starting to take shape, a concerning issue put the project on hold temporarily: a national stockout of target contraceptive commodities in Angola, meaning limited quantities of contraceptives were due to arrive in the country during FY20. With emergency procurement action on behalf of GoA leveraging World Bank funding and some limited procurement by USAID, products started to arrive in Angola in March 2020.

As these products were arriving in the country, the entire world was quickly becoming paralyzed by the rapidly spreading global COVID-19 pandemic and the government curtailment measures enforced. All staff working on the GHSC-PSM project reverted to remote work for the foreseeable future. In-person activities were cancelled and staff were unable to conduct in-person facility visits. These restrictions significantly impacted the DOOR system staff and GoA counterparts, limiting their ability to focus time and attention on this activity. To mitigate the impact of the pandemic, GoA repurposed public health resources to focus on the COVID-19 response. The pharmacy technicians who were trained in using the DOOR button were reassigned other responsibilities, including training on COVID-19 infection prevention and control measures, and staff were rotated through facilities to ensure appropriate social distancing.

By June 2020, once the world had started to settle into the new reality of a global pandemic, all the FP/RH products that had been selected as tracer commodities for the DOOR system had arrived in country and were starting to flow through the supply chain. This was a critical pre-cursor and a positive indication that the DOOR system evaluation could begin, as the effectiveness of a supply chain system intervention cannot be measured if the supply chain is not operational with product flowing through it.

In the same month, a round of telephonic check-ins was conducted with all participating SDPs. The follow-up revealed that many sites were experiencing challenges with operating the

technology successfully. It had been 10 months since the original installation, and with the staff turnover and supply chain difficulties, these challenges were expected. Over-the-phone information technology (IT) support was provided as best as possible with some sites requiring in-person support at a later undetermined date when it was safe to do so.

At the beginning of July 2020, the evaluation period officially began. With most sites operational and enough product in the system, the operating conditions needed to test out the DOOR system were present. The evaluation period was projected to run for roughly six months, until the middle/end of January 2021.

As the pilot began, two new challenges presented themselves in August 2020. The first issue was connectivity to local cell networks; the remote location of facilities made it difficult for the system to connect to the Internet as well as make telephonic contact with individuals at the facility—the modem was struggling to connect to the local cell phone network. Also, the pilot highlighted challenges with adherence to DOOR protocols by facility personnel. At the time it was believed that the inability to conduct face-to-face check-ins had made coaching adherence behaviors more challenging. With all these challenges considered, the project had only three facilities that were fully operational and without infrastructure or personnel issues. Recognizing that some degree of in-person interaction was needed to revitalize active participation, DOOR system staff crafted an approach to safely engage with staff at the various facilities.

FY21 (October 2020–September 2021)

In October 2020, the project completed its IT maintenance and refresher training visits to all 20 sites participating in the pilot and all 20 DOOR pilot sites were operational again.

The DOOR system evaluation period was successfully completed in January 2021 with all end-line data collection activities completed within the agreed-upon schedule. Results of those data collection exercises are discussed here.

DOOR System Intervention Concept

In the Angolan public health supply chain, reporting of site-level consumption and requisition for contraceptive commodities is done through a paper-based system. These reports could take

up to five weeks to be collected from SDPs, collated at the municipal health directorate, digitized at the provincial health directorate, and disseminated to the appropriate supply chain managers for decision-making purposes. With such a delay from reporting to dissemination, commodity stockouts in SDPs could go on for weeks before supply chain managers become aware and can respond to these stockouts.

The DOOR system is designed to significantly reduce the time of the feedback loop in the last-mile supply chain to bring immediate attention and response to an adverse stock event occurring within an SDP. The DOOR system was not intended to replace regular logistics management information system (LMIS) reporting, a foundational component of the supply chain that is still needed. However, in many of the LMICs where the GHSC-PSM program operates, a paper-based system is used at the last mile, which dramatically increases the time for LMIS data to deliver the notification of a stockout or low-stock situation. The DOOR button aims to make those alerts immediate and allow the supply chain to ameliorate the situation on a markedly faster timetable. The DOOR system is more appropriately considered an alert system rather than another reporting mechanism being introduced into the existent logistics system. Exhibit 2 illustrates the traditional reporting flow and the DOOR system intervention approach.

