GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa
GIS support for the 2016 MSF Yellow Fever Vaccination Campaign in Kinshasa

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Owner & Commissioner: GIS Unit Médecins Sans Frontières

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GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa
ABBREVIATIONS

DRC  Democratic Republic of the Congo
GIS  Geographic Information System
GPS  Global Positioning System
MSF  Médecins Sans Frontières
OCB  MSF Operational Centre Brussels
OCG  MSF Operational Centre Geneva
OSM  OpenStreetMap
PUC  Pool d'Urgence Congo (Congo Emergency Pool)
WHO  World Health Organization
GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa

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I. EXECUTIVE SUMMARY

The deployment of a GIS specialist for the 2016 yellow fever vaccination campaign in Kinshasa had a direct, positive impact on the work of Médecins Sans Frontières (MSF) programme staff.

The 11 MSF staff interviewed for this case study agreed that the most useful maps were those that helped them navigate safely and quickly through Kinshasa’s narrow streets, and showed where locations were in relation to each other. In addition to road maps and maps displaying buildings, this included access maps that showed which streets could be used by vehicles and which could only be navigated on foot.

Aside from the navigational maps, visualisations that showed the daily progress of the campaign in the different locations were highly appreciated by MSF staff. These visualisations were instrumental in quickly identifying and addressing gaps at specific vaccination centres, and in allocating resources in the most efficient way. GIS support made it possible to investigate and immediately address issues that might otherwise have remained undiscovered until a post-vaccination evaluation.

Based on the interviews, it is possible to conclude that GIS support was a very important enabler – although not a critical factor – in the vaccination campaign. GIS support allowed MSF staff to complete their work more quickly, more safely and more accurately.

However, we have also noticed the GIS specialist workload has reached a critical level during some parts of the deployment. GIS support relying on a unique GIS specialist has shown some limitations this time, this is especially the case over nights when the GIS specialist was only able to produce maps based on data available when teams returned from the field.
GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa
II. BACKGROUND

Following a widespread outbreak of yellow fever in Angola in late 2015 and early 2016, the disease was soon detected in the neighbouring Democratic Republic of the Congo (DRC). The first cases of yellow fever were confirmed in March 2016 along the border with Angola; in June, the virus was detected in the DRC capital, Kinshasa.

Given the severe risk of a major yellow fever outbreak in DRC, the World Health Organization (WHO), together with the DRC government, decided to embark on a massive yellow fever prevention campaign along the country’s border with Angola and in Kinshasa.

Kinshasa has a population of over 11 million and is Africa’s third-most populous city. Its proximity to the waters of the Congo River, and the city’s slums with their inadequate water supply and sanitation, provide an ideal breeding ground for the Aedes aegypti mosquitoes that transmit the yellow fever virus.

To reduce the risk of a major outbreak, the MSF Operational Centre Brussels (OCB) agreed to lead the yellow fever prevention efforts in three of Kinshasa’s 35 health zones. Activities in the other 32 health zones were managed by the WHO and DRC health authorities and are not part of this case study.

MSF’s activities included:

- vaccinating more than 710,000 people between 17 August and 26 August 2016
- various forms of vector control aimed at reducing the number of infected mosquitoes and limiting their reproduction
- advising the local population as to why they should be vaccinated and how they can help prevent the spread of yellow fever

To support the work of all MSF activities related to the vaccination campaign, the MSF Geographic Information Systems (GIS) Unit deployed a GIS specialist. In line with MSF’s Geographic Information System Strategy 2016–2019, this case study seeks to examine the role that GIS support played during
the operation, and whether (and where) there is room for improvement. The findings of this document are based on interviews with 11 MSF staff as well as on internal reports and a small number of articles in the media.

