Weekly Review

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Protecting South Sudan from the Ebola Virus Disease: Policy Implications

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1   Introduction

The Ebola Virus Disease (EVD) has recently resurfaced in Uganda, threatening the Eastern and Central African regions. In September 2022, EVD was declared in Mubende District, Uganda. Of the 36 cases detected so far, 23 of them have died, a 64% case fatality rate. Although the EVD is rare, it is severe and often kills[1]. The EVD has since the 1970s been on and off in the two regions, extending to West Africa in 2013, where it killed over ten (10) thousand people, the severest the world has so far witnessed (Ohimain & Silas-Olu, 2021). But the first EVD outbreak occurred both in the Sudan and DRC in 1976, with case fatality rates ranging from 53% in the Sudan to 88% in the DRC. In over 40 years since its first recognition, Africa has registered 34 EVD outbreaks in eleven countries, resulting in 34,356 infections and 14,823 fatalities (Rugarabamu, et al., 2020). The EVD is transmitted to people from wild animals/birds and spreads in the human population through human-to-human transmission (Goldstein et al., 2018; Leendertz, 2016). Key transmission modes include contaminated objects, blood or other bodily fluids, sex, and exposure to a sick or dead person.

In the aftermath of the EVD outbreak in the Republic of Uganda, the threat of cross-border spread to the neighboring countries, such as South Sudan, has been elevated from "high" to "very high." As a result, South Sudan has been re-classified as a priority country for the EVD prevention and preparedness. South Sudan faces an elevated risk due to its fragile health systems, porous borders, sociocultural and traditional beliefs, and socioeconomic inadequacies. Fortunately, there has not been any infection reported in South Sudan in recent times.

Drawing from the Second Round of the EVD Knowledge, Attitudes, and Practices (KAP) assessment conducted in South Sudan in 2019, this *Weekly Review* highlights the implications of the recent EVD events on South Sudan. We focus attention on key risk areas, namely

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[1] https://www.paho.org/en/topics/ebola-virus-disease

general awareness on infection sources, symptoms/signs, transmission modes, and how these outcomes vary by place (i.e., county) and sociodemographic factors (i.e., education, gender, age, and religion). Understanding people's knowledge on the above and its relation to one's residence and sociodemographic factors helps us better inform the Ministry of Health's preparedness and readiness to respond to a potential EVD outbreak.

2   EVD knowledge, attitudes, and practices in South Sudan

Tables 1- 4 present knowledge on EVD in South Sudan. The results (produced by the authors) are based on the 2019 KAP assessment (N=1015) conducted in ten counties considered high-risk areas in South Sudan. The assessment followed public health campaigns in some of the counties. Accordingly, as many as 89% of the people interviewed had ever heard or learned of the EVD before participating in the assessment; 71% believed EVD can be imported to South Sudan; 28% thought the EVD is caused by virus; and 70% thought the EVD is caused by chimpanzees, bats, or monkeys. This level of awareness appears to be associated with education, gender, and the county of residence (see Table 1). The better educated a person is the more knowledgeable about the EVD they appear. Compared to women, men are about 32% less likely to have heard of the EVD. Perhaps the level of awareness about the EVD is generally low among men compared to women and among the less educated, particularly among those residing outside major towns (Pham et al., 2022). We also notice a statistically significant difference between the residents of Juba and those in other counties, with those in Yei (3.265 times) and Lainya (7.8 times) showing greater odds of having heard of the EVD than those in Juba (see columns 1 & 4). Only the residents of Tambura and Yambio outdo Juba's residents on whether the EVD is importable (see column 3). However, the residents of Lainya, Maridi, Tambura, Wau, Torit, Yambio, and Yei are less likely to suggest that the EVD is caused by virus. Similarly, the residents of Lainya, Maridi, Morobo, Nimule, Tambura, Yambio, and Yei are more likely to suggest that the EVD is spread by wild animals/bats. No important differences between traditionalists and Christians and Muslims are observed.

