POPULATION MOBILITY MAPPING (PMM)
SOUTH SUDAN: EBOLA VIRUS DISEASE (EVD) PREPAREDNESS

CONTEXT

The tenth EVD outbreak in the Democratic Republic of Congo (DRC) is still ongoing, with a total of 3,428 EVD cases reported as of 2 February 2020, including 3,305 confirmed and 123 probable cases. A total of 2,250 deaths have been reported, with a case fatality ratio of 65.6 per cent. Although the rate of new cases in DRC has decreased and stabilized, two health zones reported 25 new confirmed cases within the 21-day period from 13 January to 2 February 2019: Beni (n=18) and Mabalako (n=7).[1]

The EVD outbreak in DRC is the second largest in history and is affecting the north-eastern provinces of the country, which border Uganda, Rwanda and South Sudan. South Sudan, labeled a 'priority 1' preparedness country, has continued to scale up preparedness efforts since the outbreak was confirmed in Kasese district in South Western Uganda on 11 June 2019 and in Ariwara, DRC (70km from the South Sudan border) on 30 June 2019. South Sudan remains at risk while there is active transmission in DRC, due to cross-border population movements and a weak health system. To support South Sudan's Ministry of Health and other partners in their planning for EVD preparedness, the International Organization for Migration (IOM) has applied its Population Mobility Mapping (PMM) approach to inform the prioritization of locations for preparedness activities.

Aim and Objectives

The aim of PMM in South Sudan is to inform the 2020 EVD National Preparedness Plan by providing partners with relevant information on population mobility and cross-border movements. More broadly, it aims to improve prevention, detection and response to the spread of infectious diseases through an improved understanding of prevailing human mobility patterns. The specific objectives of this exercise are:

- Provide information on the dynamics and characteristics of mobility between DRC, particularly EVD-affected areas, other countries at risk of EVD transmission and South Sudan to help prevent and detect the potential spread of EVD to South Sudan

- Identify priority locations in high risk areas, for the implementation of public health emergency preparedness measures.

APPROACH

In collaboration, IOM's Displacement Tracking Matrix (DTM) and Migration Health teams rolled out PMM in South Sudan in two stages:

1. Population Flow Monitoring: As part of IOM's EVD preparedness activities, DTM has been operating 26 Flow Monitoring Points (FMPs) on the borders with DRC, Uganda and the Central African Republic. Enumerators at the FMPs conduct anonymous, voluntary surveys with all passing travellers to capture daily information on the number of travellers, their areas of departure and destination, the respective length of stay / intended length of stay, reasons for travelling, demographic profiles and vulnerabilities. Individuals travelling together are surveyed as a group, which usually corresponds to the household. DTM has been producing monthly EVD-dedicated flow monitoring dashboards since January 2019. The findings presented in this report cover the period of 1 January to 31 October 2019.

2. Participatory Mapping Exercises (PMEs): IOM, in coordination with South Sudan's Ministry of Health, carried out two PMEs in South Sudan to complement flow monitoring results and inform preparedness activities. The participatory mapping approach involves collecting information from key informants through facilitated group discussions. The current methodology draws from IOM's past experience in participatory mobility mapping, specifically for preparedness and response efforts in the context of epidemics in West Africa, DRC and its neighboring countries, and is the result of a collaboration between IOM and the World Health Organization (WHO).

Key informants were identified collaboratively by South Sudan's Ministry of Health and IOM based on their knowledge of population mobility, public health and, more generally, their knowledge with respect to the area of assessment. The key informants were selected among local government authorities, immigration personnel, representatives of the formal and informal economic sector, the health and education sector, local communities and community leaders. IOM facilitated two PMEs in South Sudan:

- National-level exercise for currently designated high-risk states (Juba, 3 December 2019) to validate and complement flow monitoring data on mobility dynamics in the assessment area and identify high priority locations, i.e. key transit and destination hubs, such as cities, towns and villages, where travelers interact with each other and the local community

- Exercise for Yei River State (Yei, 5 December 2019) to validate and complement flow monitoring data on mobility dynamics in the assessment area, re-prioritize points of entry (POEs), collect information on health facilities in closest proximity to prioritized POEs and identify key points of congregation, namely gathering places within a community, such as markets, places of worship, health facilities, among others, where travelers interact with each other and the local community

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[1]Ebola Virus Disease Democratic Republic of Congo, WHO External Situation Report 78, 04 February 2020

POPULATION FLOW MONITORING: Findings

Overall Movements

- Between 1 January and 31 October 2019, a total of 254,313 individuals were surveyed at a total of 26 EVD-dedicated FMPs

- 63.5 per cent of respondents came from Uganda (n=161,464 individuals), 33.5 per cent came from DRC (n=85,242 individuals), while 1.64 per cent came from Kenya and 1.34 per cent came from Central African Republic

- 30.3 per cent of respondents were travelling for economic reasons, while 13.7 per cent of respondents were travelling for healthcare