**Geographic Information Systems (GIS)**

In this case study, the term ‘GIS’ encompasses any use of geographical information, or maps, ranging from the basic use of maps in the field to the use of GPS, remote sensing (satellite imagery), and all kinds of georeferenced information (locations of patients, infrastructure etc).
Chapter II

Background

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II. Background

III. The GIS deployment

IV. GIS products

V. Conclusion and discussion

VI. Recommendations
GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa
III. THE GIS DEPLOYMENT

The MSF GIS Unit deployed a GIS specialist to Kinshasa to support the yellow fever vaccination campaign. He was in DRC from 26 July to 15 September 2016, and supported the operation from the preparation to the evaluation phase. During this time, he produced a large number of different GIS products, such as various types of maps and visualisations, many of which needed to be updated multiple times. He produced a total of 240 GIS products, or 4.6 products a day. An overview can be found in the table below. The most important products and activities are described in detail in Chapter 4, ‘GIS products’.

<table>
<thead>
<tr>
<th>Cross-cutting</th>
<th>Vaccination</th>
<th>Vector control</th>
<th>Epidemiology</th>
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<tbody>
<tr>
<td>Base-mapping</td>
<td>Supported site selection by mapping distances between vaccination centres</td>
<td>Maps to support vector control activities</td>
<td>Developed and implemented a GIS-based sampling methodology to evaluate coverage following the vaccination campaign</td>
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<tr>
<td>MapKits: sets of common maps for staff</td>
<td>Bespoke maps for different teams (logs, waste management, cold chain etc)</td>
<td>Developed and implemented a GIS-based sampling methodology for a survey</td>
<td>GPS training for survey teams</td>
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<td>Coordination and security maps</td>
<td>Daily progress and coverage maps</td>
<td>Analysis maps (via remote support)</td>
<td>Data collection and verification of locations</td>
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<td>Installation and management of maps on smartphones</td>
<td>Improvements to the vaccination database</td>
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</tbody>
</table>
In addition to creating GIS products in the office, the GIS specialist spent a significant amount of time with the different technical departments as well as with locally hired GIS staff in the field. His activities ranged from collecting GPS points to producing bespoke maps for different technical units, and from improving a critical database to developing sampling methodologies.

3.1 GIS within the MSF operation

MSF programme staff have always used maps for their work, but having dedicated GIS specialists in the field is a comparatively new development. The success of field deployments during the 2014–2015 Ebola response in West Africa, as well as of subsequent field missions, seems to have increased knowledge about GIS within MSF. While, in 2014, many staff were unclear about how they could use GIS support to aid their activities, those interviewed for this case study had a good understanding of its potential.

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The water and sanitation (WatSan) team, for example, was already using Google Earth, and team members had attended a GIS training. Most other interviewees had been deployed in the Ebola response and worked with GIS specialists in that context.

In addition, the OCB Pool d’Urgence Congo (PUC), a unit permanently based in DRC that supports the many different and recurring emergencies in the country, has had dedicated GIS capacity since 2009.

Despite a comparatively high level of knowledge about GIS in this operation, interviewees emphasised that GIS specialists still have to be proactive about their services and their portfolio, as many programme staff do not know what kind of support they can ask for: while it might be obvious to ask for basic geographical maps (base maps) that show the terrain and roads, non-experts may be unaware that a GIS specialist can also visualise population density or design a methodology for random sampling.

Several interviewees said it was important for a GIS specialist to listen to the needs of programme staff and suggest solutions, rather than to expect programme staff to be able to request products that meet their needs. “Often, people think GIS is only about maps. They don’t understand that there are a thousand other things the GIS specialist can do.” (MSF medical coordinator)

3.1.1 Workfow and workload

Most of those interviewed said they requested maps by approaching the GIS specialist directly, mainly in the evening after they had returned to base. It was, therefore, mainly at night that the GIS specialist received the data he needed to produce maps for the next day, such as for the progress maps that showed how many people had already been vaccinated.