Table 1. Awareness

	(1) Heard of EVD	(2) Is EVD importable to South Sudan?	(3) Virus	(4) Wild animals/bats
Education (ref = no education)				
Elementary (1 - 6)	2.639***	1.571*	1.105	1.837***
	(0.804)	(0.371)	(0.361)	(0.429)
Junior High (7 - 9)	3.128***	2.181***	2.716***	2.313***
	(1.079)	(0.558)	(0.834)	(0.582)
Senior High (10 - 12)	3.277***	2.544***	4.390***	2.044***
	(1.016)	(0.622)	(1.287)	(0.469)
Higher	10.446***	4.458***	6.338***	2.613***
	(5.432)	(1.436)	(2.048)	(0.719)
Age	0.988	0.995	1.004	0.997
	(0.009)	(0.007)	(0.007)	(0.007)
Gender (ref = female)				
Male	0.678*	0.851	1.089	0.822
	(0.155)	(0.139)	(0.177)	(0.126)
County (ref = Juba)				
Lainya	7.489*	0.436**	0.428*	7.615***
	(7.840)	(0.173)	(0.208)	(4.223)

Maridi	1.125	0.297***	0.292***	2.020*
	(0.607)	(0.112)	(0.131)	(0.757)
Morobo	0.969	0.613	0.611	5.722***
	(0.438)	(0.200)	(0.225)	(2.484)
Nimule		1.683	1.045	2.102**
		(0.716)	(0.352)	(0.790)
Tambura	0.787	2.734***	0.168***	2.428***
	(0.269)	(0.856)	(0.059)	(0.630)
Torit	0.259***	0.949	0.515*	0.496**
	(0.095)	(0.351)	(0.175)	(0.148)
Wau	0.817	1.065	0.409***	1.348
	(0.270)	(0.261)	(0.097)	(0.294)
Yambio	1.597	2.814***	0.385***	3.329***
	(0.826)	(1.102)	(0.126)	(1.153)
Yei	3.265**	0.510***	0.366***	2.743***
	(1.567)	(0.130)	(0.108)	(0.727)
Religion (ref = traditional)				
Christianity	0.968	1.433	0.792	1.285
	(0.642)	(0.742)	(0.439)	(0.634)
Islam	0.507	1.055	0.997	0.681
	(0.384)	(0.626)	(0.627)	(0.384)
Constant	5.919**	1.123	0.270**	0.774
	(4.694)	(0.676)	(0.177)	(0.451)
N	937	910	991	991
Pseudo R^2	0.111	0.097	0.143	0.073

Standard errors are in parenthesis. All estimates are in odds ratios.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Protecting against the EVD requires understanding its signs and symptoms. Thus, Table 2 presents knowledge on signs and symptoms of the EVD. The number of people knowledgeable of these signs and symptoms varies between 14.8% (stomachache) and 54.5% (muscle ache). Education and county are strongly associated with correctly identifying the EVD signs and symptoms. The odds of correctly identifying these signs and symptoms improve with a resident's level of education (columns 1-8); residents in Lainya, Maridi, Morobo, Wau, and Yei are markedly different from the Juba residents, reporting relatively lower odds. This could be a result of location differentiated public health campaigns.

Table 2. Signs and symptoms of EVD

	(1) Fever	(2) Headache	(3) Muscle pain	(4) Weakness	(5) Diarrhea	(6) Vomiting	(7) Internal bleeding	(8) Stomach pain
Education (ref = no formal education)								
Elementary (1 - 6)	1.063	1.272	0.782	0.579**	1.077	1.350	0.950	1.036
	(0.229)	(0.279)	(0.171)	(0.139)	(0.300)	(0.303)	(0.228)	(0.333)
Junior High (7 - 9)	1.485*	1.932***	0.762	1.067	1.396	1.724**	1.257	1.337
	(0.338)	(0.449)	(0.176)	(0.253)	(0.397)	(0.409)	(0.307)	(0.457)
Senior High (10 - 12)	1.428*	1.437*	0.864	0.996	1.588*	2.459***	1.759**	2.124**
	(0.308)	(0.316)	(0.188)	(0.225)	(0.433)	(0.560)	(0.405)	(0.702)
Higher	1.671**	1.561*	0.692	1.289	1.927**	2.954***	2.663***	3.230***
	(0.436)	(0.412)	(0.180)	(0.342)	(0.636)	(0.794)	(0.719)	(1.376)
Age	1.012**	1.012*	1.011*	1.008	1.017**	0.998	0.993	1.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.009)
Gender (ref = female)								
Male	0.880	0.843	1.081	1.242	0.739*	0.765*	1.123	0.976
	(0.124)	(0.120)	(0.152)	(0.184)	(0.130)	(0.111)	(0.165)	(0.202)
County (ref = Juba)								
Lainya	0.502*	0.548*	2.209*	1.100	3.281***	4.351***	1.460	34.499***
	(0.178)	(0.194)	(0.942)	(0.418)	(1.295)	(1.601)	(0.520)	(15.634)
Maridi	0.418**	0.416**	0.409***	0.900	0.961	2.029**	0.624	5.913***
	(0.143)	(0.142)	(0.139)	(0.329)	(0.460)	(0.691)	(0.226)	(2.736)
Morobo	0.247***	0.253***	0.569*	0.487*	0.594	4.784***	0.507*	15.604***
	(0.081)	(0.082)	(0.172)	(0.186)	(0.302)	(1.541)	(0.177)	(6.407)