- 22 per cent of those surveyed were coming from displacement camps

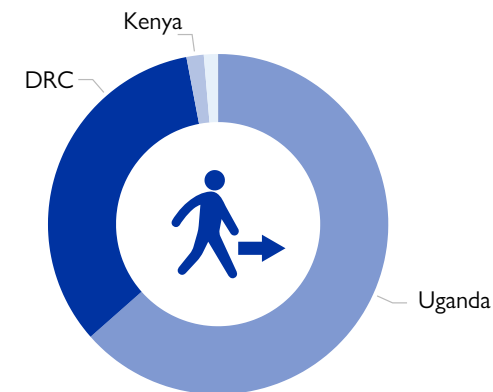- Most movement is circular, with 80.2 per cent of respondents intending to travel for a week or less

Figure 1. Countries of departure for all surveyed individuals

Movements from Affected Areas

- Between 1 January and 31 October 2019, only 0.19 per cent of all surveyed individuals came from territories in DRC (level 2 administrative subdivision) affected by EVD over the course of the current outbreak or from Kasese district in Uganda (n=489 individuals)

- Of those coming from affected areas, nearly 77 per cent were travelling for economic reasons, while only 3.3 per cent were travelling for healthcare

- No respondents from affected areas came from displacement camps

- Most movement from affected areas is circular, with 70 per cent of respondents intending to travel for a week or less

- Key departure locations for these respondents included Kasese, Ariwara and Bunia, while key destination payams included Yambio in Western Equatoria, Gulumbi (Morobo County) and Juba in Central Equatoria

- The most common routes among these respondents were Ariwara-Yambio (20.4%, n=100 individuals) and Bunia-Gulumbi (18%, n=88 individuals)
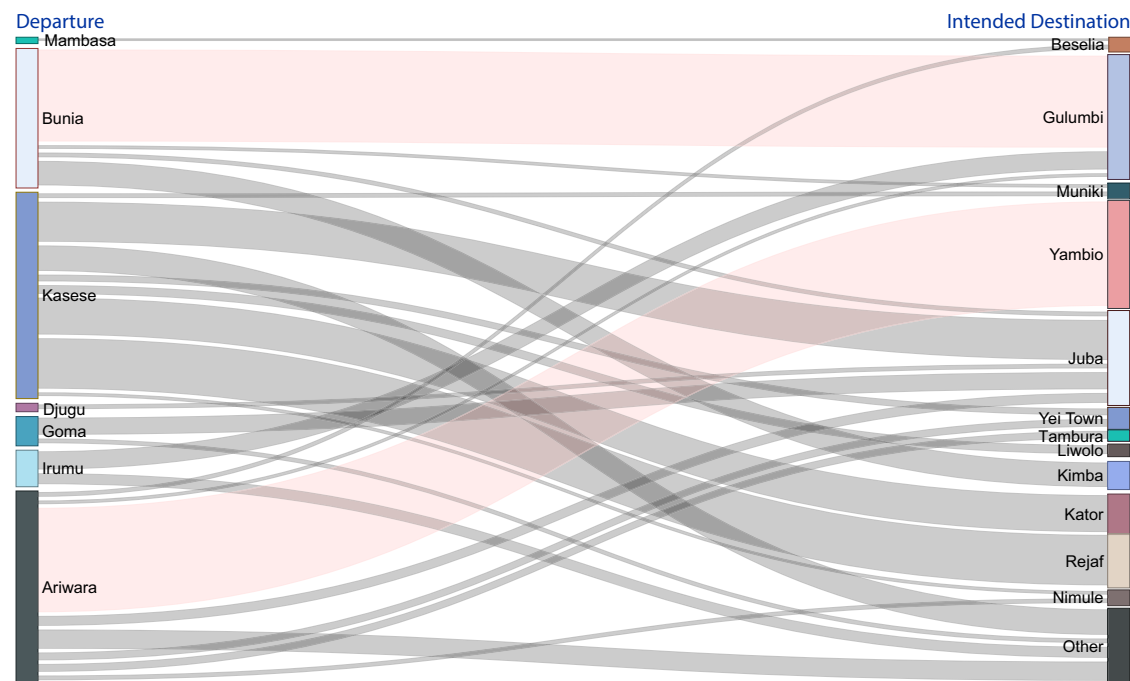

Figure 2. Departure territories (DRC and Kasese district in Uganda) and intended destination payams (South Sudan) for all surveyed individuals from affected areas. Most common routes are highlighted.

Geographical distribution of at-risk flows

- Figures 3-6 show the geographical distribution of overall incoming flows to the three high-risk states (Eastern, Central and Western Equatoria) (figure 3), flows from EVD-affected areas including Kasese district in Uganda (figure 4) and incoming flows by individuals seeking healthcare in South Sudan (figures 5-6) through borders with countries at risk of EVD. Darker areas in the figures indicate higher flows.

- The figures, which are based on data for 1 January – 31 October 2019, are monthly projections of the number of individual movements for each type of flow weighted by the number of days each FMP had been active[2] during the period. While this represents an approximation, assuming constant flows over the period of inactivity, it provides a more accurate picture than total (un-weighted) surveyed flows in that it avoids underrepresenting flows through FMPs that were activated later or suffered operational interruptions.