Most interviewees said the GIS specialist was able to produce maps very quickly, and finished them by the next morning. Unfortunately, this combination of late requests and the late provision of data meant that, on many days, the GIS specialist had to work through the night until the early hours of the morning, when the teams left for the field again. This put the GIS specialist under significantly greater stress.
When asked by the Geneva-based GIS ‘referent’\(^2\) (who was managing the specialist) whether he needed to be replaced or required additional support, the GIS specialist declined. However, in hindsight, he said this decision was a mistake. Clearly, it is difficult for remote managers to recognise signs of cumulative stress in their staff. This is especially the case with experienced and highly specialised staff who work with a high degree of autonomy. However, according to both the GIS specialist and the GIS referent, during this mission, this pushed the specialist to his limits – or slightly beyond them.

Unfortunately, there does not appear to be an easy solution as regards improving the workflow, from data collection to GIS output. While interviewees recognised this as a problem, many felt it was partly due to the sheer size of the vaccination campaign and that it would be less of an issue in smaller interventions. The scale of this particular yellow fever vaccination was exceptional, both in terms of context and target population, as well as human and material resources.

The situation was significantly better for less time-critical requests that were not directly related to the ongoing vaccination campaign, such as during the evaluation that the GIS specialist supported in September 2016 (see section 4.6, ‘Evaluating success’).

Asked whether mobile data collection with smartphones or tablets would enable data to be collected faster, two interviewees said they did not regard this as an adequate solution in Kinshasa. The main reasons were a lack of electricity in many locations, insufficient knowledge on the part of national staff about how to use the devices (and, accordingly, the need to provide resources to support them), and concerns that having these devices may expose local staff to greater risk of theft or robbery.

Given that smartphone penetration is rising sharply across Africa\(^3\), it is likely that many of these concerns will diminish over the coming years. The GIS specialist remarked, however, that implementing a large-scale, mobile data collection campaign would have required the deployment of an additional, dedicated staff member.

### 3.2 Local GIS infrastructure and stakeholders

When time permits, MSF’s GIS specialists routinely interact with their local counterparts in the administration, at local universities or with the OpenStreetMap community. In many countries, there will be a geography

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2 The MSF GIS referent is the first point of contact at the GIS Unit for the GIS focal points in the different operational centres.

department at a university or a statistics department at a local ministry that is interested in exchanging data. Occasionally, this also involves – often informal – capacity building for local GIS staff through an MSF GIS specialist.

During the 2016 vaccination campaign in Kinshasa, this kind of interaction did not take place. The main reasons were a lack of time, the fact that the PUC already had permanent GIS capacity in place, and an operational desire to limit the number of interlocutors who directly interacted with representatives of the health authorities. Nevertheless, at the end of the GIS specialist’s deployment, print-outs as well as non-sensitive data sets, such as base maps, were handed over to the Central Health Zone Office (Bureau Central de la Zone de Santé, BCZ) on a drive. In addition, many non-sensitive data sets were uploaded to OpenStreetMap (OSM), where they remain publicly available.

OpenStreetMap – www.openstreetmap.org
OpenStreetMap is often referred to as the “Wikipedia of maps”, as anyone can make changes to the maps online. OSM data is maintained by volunteers and released under an open-source licence. In many developing countries, OSM maps are more detailed than Google maps because Google has no commercial incentive to improve its maps in these countries.

3.3 ICT infrastructure

The interviewees described the information and communications technology (ICT) infrastructure as adequate. Given that the vaccination campaign took place in the capital, Kinshasa, and that the vaccination campaign team was housed close to the international airport, mobile 3G Internet service was readily available and sufficient. Later, a VSAT set-up further increased the available bandwidth at base.

The GIS specialist remarked that it would be helpful if the specific hardware needs of GIS specialists, such as an A3 colour printer, could be anticipated in advance. This way, the procurement process could be started before their arrival in the field, rather than after.

In Kinshasa, the GIS specialist had to wait 6 days before urgently needed GPS devices were brought from Geneva by international staff, and 10 days before an A3 printer and additional GPS devices arrived. The OCB GIS focal point and the MSF GIS referent said this issue had already been identified,
and that the GIS Unit had started stockpiling some essential hardware that could be deployed immediately.