	(1) Air	(2) Meat prep	(3) Eating meat	(4) Blood	(5) Sweat	(6) Breast milk	(7) Sex	(8) Handshake
Nimule	0.204***	0.149***	0.535*	1.062	3.251***	37.257***	4.542***	3.193**
	(0.074)	(0.057)	(0.176)	(0.364)	(1.158)	(27.527)	(1.750)	(1.584)
Tambura	1.309	1.021	0.742	1.057	1.087	0.636*	0.277***	1.177
	(0.314)	(0.242)	(0.172)	(0.257)	(0.343)	(0.163)	(0.079)	(0.591)
Torit	1.193	0.777	0.448***	0.889	1.139	0.684	0.882	4.093***
	(0.369)	(0.233)	(0.134)	(0.288)	(0.448)	(0.220)	(0.266)	(1.823)
Wau	0.508***	0.262***	0.499***	0.857	0.722	1.851***	0.563***	0.671
	(0.107)	(0.057)	(0.105)	(0.190)	(0.219)	(0.393)	(0.124)	(0.328)
Yambio	0.785	0.694	2.202**	1.730**	3.732***	1.856**	0.936	3.175***
	(0.214)	(0.190)	(0.692)	(0.479)	(1.129)	(0.508)	(0.259)	(1.396)
Yei	0.391***	0.231***	0.228***	0.522**	2.377***	2.815***	0.773	8.273***
	(0.093)	(0.058)	(0.057)	(0.144)	(0.664)	(0.673)	(0.188)	(3.012)
Religion (ref = traditional)								
Christianity	0.683	0.722	0.584	0.767	0.682	0.938	1.012	0.674
	(0.329)	(0.345)	(0.278)	(0.360)	(0.373)	(0.489)	(0.516)	(0.277)
Islam	0.644	0.818	0.758	1.292	0.820	0.699	0.890	
	(0.356)	(0.451)	(0.415)	(0.698)	(0.527)	(0.413)	(0.520)	
Constant	1.332	1.283	2.346	0.453	0.121***	0.402	0.627	0.046***
	(0.747)	(0.717)	(1.309)	(0.254)	(0.080)	(0.242)	(0.369)	(0.028)
N	989	989	989	989	989	991	991	970
Pseudo R²	0.060	0.081	0.062	0.034	0.060	0.102	0.082	0.159

Standard errors are in parenthesis. All estimates are in odds ratios.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Generally, the EVD is transmitted via direct contact with blood or other bodily fluids, including vomit, diarrhea, urine, breast milk, sweat, or semen of an infected person who has symptoms or who has recently died of the virus. Table 3 provides people's knowledge on the EVD's modes of transmission. The average number of the residents knowledgeable of key transmission modes is below 50% (bushmeat preparation=45.7%; blood=42.6%; sweat=33.6%; breastmilk = 12.6%; and sex = 18%). Education and the county of residence matter in the identification of the transmission modes. The odds of identifying the right modes increases with the level of education (i.e., 1-6 graders, compared to those who never went to school, are 1.9 times more likely to identify meat preparation as a transmission mode). All the residents of Nimule, compared to those in Juba, say the EVD is not airborne. Compared to those in Juba, the residents of the remaining areas are less likely to suggest that the EVD is transmitted via air; this is presumably a consequence of targeted campaigns in those areas, indicating the importance of risk communication in preventing or managing the virus.