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[2]Active days are considered to be days in which at least one interview was carried out at the Flow Monitoring Point

POPULATION FLOW MONITORING: Movements by Areas of Destination (Overall and from Affected Territories)
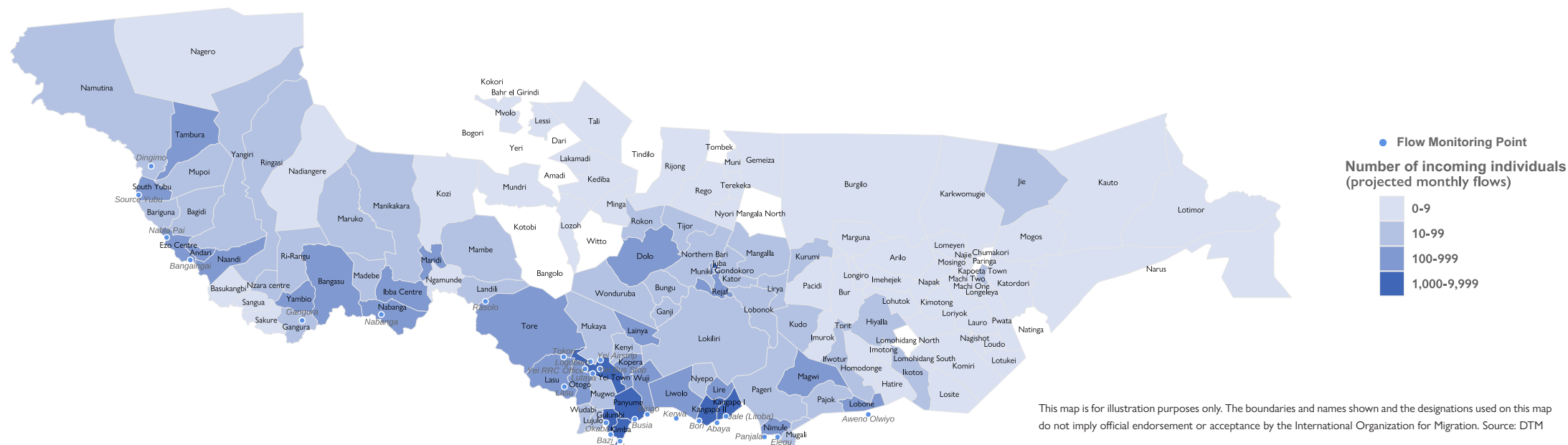
January – October 2019

Figure 3. Projected monthly flows by areas of destination from all areas of origin, based on Flow Monitoring Registry surveys conducted during the period 1 January - 31 October 2019 © IOM 2019
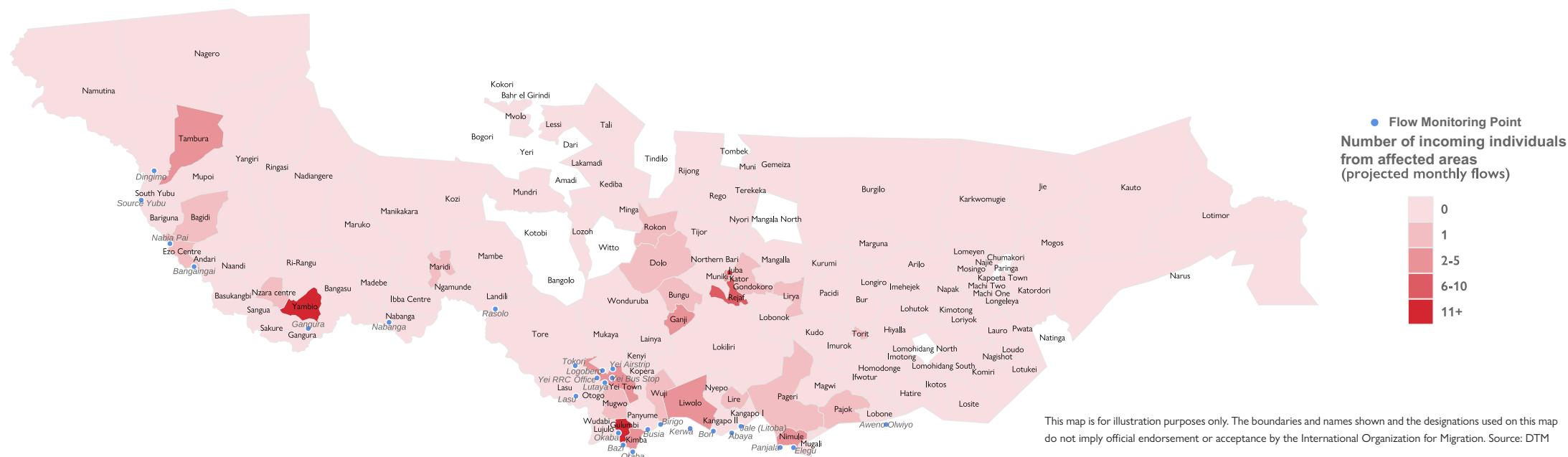

Figure 4. Projected monthly flows by areas of destination from all EVD-affected territories, based on Flow Monitoring Registry surveys conducted during the period 1 January - 31 October 2019 © IOM 2019

Flow Monitoring Point

Number of incoming individuals for Healthcare
(projected monthly flows)