Interestingly, one of the logisticians interviewed for this case study commented that, when he first worked with a GIS specialist during a different deployment, he did not understand why the GIS specialist needed a special, large and expensive printer when smaller printers were available. As a result, he did not consider the A3 printer to be a priority at the time. He only understood later that there were valid reasons for the GIS specialist’s request. Better communication between the GIS Unit – which is part of the OCG logistics department – and supply and procurement might be helpful to ensure that the right hardware is available on time.
Chapter III
The GIS deployment

I. Executive summary

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V. Conclusion and discussion

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GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa
IV. GIS PRODUCTS

Parts of Kinshasa had already been mapped prior to the yellow fever vaccination campaign. However, the extent and quality of the maps varied significantly between the three health zones that MSF had agreed to operate in.

In a small, dense, urban health zone, almost all the roads had already been mapped, including the street names. Here, only the buildings were missing.

On the other hand, the existing maps for the two semi-rural health zones showed many gaps: not only were buildings missing, but many roads were missing too. Furthermore, many streets were incorrectly labelled in existing maps.

In addition, the PUC was able to provide the GIS specialist with outlines of the health zones. These outlines turned out to be slightly bigger than the actual health zones, but the GIS specialist was able to make corrections quickly with the help of the Central Health Zone Office.

4.1 Geographical data collection

MSF followed two approaches to collect and verify geographic information:

- **Crowdsourced remote support**

  In many cases, in order to add a street or a building to a digital map, the outlines of the object are drawn onto a satellite image and this information is then saved to the map.

  In densely populated, urban areas, this task would be overwhelming for one person alone. However, it is also a task that can easily be performed remotely. For this reason, the Missing Maps project[^4] was brought in to support the vaccination campaign. Missing Maps is an initiative founded by MSF, members of the International Red Cross and Red Crescent Movement and the Humanitarian OpenStreetMap Team to map some of the most vulnerable places in the developing world with the help of remote volunteers. In Kinshasa, Missing Maps volunteers added 76,000

[^4]: See [http://www.missingmaps.org](http://www.missingmaps.org)
building outlines within 15 days, mainly within the three health zones MSF was working in. Previously, only 8,000 buildings had been mapped in the whole of Kinshasa.

The satellite imagery that MSF used for this process dates from 2011 and was freely available through Microsoft’s Bing platform5.

- **Field-based mapping**

In addition, three local GPS teams6 spent 10 days in the three health zones to capture and verify data and to enrich maps with local detail; while it is easy to draw building outlines from a satellite image, knowing whether a building is a school, a warehouse or a police station requires local knowledge or a visit to those locations. Similarly, roads that look wide enough for a vehicle on a satellite image can be in such a bad state that they should not be used by cars. Sometimes, things will also have changed since the time the satellite image was taken.

The GIS specialist also occasionally asked members of other teams (for example, logistics, medical, WatSan) to collect GPS coordinates from the areas they were travelling through or working in.

This combination of remote support and local mapping was previously identified as good practice during the Ebola crisis and has, again, proved to be beneficial since it frees up resources in the field and allows field-based teams to focus on tasks that only they can achieve.

The remotely mapped buildings, as well as the buildings’ attributes, were published on OpenStreetMap where the information can also be used by other actors.

### 4.1.1 Working with digital volunteers

One criticism during previous activations was that remote volunteers often did not know how their work was being used, or whether their contributions were operationally useful. To address this issue, the yellow fever vaccination team decided to improve the feedback loop between the field and volunteers by providing frequent, lightweight updates.

MSF’s Missing Maps coordinator said MSF field staff were frequently worried that they might be expected to send written reports or high-quality

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5 See [http://www.bing.com/maps](http://www.bing.com/maps)
6 Each GPS team consisted of a local staff member, who had been trained in the use of GPS, and a driver
images to the volunteers, when a tweet, an SMS or a simple photo taken with a smartphone was often enough to keep the volunteers motivated and engaged. This type of quick feedback from the field was greatly appreciated and was passed on to the Missing Maps coordinator by the GIS specialist with input from a logistician.