Table 3. Transmission modes

	(1) Air	(2) Meat prep	(3) Eating meat	(4) Blood	(5) Sweat	(6) Breast milk	(7) Sex	(8) Handshake
Education (ref = no formal education)								
Elementary (1 - 6)	0.924	1.902***	1.281	1.053	0.968	1.025	1.042	1.358
	(0.284)	(0.414)	(0.283)	(0.236)	(0.227)	(0.353)	(0.311)	(0.426)
Junior High (7 - 9)	1.825**	1.927***	1.239	1.069	0.936	0.671	1.226	1.019
	(0.544)	(0.442)	(0.288)	(0.254)	(0.234)	(0.273)	(0.385)	(0.354)
Senior High (10 - 12)	1.886**	1.985***	1.699**	1.814***	1.679**	2.444***	2.229***	2.994***
	(0.537)	(0.435)	(0.375)	(0.403)	(0.389)	(0.812)	(0.642)	(0.894)
Higher	1.782*	1.879**	1.497	2.375***	1.540	2.310**	1.658	2.606***
	(0.578)	(0.494)	(0.398)	(0.626)	(0.423)	(0.926)	(0.571)	(0.892)
Age	1.007	0.998	1.015**	0.997	1.003	1.011	1.006	1.003
	(0.008)	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.008)	(0.008)
Gender (ref = female)								
Male	0.774	1.033	1.240	1.051	1.029	0.816	1.108	1.063
	(0.138)	(0.144)	(0.176)	(0.151)	(0.153)	(0.174)	(0.198)	(0.189)
County (ref = Juba)								

Lainya	0.364**	4.267***	7.017***	2.662***	2.930***	12.105***	4.960***	2.885***
	(0.174)	(1.601)	(3.005)	(0.967)	(1.059)	(4.995)	(1.880)	(1.133)
Maridi	0.468*	1.683	1.693	0.757	0.382**	2.594**	0.737	1.071
	(0.184)	(0.570)	(0.575)	(0.262)	(0.159)	(1.141)	(0.351)	(0.465)
Morobo	0.103***	4.214***	2.030**	1.232	1.468	2.507**	1.836*	1.218
	(0.063)	(1.362)	(0.620)	(0.374)	(0.450)	(1.074)	(0.668)	(0.486)
Nimule		3.007***	3.718***	9.665***	2.779***	2.109*	1.450	2.308**
		(1.024)	(1.307)	(4.804)	(0.952)	(0.886)	(0.549)	(0.822)
Tambura	0.242***	1.692**	1.239	0.546**	0.567**	0.459*	0.456**	0.411**
	(0.077)	(0.393)	(0.290)	(0.133)	(0.143)	(0.217)	(0.170)	(0.153)
Torit	1.029	0.605	0.373***	0.782	0.448**	1.201	0.727	1.575
	(0.314)	(0.199)	(0.139)	(0.236)	(0.154)	(0.527)	(0.304)	(0.539)
Wau	0.132***	1.260	0.810	0.580**	0.449***	0.560	0.835	0.941
	(0.044)	(0.266)	(0.177)	(0.126)	(0.106)	(0.214)	(0.229)	(0.247)
Yambio	0.218***	1.412	1.552	0.352***	0.207***	0.132**	0.427*	0.406*
	(0.084)	(0.385)	(0.425)	(0.110)	(0.083)	(0.136)	(0.196)	(0.187)
Yei	0.321***	1.702**	2.265***	0.913	1.145	1.446	1.482	0.747
	(0.095)	(0.400)	(0.533)	(0.215)	(0.273)	(0.518)	(0.425)	(0.246)
Religion (ref = traditional)								
Christianity	1.215	0.837	1.350	1.803	1.433	0.552	1.684	1.127
	(0.815)	(0.397)	(0.678)	(0.965)	(0.778)	(0.366)	(1.286)	(0.731)
Islam	2.134	1.368	0.956	1.433	1.020	0.225*	1.918	0.516
	(1.600)	(0.746)	(0.553)	(0.870)	(0.641)	(0.202)	(1.599)	(0.403)
Constant	0.300	0.394*	0.171***	0.371	0.319*	0.114***	0.068***	0.104***
	(0.228)	(0.220)	(0.101)	(0.226)	(0.199)	(0.089)	(0.058)	(0.077)
N	946	991	991	991	991	991	991	991
Pseudo R²	0.120	0.048	0.069	0.080	0.075	0.121	0.057	0.073