Exhibit 2. Angolan supply chain map with the DOOR system
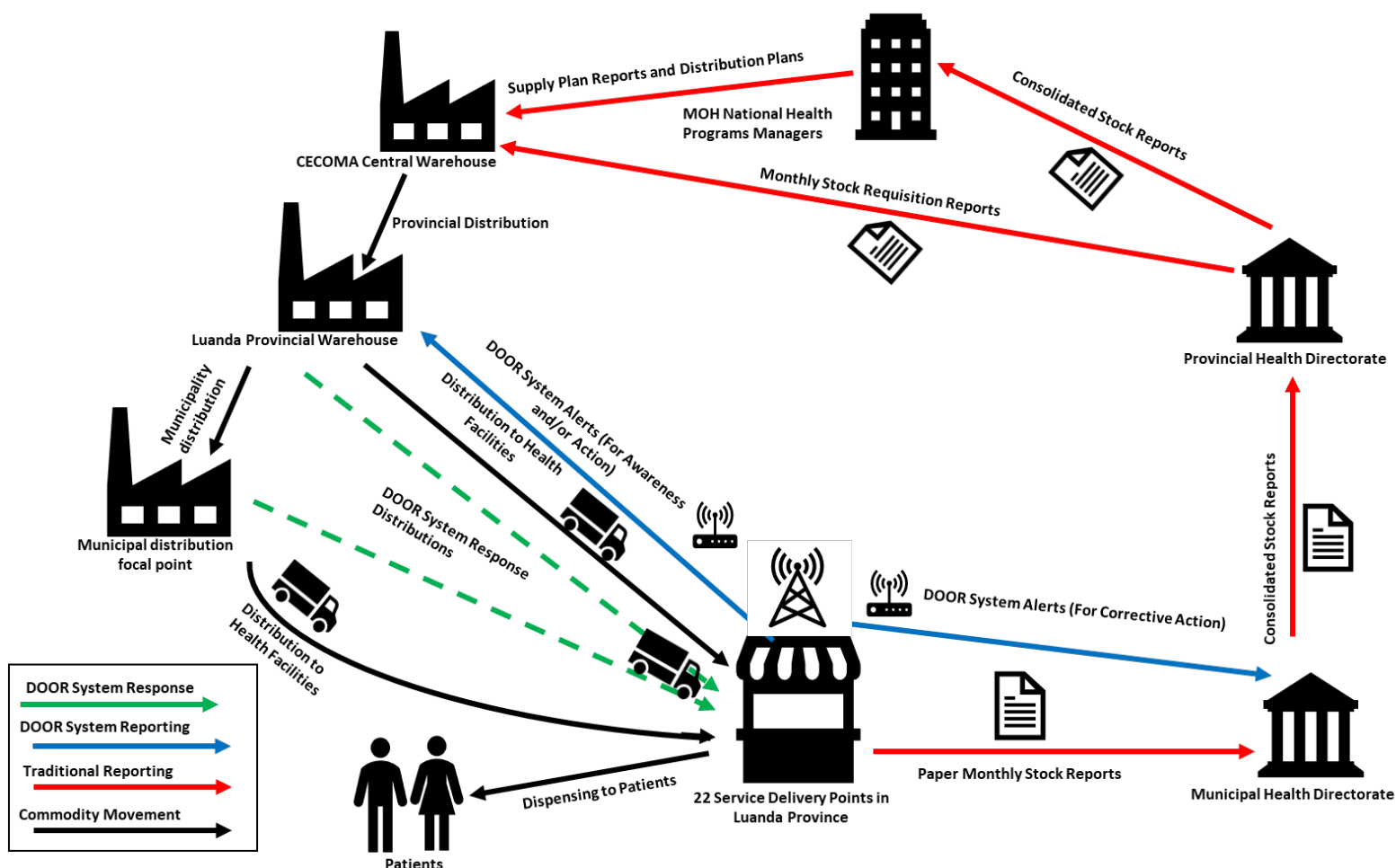
DOOR System Technology

The DOOR system is based on simple but proven technology, leveraging IoT devices that contain a small processor chip and have the capability to connect to Wi-Fi Internet. The device contains three buttons and a small LED screen that displays messages. Each button sends a specific message: Green is to indicate the product is fully stocked, yellow to indicate the product inventory has reached low stock, and red to indicate that the product has stocked out. Exhibit 3 shows the layout of the button.

Exhibit 3. A DOOR button being operated

The DOOR button relies on a sequence of cloud-based technology services that allow for a button push to result in simultaneously recording the event in a database and alerting several key supply chain actors through SMS directly to their phone of the stock event that corresponds to the button that was pushed. Exhibit 4 illustrates the DOOR system technical design.

Exhibit 4. DOOR technical design
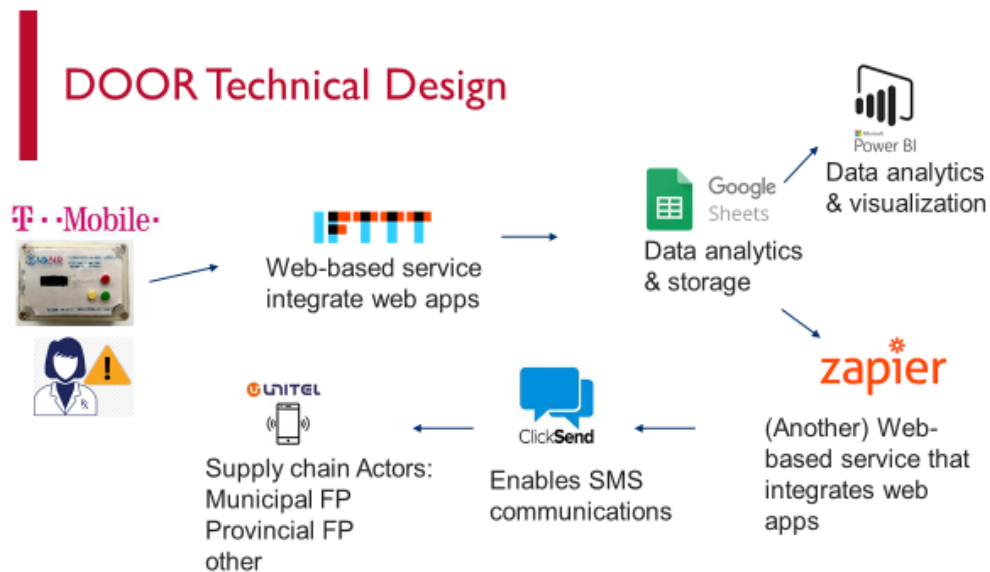
Each DOOR device is inexpensive to build (less than USD15 in materials per unit) and is tied to a specific commodity. For the pilot program, commodities were carefully selected to provide a good sample of contraceptive products commonly used in Angola. The final products included in the pilot were:

- Sayana Press 104 mg/0.65 ml suspension for injection

- Jadelle 2-rod levonorgestrel-releasing implant

- Male condoms

- Artemether/lumefantrine tablets (in up to four formulations) *

*This commodity was selected to reflect other disease priorities that USAID and GHSC-PSM have in Angola for the malaria program.

Once the hardware is installed in the target facility's storage room, the system works on an on-demand basis. Pharmacy technicians regularly monitor stock levels during their work. When they observe that a particular product is low on stock, out of stock, or has just received new stock, they press the appropriate button on the device. The device requires the button to be pushed until the message is sent and a confirmation message is displayed on the screen. When the Internet connection is strong, the required push time is 3–4 seconds. This triggers a cascade of actions detailed in Exhibit 5. Each time the system is activated through a button push, it is considered a stock alert event.

Exhibit 5. The DOOR system process map
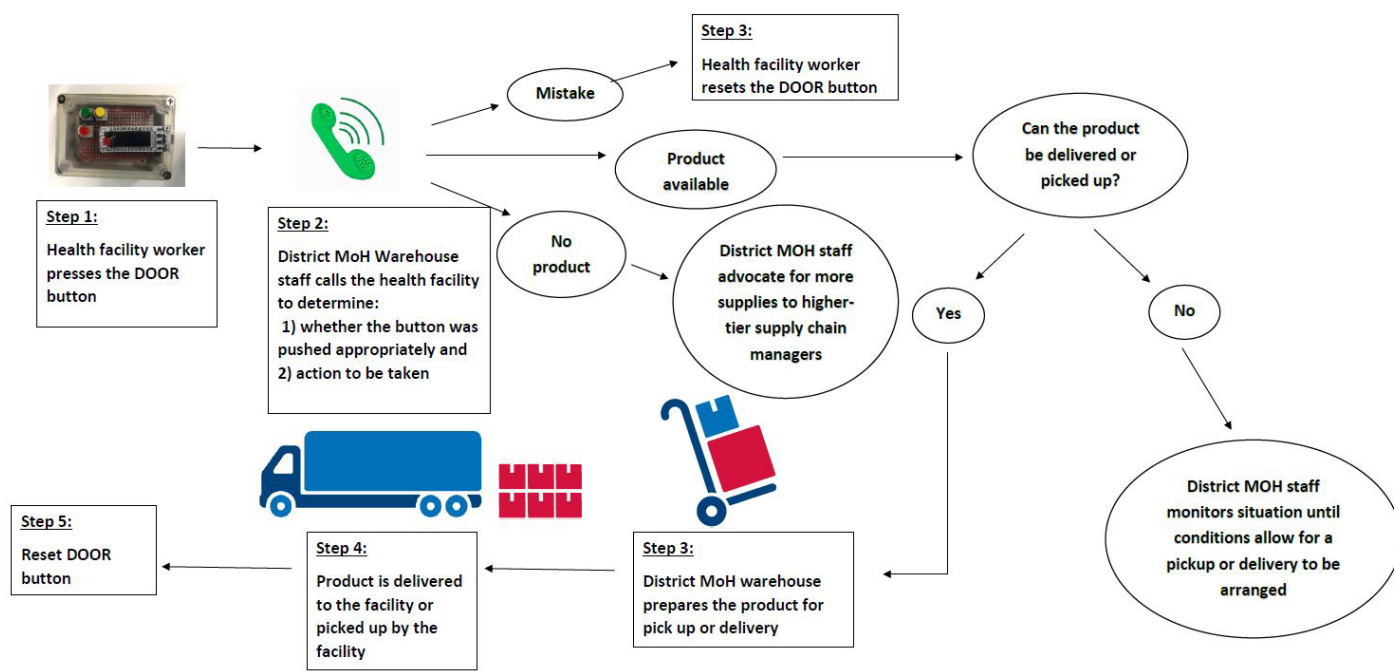
Country Context

Pilot country selection was a crucial part of the initial conceptualization of the DOOR system. Selection included a list of requirements. Specifically, the country needed to be a country where:

- GHSC-PSM currently has an operating presence.
- GHSC-PSM receives Task Order 3 funding for supply chain systems strengthening interventions.
- Inventory visibility at the last mile was inadequate or non-existent.
- Another last-mile visibility intervention was not already being implemented.

Using these for requirements as non-negotiable criteria for selection, Angola emerged as the most reasonable and logical choice from the list of available countries. While some countries met two or even three of the requirements, Angola was the only country to satisfy all four requirements. Before the start of the pilot, GHSC-PSM had inadequate visibility into data at the service delivery level in Angola. The project's visibility into inventory levels in Angola mostly stopped at the district warehouse level in the supply chain system.