MSF’s communications staff in DRC were involved in the process to ensure that the messages were in line with the overall communications approach and that they correctly reflected the operation.

The Missing Maps coordinator also said it was very helpful to be given clear priorities by the GIS specialist. Rather than asking the volunteers to map everything in a large area, he asked for specific areas and map features within a defined time frame. For example, when the field team had to change its plans for the following day due to security concerns, the GIS specialist re-tasked the remote volunteers to focus on the new area and was able to produce printed maps by the next morning. For this, it was helpful that the field-based GIS specialist was able to interact directly with the volunteer coordinator without having to go through an intermediary.

“If you want good, fast data, then you need to build communications in.” (MSF Missing Maps coordinator)
Above: Google Maps (left) shows roads and identifies some buildings, while OSM (right) provides more and richer detail. Below: The number of mapped buildings in the area before (left) and after (right) the Missing Maps volunteers had traced 76,000 building outlines onto satellite images.
4.2 Navigation: Getting from A to B

All interviewees said it was extremely difficult to navigate the small streets of the health zones, and that having precise road maps with landmarks and the location of all vaccination centres was very helpful. They consistently cited street navigation maps as the most useful GIS products for their work, as they offered the following benefits:

- Filling in the gaps on existing maps meant that new routes became visible. One of the logisticians recalled a case where a small river flowed through his area of operation. Prior to the detailed mapping, the logistics team assumed they had to make a long detour to get to the other side of the river. Then, the new detailed maps showed numerous places where vehicles could cross.

- Seeing the shape, size and position of buildings on a map was important for teams that needed to determine their own position on a street. Being able to see landmarks on a map, for example, churches or high-voltage power lines, was helpful for the same reason.

- Combining the names of landmarks with GPS coordinates revealed that some locations had been given multiple names by different teams. Harmonising the names helped to avoid confusion.

- Access maps showed whether staff could drive to the vaccination centres or whether the centres were only accessible on foot. These maps also showed which route MSF teams should take, as well as stretches of road they should avoid.

- Most interviewees agreed that drivers did not use the maps since they were familiar with the area. However, team leaders referred to the maps with the drivers before leaving base to discuss where to go and how to get there.

“At the beginning, we were working with maps that were like child[ren’s] drawings. With GIS, we had a real view of where we were going and the reality in the field.” (MSF logistics coordinator)
4.3 Security

Given the large number of vaccination centres, knowing where each centre and each team were was crucial from a security point of view.

The emergency coordinator said she needed to inform the relevant teams quickly when she received security alerts, for example, when shots had been heard at a particular location or when large groups of protesters were in the vicinity.

Without a map, it would have been very difficult to know exactly where each of the 94 vaccination centres was in relation to reported incidents. With the map, she could find all the centres easily and see which centres and teams were nearby and needed to be informed. This allowed teams to avoid areas that might have presented risks (such as the route of a protest march). The emergency coordinator called this the most important map for her role.

4.4 Mapping vaccination progress

Many of the GIS products were cross-cutting and benefited several sectors. However, the GIS specialist also produced maps that were targeted more specifically towards one aspect of the operation. For the vaccination campaign, these included:

- Maps that showed the distances between the vaccination centres to ensure that they were neither too close nor too far apart. These maps had to be adapted almost daily during the preparation phase as different buildings became available or were deemed unsuitable, or simply to visualise the alternatives. There was no consensus as to how useful these distance maps were. While one logistician referred to them as one of the most important GIS products, another felt they were not very useful, since to him information about accessibility was more important than distance.

- Daily visualised statistics for each vaccination centre, such as the number of people vaccinated that day, and each day since the beginning of the campaign.
• Maps that visualised the progress of the vaccination campaign for each day and for the different areas within each health zone. Since the vaccination campaign progressed more quickly in some areas than in others, these progress maps helped coordinators shift resources when possible and where necessary.