- 0-9
- 10-99
- 100-499
- 1,000+

This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration. Source: DTM
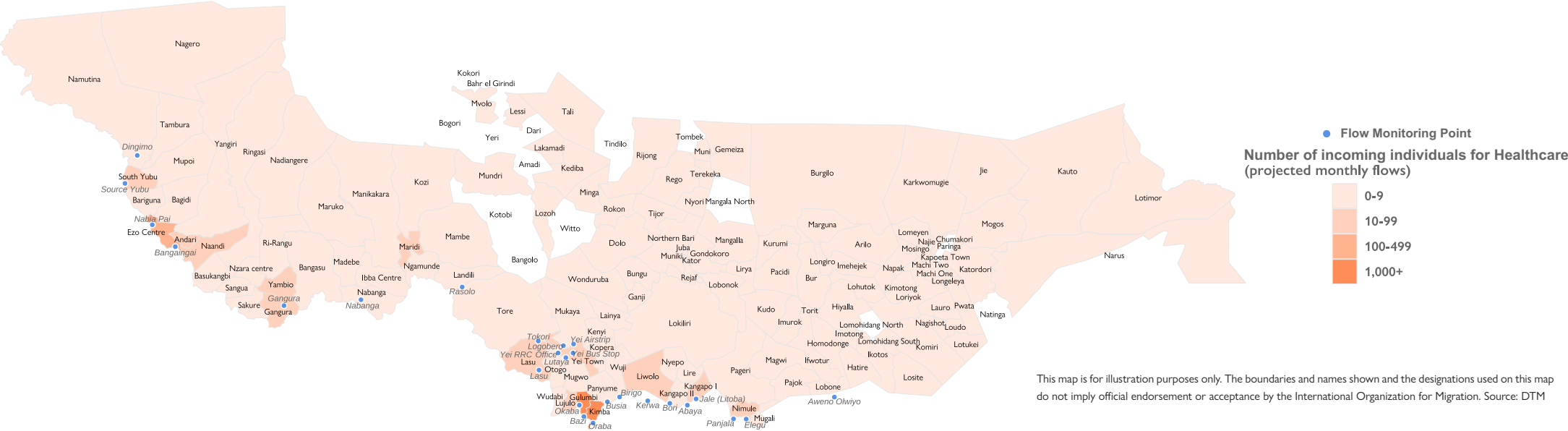
Figure 5. Projected monthly flows by areas of destination for travellers seeking healthcare from all areas of origin, based on Flow Monitoring Registry surveys conducted during the period 1 January - 31 October 2019 © IOM 2019

Flow Monitoring Point

Share of incoming individuals for Healthcare
(projected monthly flows)

- 0-10.0%
- 10.1-20.0%
- 20.1-30.0
- 30.1-40.0
- 40.1+

This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration. Source: DTM
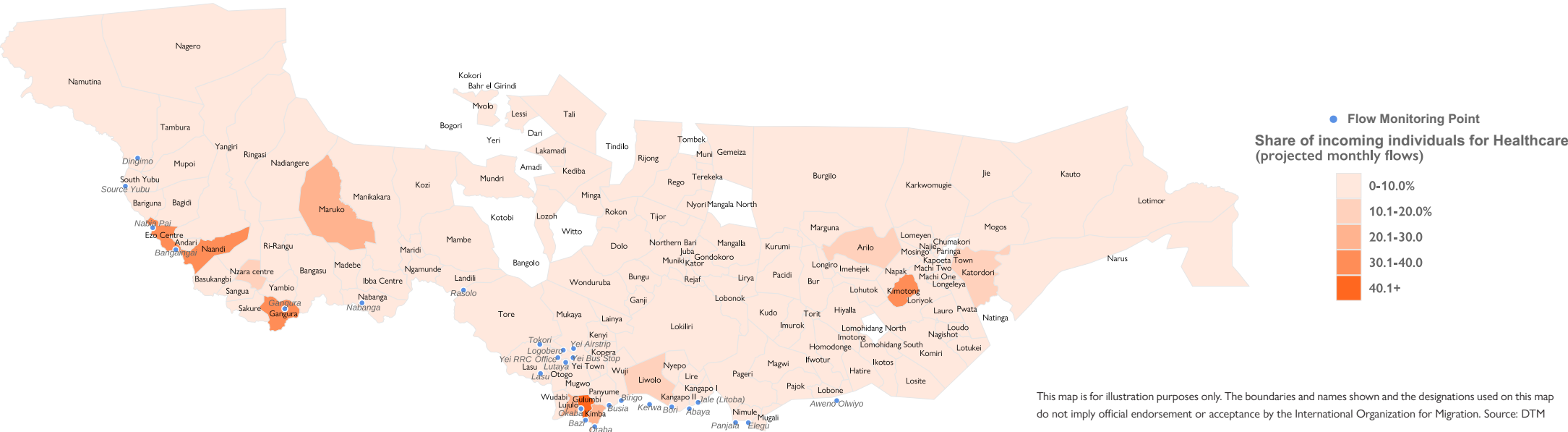
Figure 6. Travel for healthcare as share of projected monthly flows by areas of destination, based on Flow Monitoring Registry surveys conducted during the period 1 January - 31 October 2019 © IOM 2019

PARTICIPATORY MAPPING OF POPULATION MOBILITY: Findings

National-level Participatory Mapping Exercise: Juba, 3 December 2019

Number of participants: 19

Profiles of participants:

- County commissioners
- Ministry of Health representative
- Humanitarian and development partners[3]

Objectives:

- Validate and complement flow monitoring data on mobility dynamics in the high risk states
- Identify high priority locations in the high risk states based on prevailing human mobility patterns and connections with DRC

High priority locations

The following high priority locations identified in the national-level PME are key transit and destination hubs, such as cities, towns and villages, where travelers interact with stationary, local communities.