Methodology

The DOOR system project evaluation used a mixed-methods approach, leveraging the data analysis technique most appropriate for the type of source data employed. The evaluation framework in Exhibit 6 demonstrates the approach used for the five key evaluation questions identified. The period of interest in which system performance was examined spanned from July 2020 to January 2021. Interviews were conducted by a GHSC-PSM consultant, as well as the GHSC-PSM FP/RH Technical Advisor. Data collation, analysis, and report writing were conducted by the GHSC-PSM Monitoring and Evaluation Specialist.

Though a baseline and end line approach is taken in this evaluation, the date of baseline data collection was several months after the buttons were originally installed in facilities. To be transparent, the report will use the term "post-baseline." This term is used here because of the

delay in beginning the evaluation period, as detailed in the timeline, implies that is not a true baseline. The devices had been installed in the facilities for some time but could not be used as product in the supply chain was insufficient.

In selecting the sample, the DOOR team relied on guidance and existing relationships the project had. Before the DOOR pilot, the GHSC-PSM project did not work directly at the service delivery level for FP/RH supply chain systems strengthening in Angola. On a practical level, the GHSC-PSM project works through Population Services International (PSI) (as a legally registered entity in Angola), which works on a different USAID-funded FP/RH service delivery project. The DOOR team leveraged established relationships through PSI to identify health facilities that would be appropriate for the pilot. The team felt that having facilities within Luanda province, where the capital was located, would allow for some testing of the DOOR system in a rural setting but would ensure that the travel distance from the facilities was not prohibitively far for regular visits. In consultation with PSI, the team agreed to a list of 20 facilities in and around the city of Luanda, but all within Luanda province. The names of participating facilities can be found in Annex 1.

For measures associated with system effectiveness, the DOOR team extracted source data directly from the DOOR system database and established the associated follow-up mechanism to track stock alert related activity. To inform this evaluation, we leveraged a follow-up mechanism that allowed us to confirm the fidelity of the button pushes and track associated post-alert events, particularly actions carried out to help correct any concerns about inventory levels for that commodity. Follow-up was already engineered into the DOOR system protocols to promote a response by the appropriate municipal focal points. To validate the follow-up by municipal focal points, our local consultant would receive a separate text that was triggered every time an alert was sent out, to complete a stock alert event follow-up form. This form required our local consultant to call the facility from where the alert was generated to determine if the button was intentionally pushed, if it was pushed correctly (as in the need matched the action taken), and if the facility had received a follow-up call and subsequent necessary actions from the municipal focal point. Every stock status change event that was documented was compared to the follow-up form that our consultant was required to complete. Using the information within the follow-up form (questions included in Annex 3), the

button pushes could be categorized as intentional or unintentional, and then subsequent questions were used to calculate metrics that are here within. To calculate the metrics, the team matched data tables from the DOOR system database and the response tracking database through the unique date/facility/product/stock alert combinations on a line-by-line basis. Each line in these databases represents a stock alert event. Once the tables were joined together, pivot tables were employed to generate percentage figures for each relevant question that was used as the basis of a calculated metric. For example, in Exhibit 7 in the Results section, the incidence of unintended pushes was calculated by pivoting the total number of button pushes recorded during the evaluation period against the response question, "Why did the facility staff press the button?" A complete list of questions asked (and corresponding data fields) in the response tracking database can be found in Annex 3. Accidental pushes were logged in the response tracking database, so it was straightforward to categorize unintentional versus intentional pushes. This analysis approach was used for all of the quantitative metrics you will see in the report.

For measures associated with system viability, the team conducted interviews with all municipal focal points. These individuals are responsible for ensuring commodity availability for the SDPs under their supervision. They are the primary recipient of any DOOR alert sent by a facility technician and are responsible for confirming the situation with the facility and arranging a delivery of medicines, if necessary, and if available. These interviews examined their role in the project, the impact that participation had on their job duties, and their perceptions of the project and its overall practicality.

Finally, for measures associated with system acceptability, the team administered a short-form, closed-ended questionnaire to SDP staff who were responsible for engaging the DOOR system when a relevant stock alert occurred. This questionnaire was implemented as a pre/post design during the evaluation period of interest. All questionnaires and interview protocols can be found in Annex 2.

Exhibit 6. Evaluation framework

Evaluation Predicate	Evaluation Question	Data Collection Method and Source
Effectiveness	Is the DOOR system effective at increasing the visibility of stock levels at SDPs?	Data points collected using IoT devices through IFTTT (If This Then That) data pushing mechanism and confirmed through supervision visits to the participating sites
	Is the DOOR system effective at reducing stockouts of health commodities?	
Viability	Is the DOOR system practical, cost effective, and feasible in the low-resource environment it is deployed in?	Individual interviews with district warehouse manager, FP/RH national program manager, and other supply chain actors
	Is the implementation approach of the DOOR system effective in generating compliance by both downstream participants generating stock alerts and those who respond to stock alerts?	
Acceptability	Does the DOOR system increase users' sense of empowerment and satisfaction with stock management and reporting?	Short-form, close-ended questionnaires completed by stock managers before/after implementation

Results

EQ1: Is the DOOR system effective at increasing the visibility of stock levels at SDPs?

During the six-month evaluation period, the DOOR system recorded 40 stock alert events from participating facilities. Using our follow-up confirmation process, the team determined that 15 of these events were accidental pushes, meaning that 25 of 40 stock alerts were intentional and represented true stock status changes. Exhibit 7 provides a summary of these figures.