In one instance, the medical coordinator used the information from the progress maps to decide to open an additional vaccination centre in an area where attendance was poor. In another area that showed low attendance on the maps, the team discovered that people in this area had already been vaccinated during a previous vaccination campaign.

The medical coordinator stressed that without GIS, gaps in coverage or low attendance would probably only have been discovered during the post-vaccination evaluation. The daily visualisations, on the other hand, helped the coordinator identify potential issues and respond to them within a day.

• The GIS specialist also provided technical support for the Excel-based vaccination database by improving the data entry process and fixing incorrect formulas that produced misleading results during the first days of the response. Information from this database fed into some of the maps.
Clockwise from top left: Map showing the distances between different vaccination centres. Map showing daily statistics for each vaccination centre in one health zone (updated daily). Map showing overall progress and coverage in all three health zones (updated daily).
4.5 Vector control

The water and sanitation team, which was in charge of vector control, already had internal GIS capacity; prior to the arrival of the GIS specialist, the team had already collected the GPS coordinates of reported yellow fever cases and used Google Earth to draw an area for fumigation around patients’ homes (see below).

The WatSan team leader said they were not able to benefit as much from the services of the GIS specialist as they would have liked. This statement was echoed by the GIS specialist. Based on the interviews, there were two main reasons for this:

- **Timing:** The GIS specialist arrived after the vector control team had already conducted a first study of locations where larvae, pupae and mosquitoes that can carry yellow fever were present.
- **Priorities:** The GIS specialist’s workload did not allow him to support all teams equally. Based on a decision that was taken together with the WatSan team, vector control activities received less support than the vaccination team.

*The WatSan team had internal capacity to produce maps showing which areas needed to be fumigated (left). The GIS specialist produced similar maps for the team (right). (Note: The left-hand image is not from Kinshasa, but from a town close to the Angolan border. The Google Earth files from Kinshasa were no longer available at the time of writing.) Images: Google Earth (left), MSF (right)*
Despite these issues, the WatSan team leader emphasised GIS was very important for his work. He regarded the main added value of GIS as combining maps with data, rather than in just creating topographical maps. In particular, he would like to have seen maps that combined information about current patients’ homes with patient data from previous outbreaks, as well as with data from previous vaccinations and fumigations. Taken together, this information could help identify areas that should be prioritised for vector control measures.

The WatSan team leader also said he would be interested in building more GIS capacity within his team, and suggested that he would appreciate additional GIS training that went beyond the existing training.

Apart from the immediate, operational aspects, both the health promotion team and WatSan used GIS to evaluate the success of their activities after the vaccination campaign had concluded (see section 4.6, ‘Evaluating success’): the health promotion team used a GPS-based sampling methodology to identify interview locations for a post-vaccination survey, while the WatSan team took advantage of additional HQ-based GIS support to produce maps that showed the speed and effectiveness of their vector control activities.

### 4.6 Evaluating success

The GIS specialist supported a number of activities aimed at evaluating the effectiveness of the yellow fever vaccination campaign. In addition, HQ-based remote support helped assess the results of the vector control activities.

#### 4.6.1 Evaluating epidemiology and health promotion

Following the vaccination campaign, the epidemiological team launched an evaluation to see whether the vaccination targets had been reached. In order to be valid, such an evaluation depends on a random sample, which can be challenging to draw in the field.

To support the team, the GIS specialist developed a methodology in which software selected GPS points at random within each health area (see below). The GIS specialist then removed the GPS points that were in inaccessible locations, and reduced or increased the total number of points to correspond to the number of people living in the area. It was to these locations that the survey teams were then dispatched. The GIS specialist repeated this process two more times in order to create two
back-up locations for each GPS point. In total, the GIS specialist marked 1,551 GPS points in the three health zones.