1. **Morobo:** Morobo town and the surrounding villages witness important circular flows by South Sudanese refugees living in cross-border host communities in DRC and Uganda, who return to Morobo on a daily or weekly basis to access healthcare, for primary education and to engage in commercial and other livelihood activities. Transit flows are primarily from Koboko (Uganda) and sometimes Aru and Ariwara territories in DRC to Yei Town. Trucks operating between Koboko and Aru and Ariwara territories in DRC cross Morobo County between Kaya and Bazi.

2. **Yei:** As the capital of Yei River State, Yei Town is an important destination for healthcare and refugee movements, as well as commercial movements from both DRC and Uganda. It is a key transit point for longer-distance movements to Tore, Maridi, Lainya and Juba for commercial and healthcare purposes, though movements from DRC to Yei are primarily short-distance movements from nearby localities rather than long-distance movements from affected areas close to the epicenter of the current outbreak. Yei is also linked to Rasolo, a crossing point to the Garamba National Park in DRC commonly used for hunting and bush meat trading.

3. **Yambio:** Yambio is a growing urban center and important regional commercial center with a large market. Long-distance movements, especially by truck, link areas in Uganda and DRC (including Ariwara) with Yambio.

Participants share information on population mobility and priority vulnerable locations in Yei. | © IOM December 2019

4. **Nimule:** Nimule is a key urban center located on the main commercial road between Uganda and Juba, right at the border with Uganda. This is an area with significant cross-border movement for trade and healthcare, as well as long-distance movements by bus, truck and shared taxis. There is a major daily market in Nimule, two kilometres (km) from the border with Uganda.

5. **Juba:** The national capital is a key destination for long-distance movements from border areas and commercial centres in neighbouring countries, in particular Uganda, attracting both South Sudanese refugees / returnees and foreign traders. A primary bus route operates between Juba and Kampala in Uganda, while shared taxis link Juba with other towns and camps in Northern Uganda and Kenya. Juba also experiences flows from DRC, though in lesser number relative to those from Uganda and Kenya. Within South Sudan, the capital is connected with other major urban centres and is an important economic destination as well as attracting healthcare-seeking behavior.

Other locations of interest

6. **Tambura:** Important transit point for commerce at the crossroad between Yambio, Wau and the Central African Republic, with some long-distance movements from commercial centers in DRC such as Ariwara.

7. **Maridi:** Town with reported commercial and healthcare related movements with Yei and Yambio, as well as being an important centre for bush meat trade supplied by hunters operating in the Garamba forest in DRC.

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[3]The following agencies and NGOs participated to the PME held in Juba: EVD Secretariat, CDC, WHO, DFID, OCHA, WFP, CordAid, World Vision, CUAMM, REACH, Save the Children.

Yei River State Participatory Mapping Exercise: Yei, 5 December 2019

Number of participants: 43

Profiles of participants:

- County commissioners
- Paramount and Head chiefs
- Health workers
- Community representatives (including representatives from the boda boda association, women's association and media representatives)
- Humanitarian and development partners

Objectives:

- Validate and complement flow monitoring data on mobility dynamics in Yei River State
- Identify high priority POEs and points of congregation in Yei River State based on their connections with DRC, particularly outbreak affected areas, and the volume of population flows at these points

High priority Points of Entry in Yei River State

Name of POE	County Name	Connections with DRC/ outbreak affected areas	Flow of Travellers	Average Number of Weekly Screenings[4]	Nearest Health Facility	Distance from PoE
Salia Musala	Morobo	High	High	3,642	Kaya PHCC	8 km
Okaba	Morobo	High	High	1,447	Morobo PHCC	0.25 km
Bazi	Morobo	High	High	1,514	Rodoba PHCU	0.5 km
Kaya	Morobo	High	High	3,399	Kaya PHCC	1 km
Lasu (Libogo)	Yei	High	Low	79	Lasu PHCC	1 km
Tokori	Yei	High	Low	114	Tokori PHCU	0.25 km

In addition to the above POEs, **Nyei village** in Morobo county was identified as an important convergence point for travellers moving on secondary roads (known as "panya") from across the border in DRC to other destinations. It is in close proximity to the former POE in Isebi and sees heavy flows on market days as multiple routes connect through Nyei.

[4]EVD POE screening data, Week 47
[5]Average daily volume of patients at each health facility should be verified with South Sudan's Ministry of Health

High priority Points of Congregation in Yei River State

Points of congregation are gathering places within a community, where travelers interact with each other and the local community. Participants identified health facilities and markets as key congregation points to target for EVD preparedness, given the cross-border links between DRC and Yei River State for both commmerce and healthcare. While there are no significant connections between EVD affected areas and health facilities in Yei River State, participants noted the importance of prioritizing health facilities given the critical need to rehabilitate/reinforce the capacity of health facilities and considering healthcare-related movements from towns in DRC on the border with South Sudan.