Exhibit 7. Summary of DOOR system–generated stock status alert

Button Pushes During Evaluation	
Total number of observed button pushes	40
Total number of intended button pushes	25
Percentage of pilot facilities that registered any button push at any time during the evaluation period	55% (11/20)
Range of button pushes per facility	1–7
Incidence of unintended button pushes	38%

While such a high rate of unintended pushes is concerning, we can attribute this partially to technology challenges and staffing attrition challenges at health facilities caused by the COVID-19 pandemic. In interviews, facility staff and municipal focal points expressed frustration with the network connectivity issues that were a challenge in using the system. A scenario that played out for many staff was after sending a message through the system correctly (but not receiving the appropriate confirmation message), patience gave way to frustration and various buttons were pushed multiple times just to see if the system would respond to any input. Though challenging to quantify, many of these false positives are believed to be associated with network connectivity issues. These issues notwithstanding, we found a concerning degree of false positives being activated at health facilities. Further investigation and training of SDP staff would be helpful to address this issue.

Of those 25 pushes that were true, we observed a variety of stock status changes, as detailed in Exhibit 8.

Exhibit 8. Distribution of stock status alert types

Stock status of intended pushes		
Fully stocked	60%	(15/25)
Minimum stock reached	12%	(3/25)
Stocked out	28%	(7/25)

Of the 25 events that occurred, 10 were communicated as a critical stock event to the municipal focal points. That represents 10 concrete instances where a focal point learned

immediately, as opposed to weeks later as the local paper-based reporting cycle would dictate, that a health facility under its supervision had a concerning stock level for an FP/RH commodity. Furthermore, the 15 events that were notifications of re-stocking serve as a confirmation of delivery of a sufficient quantity of goods to raise the stock level out of a critical state—something that would have taken weeks to learn through traditional reporting channels and distribution tracking mechanisms.

When considering the extent to which the DOOR system increased visibility, a logical approach would be to compare the number of actual button pushes to expected button pushes. As part of an analysis that is further detailed in Exhibit 8, the DOOR team endeavored to understand how button pushes are expected from our 20 sites in a given month. To answer this question, the DOOR team contacted facilities at the beginning and the end of a one-month period to ask for the stock status of the various tracer products. The team determined that 27 stock status instances changed (these are product-facility combinations) in the October to November 2020 period. If we assume that this represents a typical number of stock status changes in one month, we could assume that the entire six-month period would have 162 expected stock status changes. Dividing the number of intended button pushes that were observed by the total number of expected stock status changes, we would get a utilization rate of 15 percent (25/162), meaning that 15 percent of the time, the buttons were pushed when they were expected to be. A variety of reasons are influencing this but the most pronounced are the network connectivity issues with the buttons.

Steps need to be taken to reduce the rates of false positives, most notably the network connection issues, but still, there is evidence that the DOOR system has increased visibility into the supply chain. This perception is further reinforced by the interviews conducted with municipal focal points who highlighted this new visibility as a key benefit of the system to them.

EQ2: Is the DOOR system effective at reducing stockouts of health commodities?

The DOOR system can be effective at reducing stockouts only if coordinated actions are taken by those involved when they receive an alert. As mentioned above, 25 stock alert events were

recorded during the six-month evaluation period. Exhibit 9 details the follow-up response rate from the GoA MOH municipal focal points and then associated actions.

Exhibit 9. DOOR response metrics summary

DOOR response metrics		
Percent of button pushes that received a follow-up phone call from municipal focal point	80%	(20/25)
Percent of minimum stock alerts that resulted in a prioritized delivery	67%	(2/3)
Percent of stockout alerts that resulted in a prioritized delivery	0%*	(0/7)

*All seven municipal focal points indicated that no commodities were available to distribute in response to the alert, which was subsequently validated by the GHSC-PSM team during the evaluation.

The first step in reducing stockouts is effective communication between the parties involved: the requestor and the next point along the supply chain. It is encouraging that 80 percent of button pushes received a follow-up phone call from the municipal focal point. This was confirmed by calling the SDP staff within a short time after the alert was registered, as is detailed further in the methodology section. The call confirms to the SDP technician that their request was received and is being addressed, and it is an important point, since to be truly effective, the DOOR system theory of change relies on behavior change. The fact that these focal points had such a high response rate means that they recognized the value of the system and used its benefits to full capability in responding to stockouts.

Of the three types of messages that can be sent using a door button (fully stocked, low stock, stocked out), the latter two messages require the most urgent corrective action. Ten stock alerts were recorded for low stock or out-of-stock. Looking at low stock alerts that were sent, 67 percent (two out of three) of those alerts resulted in a prioritized delivery to the health facility to avert a stockout. This is the most substantial evidence generated during the evaluation period that indicates that the DOOR system can avert a stockout before clients arrive to empty shelves.

For the seven observed stockout alerts, none resulted in a prioritized delivery. When further questioned as to why this did not occur, seven out of seven municipal focal points indicated that no commodities were available in the warehouses to distribute in response to the alert. Were stock available to distribute, these seven stockouts would most likely have been addressed with a prioritized delivery. As explained in the timeline, Angola struggled with consistent contraceptive supply at a national level, and this dynamic reverberates down the supply chain, significantly influencing the observed result. For example, from April to July 2020, the subnational warehouse stockout rate for the three FP/RH products was 86 percent. It decreased to 49 percent from July to October 2020. This clearly shows how truly constrained the supply chain was for FP/RH products.