### Using GIS to draw random samples

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<th>Description</th>
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<tr>
<td>1</td>
<td>Random GPS points are marked within a health area.</td>
</tr>
<tr>
<td>2</td>
<td>Inaccessible GPS points are removed (for example, when they fall within a lake, ravine or military installation).</td>
</tr>
<tr>
<td>3</td>
<td>The total number of GPS points is adjusted to correspond to the number of people living in the area.</td>
</tr>
<tr>
<td>4</td>
<td>The process is repeated two more times in order to create back-up locations in the event that interviewers can’t find people at these locations, or where people at these locations are unwilling to answer questions.</td>
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The epidemiologist in charge of the survey explained that, in addition to being scientifically rigorous, this methodology yielded faster results than the alternative cluster sampling methodology. In a cluster sample, additional surveys have to be conducted to compensate for the bias that is inherent in the cluster approach. Since the GPS points were truly random, no bias needed to be compensated for, which meant fewer surveys needed to be completed. The epidemiologist estimated that with cluster sampling, the survey would have taken seven to eight days, instead of the three days it took using the random GPS points.

Prior to this coverage survey, a more lightweight version of the approach was used by the health promotion team for a different, smaller survey that looked at the effectiveness of messages related to vector control.
This survey served as a pilot for the more rigorous and labour-intensive coverage survey.

4.6.2 Evaluating Vector control

In November 2016, headquarters allocated additional remote support for five days to help produce maps based on data that the vector control teams had collected. These maps served to evaluate the effectiveness of the response. Using four different data sets, the maps showed how quickly the vector control teams responded to reported cases, as well as the extent to which vector control activities had reduced the population of larvae, pupae and mosquitoes close to patients’ homes.

One of the major challenges in producing these maps was that the data sets had not been collected in a way that facilitated the matching of cases or vector control activities to locations. For example, in some instances, cases or activities had been recorded without locations, and it wasn’t always clear which activities were linked to which case.

The HQ-based GIS specialist stressed that these were not issues that required the expertise of a GIS specialist on the ground, but that they were, instead, related to information and data management. His recommendation was to supply field teams with Excel templates that supported the consistent and structured collection of data in a way that facilitated the work of GIS specialists.
Maps showing the speed (top) and effectiveness (bottom) of vector control interventions were produced after the response.
4.7 Distribution of GIS products

Most GIS products were shared directly with field team members on paper. Some were also hung up on noticeboards. These boards were updated daily.

In addition, many GIS products were also uploaded to the MSF Map Centre⁹ and shared by email with staff locally and at headquarters. Paper and email were the preferred means of distribution for all interviewees: paper for the field teams and email for tasks involving management, coordination and reporting.

4.7.1 MapKits

MapKits are another example of good practice that the GIS specialist has continued to roll out after positive experiences in previous deployments. MapKits are ready-to-use sets of A3 maps, which were given to all staff who had a supervisory role. These kits included the most common maps (such as road maps) and were updated with the most recent specialised maps for logistics, epidemiology etc. Teams could pick these maps up as needed, without the GIS specialist needing to be present.

⁹ see https://mapcentre.msf.org/en
4.7.2 Smartphone maps

The GIS specialist used the OsmAnd\textsuperscript{10} smartphone app to install an offline map of all vaccination centres onto the phones of some team members. The use of the OsmAnd app started as an experiment for the coordination team but soon proved to be very popular with both national and international staff. In total, the GIS specialist equipped 59 phones with OsmAnd and his custom maps over the course of the vaccination campaign.

According to the GIS specialist, many local staff said they planned to carry on using OsmAnd beyond the end of the mission on their personal phones. Vaccination centres highlighted in the OsmAnd smartphone app were marked by a number of MSF staff also used OsmAnd to mark points of interest on the maps and report this data back to the GIS specialist. While these contributions were useful for the GIS specialist, he remarked that OsmAnd was not the right tool for this purpose since data entry was largely unstructured. Dedicated mobile data collection tools would have been more appropriate.