Health facilities:

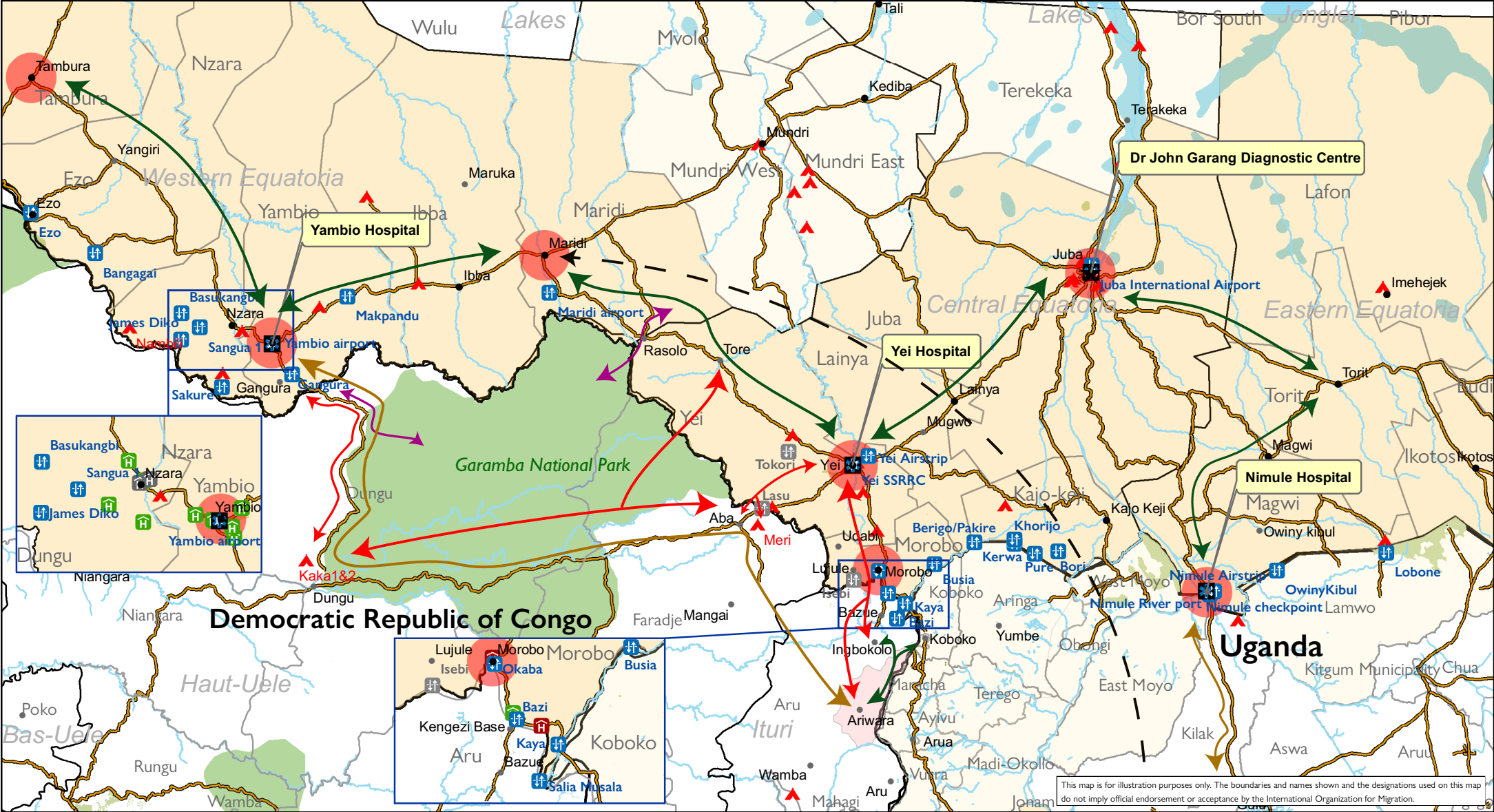| Name of Health Facility	County Name	Connections with DRC	Flow of Travellers[5]
Yei Hospital	Yei	Medium/Low	High
Lasu PHCC	Yei	High	High
Tore PHCC	Yei	Medium/Low	High
Tokori/Kirikwa PHCU	Yei	Medium	High
Rodoba PHCU	Morobo	High	High
Morobo PHCC	Morobo	High	High
Lainya PHCC	Lainya	Low	High

Markets:

Name of Market	Connections with DRC/ outbreak affected areas	Flow of Travellers	Market Days	Day with Higher Flows	Estimated Volume of Flow (High Flow Day)
Morobo	High	High	Monday, Thursday	Monday	>1000
Ombasi	High	High	Tuesday, Thursday, Saturday	Saturday	>700
Mugwo	High	High	Wednesday, Saturday	Saturday	500 – 1000
Mitika	High	High	Wednesday, Saturday	Wednesday	>600
Udabi	High	Medium	Monday, Saturday	Saturday	>400
Mapoko	High	Medium	Wednesday, Saturday	Saturday	400 – 500

Feedback from PME participants

- Participants at the national level strongly agreed that insights from the exercise will be helpful to inform preparedness measures. A key recommendation is to focus these exercises at the state-level.
- Awareness raising events can complement PMEs in high risk states.