EQ3: Is the implementation approach of the DOOR system effective in generating compliance by participants in the response to stock alerts?

This question has two components to examine, the action of (1) health facility staff when they recognize a stock status change in their pharmacy and (2) municipal focal points when they receive a DOOR alert SMS on their phones.

Understanding the dynamic of the first part was enabled by a special data collection exercise that was conducted mid-evaluation period. In November 2020, as part of regular support to the facilities, GHSC-PSM staff conducted telephonic check-ins with the SDP staff. Apart from the normal support questions, the staff also asked the health facility staff to provide the current stock status of each of the tracer commodities according to the three classifications that the DOOR button uses. This information was later compared against the aggregated paper reports that the facilities are required to complete. By observing stock status changes according to the paper reports, identifying where stock status had changed, and comparing it to the button pushes that facilities initiated on their own, the team generated a comparative analysis to understand how many button pushes should have occurred according to the guidelines and subsequently how many button pushes actually occurred. Results of this comparative analysis are presented in Exhibit 10.

Exhibit 10. Proportion of facilities that complied with expected button pushes

Indicator	Facilities not experiencing Wi-Fi hub issues	All facilities
Percent of expected button pushes that occurred	56% (5/9)	30% (8/27)
Percent of expected button pushes that did not occur	44% (4/9)	70% (19/27)
Percent of facilities that correctly logged any of their expected pushes	50% (3/6)	27% (4/15)
Percent of facilities that correctly logged all of their expected pushes	33% (2/6)	20% (3/15)

As detailed in Exhibit 10, during this one-month period (October 2020 to November 2020), for those facilities that were not experiencing network connectivity issues, nine button pushes should have occurred but only five button pushes occurred in that time. During this time, 12 out of 20 facilities were having issues with their Wi-Fi hubs not connecting properly to the local cell network. That represents a 56 percent compliance rate with expected protocols. This is less than ideal adherence to the protocols during this one-month snapshot, providing some indication that the implementation approach was not eliciting full compliance. Our evaluation period was almost 12 months after the actual hardware installation, which contributes to this dynamic.

Looking at the actions of the municipal focal points when they receive a DOOR alert SMS on their phones, we see a high degree of compliance by the municipal focal points. As detailed in the previous section in Figure 9, 80 percent of door button alerts sent prompted a follow-up phone call and in the case of a low stock or stockout alert, all focal points attempted to arrange delivery, but most were unable to fulfill the request due to a lack of stock in the warehouse. Therefore, the DOOR system in its current set-up is generally effective in eliciting compliance from the municipal focal points but the evidence does not suggest that the effect is as strong for compliance from SDP staff.

EQ4: Is the DOOR system practical, cost effective, and replicable in other environments?

Answering this question involved interviewing 12 municipal focal points, the individuals charged with actuating a response (if appropriate) to the DOOR button alert that they received. Participants overwhelmingly conveyed a positive experience participating in the program. No respondents indicated that participating in the system forced them to divert attention away from their regular job duties. On the contrary, they felt better equipped to do their job because they had a mechanism for real-time alerts and the ability to mitigate them much more quickly. Most respondents indicated that they followed up with the sender of the alert within 24 hours and appreciated receiving the alerts. This was validated through follow-up calls to all SDP staff who were the original senders of the alert. The overwhelming consensus by the municipal focal points indicated that lack of network connectivity and IT challenges were the concern and area for improvement with the DOOR system. Also, many respondents expressed a desire to see more contraceptive methods covered under the DOOR alert system.

When asked if the program should be expanded to other locations in Angola, all respondents believed that it should be. However, a sizable minority expressed concern that the system needed technological improvements. The inability of the Wi-Fi hubs to hold a consistent network connection is the most common issue cited. Also, they wondered if a sufficient cell signal was widely available throughout the country to support the use of such a technology.

Overall, respondents were pleased with the system, recognized the benefit and value to empowering them to achieve their work objectives, and hoped to see it expanded. Satisfaction was conditional on the IT challenges being resolved first to bring greater reliability and confidence in the system.

While startup costs are significant, the costs of building new buttons and maintaining the management information system solution are low. This would indicate that system maintenance or expansion would not be costly and presents good value for money.

EQ5: Does the DOOR system increase users' sense of empowerment and satisfaction with stock management and reporting?

The behavioral component of the DOOR system relies on principles derived from the Reasoned Action Approach, which theorizes that people's attitudes toward a specific behavior, their perceived norm, and perceived behavioral control (self-efficacy) all affect intention, which drives behavior (in conjunction with actual control and environment) (Fishbein, 2010). The DOOR system aimed to influence attitude and perceived behavioral control to motivate staff in engaging with the new technology system and reporting stock statuses in real time.

As previously mentioned, a questionnaire was developed to use in a pre-post design to measure changes over time. Due to the various challenges beyond the control of the project that were detailed in the timeline, the baseline implementation for this questionnaire was delayed and the DOOR buttons were already present in the facilities for some time. The results of post-baseline and end line questionnaires are detailed in Exhibit 11. The questionnaire measured people's responses to statements read out loud to them. Respondents picked a number from 1 (strongly disagree) to 5 (strongly agree), in whole numbers.