Two interviewees commented that these digital smartphone maps were very much appreciated, but that installing and managing these maps took more time than the GIS specialist had anticipated.\textsuperscript{11}

\textsuperscript{10} see http://osmand.net

\textsuperscript{11} Discussions during GIS Week 2017 revealed that many of these technical issues had since been resolved through updates to the OsmAnd software.
GIS support for the 2016 MSF yellow fever vaccination campaign in Kinshasa

© Author photograph...
Based on the interviews with 11 MSF staff who were directly involved in the 2016 yellow fever vaccination campaign in Kinshasa, it is clear that the deployment of a GIS specialist to the field added significant value to the operation.

All those interviewed stressed that having accurate maps of the area of operation was very helpful and facilitated their work. At the same time, no interviewee said they would have been unable to do their work without the maps. The overall impression is that MSF staff were able to do their work faster and more accurately since GIS support removed a lot of guesswork and added accuracy in many areas of the response.

The most useful GIS products were maps related to navigation, followed by visualisations that showed the progress of the vaccination campaign. The former helped field teams get to their destinations more reliably and supported the coordinators who needed to know who was working where and what was happening where. The latter contributed to more accurate reporting and supported a more efficient resource allocation.

With the exception of the epidemiological survey, these efficiency gains were not quantifiable, and it would have been interesting to compare the work done by MSF in its three health zones to the work done by the Ministry of Health and the WHO in the remaining 32 health zones. However, such a comparison would have exceeded the scope of this case study – not least because GIS support was not the only variable between the different zones. The interviews conducted for this case study indicate that interest in and knowledge of GIS within MSF has increased substantially compared with 2015. However, it is not clear to what extent this is due to ongoing efforts by headquarters to increase knowledge about GIS within MSF, and to what extent it is a fortunate coincidence that many of the team members of this specific deployment had already worked with GIS officers during previous field missions. The author found the difference in the level of knowledge about GIS – compared with 2015 – remarkable, yet most interviewees commented that, while they understood the benefits of using GIS, many members of their team did not.

The interviews also indicated that there is a need for improvement regarding how GIS is integrated into the overall flow of information during
an operation. The current set-up, where data is collected on paper in the field and then entered and verified at base, before the GIS specialist receives it at night, is inefficient and puts significant strain on GIS staff in the field.
TOUS, FAISONS-NOUS VACCINER AU SITE LE PLUS PROCHE POUR NOUS PROTEGER CONTRE LA FIEVRE JAUNE

Le vaccin est gratuit!
VI. RECOMMENDATIONS

- Investigate how information workflows can be improved to ensure that GIS specialists get data sooner.
- Together with the technical departments, develop Excel templates that support programme staff in collecting ‘clean’ data that can be used by GIS specialists.
- Ensure that critical hardware, such as printers and GPS devices, have been procured prior to the arrival of the GIS specialist.
- In cases where digital volunteers (for example, via Missing Maps) support the field teams: continue to communicate the impact of their support to these volunteers via short, lightweight messages (such as photos, SMS or tweets). Obviously, this can only be done in situations where there are no confidentiality issues and should also involve MSF’s field-based communications officers.
- Consider whether providing offline smartphone maps should become a standard service in GIS deployments.
- Continue to select field-based GIS staff based on their ability to listen to the needs of programme staff. Since many programme staff do not have enough GIS knowledge to ask for specific products, it is essential that the GIS specialist is able to translate the needs into product recommendations.
- In order to cope with high peaks of activities and prevent the GIS specialist to be overloaded, day/night shifts could be organized. This would imply having two GIS specialists in place during these peaks.
In August 2016, MSF OCB conducted the biggest yellow fever vaccination campaign in the organisation’s history. Over a period of just 10 days, MSF staff vaccinated more than 710,000 people in Kinshasa, the capital of the Democratic Republic of the Congo.

To support this massive undertaking, the MSF GIS Unit deployed a geographic information systems (GIS) specialist. This case study looks at how GIS was able to contribute to the success of the vaccination campaign, from the preparation phase to the evaluation phase.