PARTICIPATORY MAPPING OF POPULATION MOBILITY: Mobility Corridors and High Priority Locations

National-level (Juba, December 3, 2019) and Yei River State (Yei, December 5, 2019)
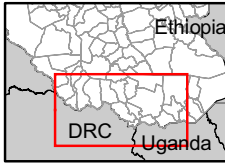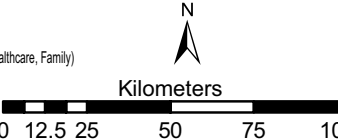
Source: IOM, WFP, OCHA, WHO, MoH, UNHCR, OSM, Participatory Mapping Exercises (December 3-5, 2019)

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Available Information/Information Collected from Partners

★ National Capital
● County Capital
○ Large Town/Locality in Bordering Country
International Boundary
National Adm 1
National Adm 2

Health Facility Status
H Functional
H Non-Functional
H Unknown
▲ IDP/Refugee Camp
Primary Road
River

Isolation Unit
Functional POE
Temporarily Suspended POE

Lakes and Marshland

Preparedness Priority Levels
Preparedness Priority Level 1
Preparedness Priority Level 2

Affected Health Zones (DRC)
Number of days since last reported case
<21
42
>42

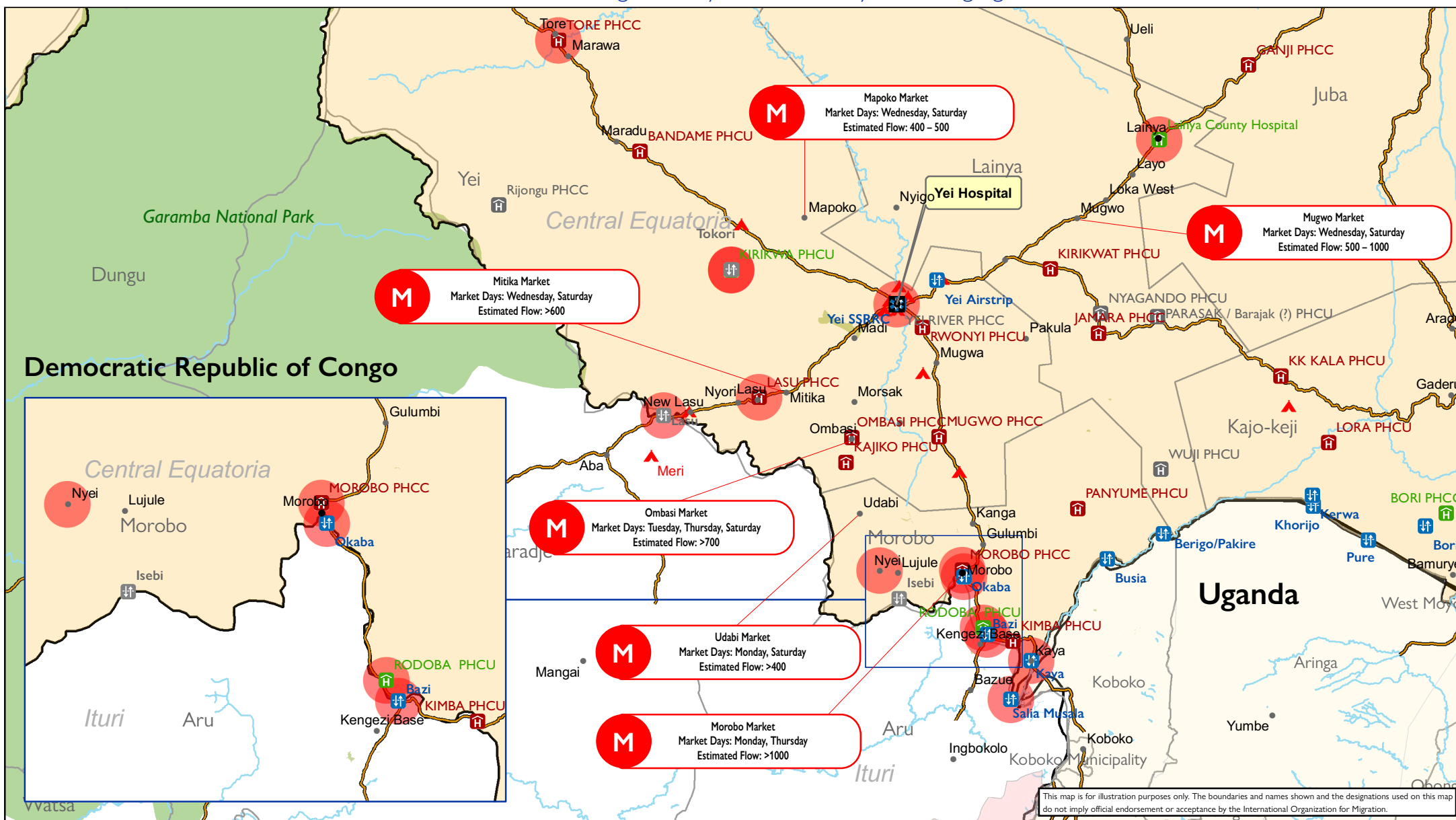**Mobility Information Collected Through Participatory Mapping**