Exhibit 11. Facility staff questionnaire results summary

Question Number	Description	Sep 2020 Mean	Jan 2021 Mean	Change
Number of sites that responded to the questionnaire		n=20	n=19	N/A
Q1	Management of medicine supply is an important part of my job responsibilities	5.0	5.0	0.0
Q2	I enjoy managing the medicine supply in my pharmacy	5.0	5.0	0.0
Q3	I believe I can help prevent stockouts of medicine.	4.0	5.0	1.1
Q4	It is my responsibility to ensure that my health facility has sufficient medicine supply	2.1	2.0	-0.1
Q5	When I place an order for more stock, I am confident that I will receive it	3.0	3.0	0.0
Q6	When I place an order for more stock, I am confident that I will receive the correct amount	2.2	2.0	-0.2

Q7	When I place an order for more stock, I am confident that I will receive the medicines quickly	2.2	1.0	-1.2
Q8	I feel confident that the supply system will provide me the medicines I need	2.9	3.0	0.1
Q9	It is easy to ensure that I have sufficient medicines available in my facility	2.7	3.5	0.8
Q10	Reporting stockouts of medicine is easy and quick	4.8	4.0	-0.8
Q11	I only press the button to order more stock when I know that stock is available in the warehouse.		1.0	
Q12	My supervisor cares that I use the button to report stock outages		5.0	
Q13	I didn't use the button to report stock outages because the physical button was not working.		3.0	
Q14	I didn't use the button to report stock outages because it took too long to be pressed.		3.0	
Q15	I did not use the button to report stock outages because the button had no Internet.		5.0	

** Q11–Q15 were added onto the survey at the end to investigate additional concepts identified during program implementation

As Exhibit 11 shows, the most notable improvements are for Q3 [I believe I can help prevent stockouts of medicine] and Q9 [It is easy to ensure that I have sufficient medicines available in my facility]. Both questions experienced a substantial increase, indicating that attitudes around these two questions had improved over the course of the evaluation period. This aligns with the reasoned action approach theory that was posited as playing a role in the psychology of why the DOOR system would work.

At the same time, it is concerning to see that attitudes became poorer for Q7 [When I place an order for more stock, I am confident I will receive the medicine quickly] and Q10 [Reporting stockouts of medicine is easy and quick]. With a closer look, question 7 more examines the system response beyond the DOOR technology. It appears, however, that the DOOR system did not have a positive impact on this measure and may be associated with a decrease. Further investigation would be required to understand the dynamics at play here. The concerning

finding is question 10. Stated results are the opposite of intended effect. The DOOR system was meant to make reporting quick and easy. Internet connectivity challenges notwithstanding, more needs to be understood from the perspective of the facility staff regarding this question.

Conclusion

The DOOR system has been examined through the lenses of effectiveness, viability, and acceptability to determine its value and worth. It is challenging to make a summary statement about the success of the DOOR system due to the many challenges faced. Across the five key evaluation questions, evidence is emerging that the DOOR system can increase visibility into the supply chain and ultimately reduce stockouts caused by the lack of visibility. These vignettes of evidence include:

- Two dozen instances were found where supply chain managers had immediate visibility into a stock alert that otherwise would have gone undetected for several weeks.
- The majority (80 percent) of DOOR system alerts received a timely response from the municipal focal points.
- Two events were documented where a DOOR system alert and its associated responses averted a stockout of a contraceptive medicine in a health facility.
- Municipal focal points can absorb the system responsibilities into their daily work without issue and are grateful for the increased visibility they receive.

However, the operating constraints of the global COVID-19 pandemic and the national contraceptive stockout have almost entirely eclipsed the documented benefits of the project. Also, significant technological challenges hamper the effectiveness of this intervention, national stockouts and global pandemic notwithstanding. Any continued expansion of the DOOR system would require a root-cause investigation of the network connectivity issues and upgrades to both the DOOR system's SIM routers to establish a more secure connection and a redesign of the DOOR hardware. Specifically, the team has identified the following upgrades as key technical design recommendations:

- Enhance the aesthetic look and feel of the exterior button for further enticing users to want to engage with the device.
- Use an easily replaceable external battery source (e.g., AA batteries) to eliminate importation challenges.
- Update the DOOR button code to have the hardware send out a periodic signal every 24 hours to indicate that the system is functioning correctly and is maintaining Internet connectivity.
- Allow the DOOR button to capture a button press and store the information in case of a network outage.
- Source Wi-Fi hubs locally to ensure compatibility with local communication networks.
- Redesign the management information system to integrate the piecemeal functions into a single web-based service provider.
- Co-locate DOOR buttons with the commodity in the storage area of the facility.

Any new hardware improvements would need to be coupled with a bolstered training approach to reaffirm DOOR operating principles and responsibilities for all stakeholders involved. However, until the technology challenges can be confidently resolved, an expansion cannot take place given existing contextual constraints. Also, geographical expansion would require a feasibility assessment to determine what level of cell phone network coverage exists in a proposed expansion zone.

The DOOR system pilot evaluation findings have demonstrated that this intervention stands on the precipice of potentially demonstrating that it can impact supply availability in the Angolan supply chain. However, the major hurdles of technology challenges and lack of contraceptive supply within the country are inhibiting the system's ability to realize this impact.