● High priority location
Movement for Bush meat/Hunting
Refugee Movements (Returns, Healthcare, Family)
Commercial/Trade Movements
Long-distance Movements (Truck/Bus)
Aerial movement (from Kampala)

Kilometers
0 12.5 25 50 75 100

Mapoko Market
Market Days: Wednesday, Saturday
Estimated Flow: 400 – 500

Mugwo Market
Market Days: Wednesday, Saturday
Estimated Flow: 500 – 1000

Mitika Market
Market Days: Wednesday, Saturday
Estimated Flow: >600

Ombasi Market
Market Days: Tuesday, Thursday, Saturday
Estimated Flow: >700

Udabi Market
Market Days: Monday, Saturday
Estimated Flow: >400

Morobo Market
Market Days: Monday, Thursday
Estimated Flow: >1000

Democratic Republic of Congo

Central Equatoria

Garamba National Park

Uganda

Yei Hospital

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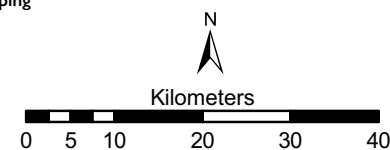
Available Information/Information Collected from Partners

★ National Capital
● County Capital
● Large Town/Locality in Bordering Country
▭ International Boundary
▭ South Sudan Adm 1
▭ South Sudan Adm 2

Isolation Unit
Health Facility Status
Functional
Non-Functional
Unknown

Functional POE
Temporarily Suspended POE
▲ IDP/Refugee Camp
Primary Road
River

Lakes and Marshland

Preparedness Priority Levels
Preparedness Priority Level 1
Preparedness Priority Level 2

Affected Health Zones (DRC)
Number of days since last reported case
<21
42
>42

Mobility Information Collected Through Participatory Mapping

High priority POE/Health Facility
M High priority Market

Kilometers
0 5 10 20 30 40

Source: IOM, WFP, OCHA, WHO, MoH, UNHCR, OSM, Participatory Mapping Exercises (December 3-5, 2019)

CONCLUSION AND RECOMMENDATIONS

Information from IOM's PMM has been shared with South Sudan's Ministry of Health and preparedness partners to help inform the EVD strategic planning workshop for 2020, held from 11 to 12 December 2019. The results of this exercise contribute to a better understanding of the dynamics and characteristics of population mobility between DRC and South Sudan, and facilitates the prioritization of POEs and congregation points in South Sudan for the implementation of public health measures in line with the International Health Regulations (IHR 2005).

While South Sudan has important cross-border links with DRC associated with trade, healthcare-seeking behaviour and movements of refugees and returnees, no significant long-distance movements from the epicenter of the outbreak in North Kivu province, DRC, have been reported. Movements from affected areas, based on findings from both PMEs and flow monitoring data, are primarily from the nearby locality of Ariwara, in DRC, which reported 1 case in July 2019[6], and limited movements have been reported from Bunia.

While active transmission remains ongoing in DRC, preparedness measures should continue – and where appropriate be reinforced – in South Sudan at high priority locations, taking into account the risks of transmission associated with population mobility, local capacities and security constraints. Security issues, in particular, pose a challenge to preparedness efforts in South Sudan and constitute a major risk to the response in DRC, complicating efforts to contain the outbreak.

Specific recommendations based on mapping results include:

- **Border health and POEs**: Six POEs in Yei River State (Salia Musala, Okaba, Bazi, Kaya, Lasu and Tokori) have been prioritized for the implementation of the minimum package for POEs, including surveillance activities and support for appropriate referral mechanisms.

- **Infection Prevention and Control/Water, Sanitation and Hygiene (IPC/WASH)**: Six Markets, six POEs and seven health facilities have been prioritized in Yei River State for consideration by the IPC/WASH technical working group for the reinforcement of WASH interventions. After the phasing out of most POEs during the transition phase, support to the nearby health facilities will be crucial to sustain EVD preparedness efforts and contribute to health system strengthening.

- **Risk communication and community engagement**: Six POEs and six markets have been prioritized in Yei River State for risk communication and community engagement activities, including hygiene promotion, and will be integrated into existing activities as part of the transition phase.

- **Support to health facilities:** The functionality of health facilities remains in question and should be verified. The seven health facilities that have been prioritized in Yei River State should be assessed for any required support, and health facilities should be prioritized and assessed for support at the high priority locations identified through the national-level PME. In general, support to health facilities should be prioritized during the transition phase as POEs are phased out and in order to contribute to health system strengthening. This is particularly the case for health facilities that have been receiving support only through EVD preparedness programs.

- **Priority cross-border populations:** While long-distance movements from DRC are limited, truck drivers have been identified as a priority target population for health screening and risk communication. Yambio (through Gangura POE), Kaya and Nimule are important convergence points for such movements. Since the most common mode of transport for cross-border movements are boda bodas (motorbike taxis), boda boda drivers should also be targeted with risk communication.

Implementation of the above prioritization and recommendations should be conditional on there being appropriate security conditions for preparedness activities. In November 2019 IOM suspended its operations in Lasu and Tokori as a result of access constraints due to a local escalation in the conflict.

[6]Ebola Virus Disease Democratic Republic of Congo, WHO External Situation Report 48, 02 July 2019

IOM February 2020