Annex 1: Evaluation Study Sites

All participating SDPs were located in Luanda Province, Angola. The names of the participating facilities are as follows:

SDPs participating in the DOOR Evaluation
Hospital M. Icolo Bengo
Hospital M. Cacuaco
Health Center Sequele
Hospital Mãe Jacinta
Health Center Viana II
Health Center Chimbicato
Health Center Mbondo Chape
Health Center do Kilamba
Hospital Especializado Kilamba Kiaxi
Health Center Cassequel
Health Center Bairro operário
Health Center 4 de Fevereiro
Health Center Ramiros
Health Center Palanca II
Hospital Cajueiros
Health Center Vila da Mata
Health Center Viana I
Health Center Mater. L. Paim
Health Center Samba
Health Center Rangel

Annex 2: Interview Protocol and Questionnaires

DOOR System Pharmacy Manager Questionnaire
As part of your participation in the DOOR system pilot, we request that you complete this questionnaire. Consider the questions as they relate to your work responsibilities.
*For each statement, select a response from 1 (**strongly disagree**) to 5 (**strongly agree**).*

Question 1: Management of medicine supply is an important part of my job responsibilities.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 2: I enjoy managing the medicine supply in my pharmacy.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 3: I believe I can help prevent stockouts of medicine.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 4: It is my responsibility to ensure that my health facility has sufficient medicine supply.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 5: I only push the button to order more stock when I know there is stock available in the storage facility.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 6: When I push the button, I am confident that I will receive it.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 7: When I push the button to order more stock, I am confident that I will receive the correct amount.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 8: When I push the button to order more stock more stock, I am confident that I will receive the medicines on time quickly.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 9: I feel confident that the supply system will provide me the medicines I need.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 10: It is easy to ensure that I have sufficient medicines available in my facility.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 11: Reporting stockouts of medicine was easy and quick with the button.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 12: My supervisor cares that I use the button to report stockouts.

Strongly Disagree				Strongly Agree
1	2	3	4	5

Question 13: I did not use the button to report stockouts because the physical button was not working.				
Strongly Disagree →————————————→ Strongly Agree				
1	2	3	4	5

Question 14: I did not use the button to report stockouts because the button took too long to push.				
Strongly Disagree →————————————→ Strongly Agree				
1	2	3	4	5

Question 15: I did not use the button to report stockouts because the button was not online.				
Strongly Disagree →————————————→ Strongly Agree				
1	2	3	4	5

DOOR System Evaluation Interview Protocol

Interviewer: Hello. My name is _____ . I am working with the USAID-funded Global Health Supply Chain-Procurement & Supply Management project. This is the project that helped install the stock-reporting buttons in some sites in Luanda province. I would like to ask you a few questions today regarding your experiences with these buttons. I want to emphasize that this interview is completely voluntary and any responses you provide will not be associated with your name. Feel free to answer openly and honestly, knowing your name will not be shared and there will be no ramifications, positive or negative, to your honest responses.

1. Can I get your first name?

2. What is your job title?

3. What organization and unit do you work for?

4. Please describe what role you play in the national public health supply chain.

5. What was your involvement in the stockout-button project, also called the DOOR system?

6. What responsibilities were you given as part of your involvement?

7. How did you find managing these responsibilities in addition to your normal duties?
[If the respondent replies with "difficult," "burdensome," or similarly, then follow up with clarifying questions to understand how and why]

8. Has participation in the DOOR system caused you to divert attention away from your principal job responsibilities?

9. Did you successfully receive alerts from the DOOR system?

10. Roughly, how often did you receive DOOR system alerts?

11. What was your expected response when you received a DOOR system alert?

12. In what timeframe were you generally able to reply with a phone call, SMS. or email to the DOOR system alert?

13. In what timeframe were you generally able to respond or direct a response to the alert by directing resupplies?

14. How would you characterize your overall experience in participating in the DOOR system?

15. What did you like most about it?
[Follow up on each item highlighted and ask why.]

16. What did you like the least?
[Follow up on each item highlighted and ask why.]

17. Are there ways to improve the DOOR system in its current implementation?

18. Do you think the DOOR system would be successful if it were implemented in other provinces in Angola?
[Follow-up question: Why or why not?]

19. Would you recommend putting these devices in more facilities?

20. Is there any other feedback that you would like to share with the team?

Thank you for your participation today. Your responses will be used to improve the DOOR system implementation here in Angola. If you have any questions or concerns with the program, please feel free to contact _____.

Annex 3: DOOR System Response Confirmation Form

(This is a transcription of the Google form where the answers were captured)

Q1   What is the name of the facility that sent the alert?

Q2   What is the name of the product for which the alert was sent?

Q3   What was the stock status that was transmitted?

Q4   What is the date you received the alert?

Q5   What is the date of the follow up? (Today's date)

Q6   What was the name of the facility staff you spoke to?

Q7   What is the title of the facility staff you spoke to?

Q8   Did the facility staff confirm that they pressed the button?

Q9   Which button did the facility staff claim they pressed?

Q10   Why did the facility staff press the button?

Q11   Did the facility staff receive a follow up from the municipal focal point?

Q12   What was the response of the municipal focal point?

Q13   Did the facility staff confirm that product was restocked? (if applicable)

Q14   Where did the product come from?

Q15   Do you have anything else you want us to know about this alert or facility?