Standard errors are in parenthesis. All estimates are in odds ratios.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 4 presents who the residents think is an influential authority on the management of the EVD. Government (80%), local organizations (25%), and communities (21%) are considered the most influential authorities. The most educated, those who have attained high school or higher, are more likely to regard communities, government, and local organizations as influential in the fight against the EVD. Unlike women, men are 35% less likely to suggest the government is influential, but what underlies this gender difference remains unclear. The influence of these institutions varies significantly across counties. For example, the residents of Lainya compared to Juba, are less likely to suggest that communities and aid organizations are influential, and 2.74 times more likely to suggest that religious leaders are influential. Being a Christian or Muslim reduces one's belief in communities' influence. Christianity, however, increases one's view of suggesting that the government is influential.

Table 4. Perceived influential authority on management of EVD

	(1) Communities	(2) Government	(3) Aid orgs	(4) Local orgs	(5) Religious leaders
Education (ref = no formal education)					
Elementary (1 - 6)	0.919	1.057	0.937	1.189	1.126
	(0.265)	(0.265)	(0.276)	(0.322)	(0.306)
Junior High (7 - 9)	1.271	1.281	1.120	1.535	1.170
	(0.365)	(0.352)	(0.330)	(0.419)	(0.341)
Senior High (10 - 12)	1.445	1.612*	1.406	1.790**	1.513
	(0.390)	(0.427)	(0.394)	(0.463)	(0.406)
Higher	1.788*	1.895*	1.404	1.698*	1.410
	(0.545)	(0.639)	(0.459)	(0.513)	(0.479)
Age	1.013*	0.997	0.999	1.009	1.021***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)
Gender (ref = female)					
Male	1.070	0.650**	0.826	1.017	0.994
	(0.181)	(0.116)	(0.145)	(0.163)	(0.177)
County (ref = Juba)					

	(1)	(2)	(3)	(4)	(5)
Lainya	0.138***	1.525	0.330**	0.536	2.714**
	(0.104)	(0.800)	(0.184)	(0.256)	(1.069)
Maridi	0.837	0.443**	0.322**	0.720	4.717***
	(0.328)	(0.174)	(0.161)	(0.304)	(1.700)
Morobo	0.761	0.153***	0.329**	0.241***	0.543
	(0.277)	(0.051)	(0.152)	(0.131)	(0.276)
Nimule	0.739	3.759*	0.505	2.546***	2.067*
	(0.279)	(2.825)	(0.211)	(0.849)	(0.773)
Tambura	0.231***	0.764	0.350***	0.334***	2.074***
	(0.085)	(0.231)	(0.113)	(0.114)	(0.574)
Torit	1.088	0.603	0.218***	0.978	0.970
	(0.350)	(0.225)	(0.107)	(0.328)	(0.395)
Wau	0.601**	0.550**	0.215***	1.028	0.524**
	(0.147)	(0.145)	(0.071)	(0.240)	(0.172)
Yambio	0.380**	1.530	1.574	1.553	0.165**
	(0.146)	(0.674)	(0.446)	(0.449)	(0.122)
Yei	0.506**	0.644	0.691	1.370	2.141***
	(0.149)	(0.188)	(0.192)	(0.349)	(0.596)
Religion (ref = traditional)					
Christianity	0.369**	2.528*	0.882	0.610	0.599
	(0.178)	(1.214)	(0.576)	(0.303)	(0.313)
Islam	0.366*	1.475	1.045	0.384	0.629
	(0.210)	(0.833)	(0.770)	(0.230)	(0.401)
Constant	0.531	2.584	0.434	0.291**	0.120***
	(0.312)	(1.555)	(0.326)	(0.173)	(0.077)
N	992	992	992	992	992
Pseudo R^2	0.057	0.083	0.071	0.055	0.082

Standard errors are in parenthesis. All estimates are in odds ratios.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

3 Lessons learned and next steps

Based on the above, community engagement is key to successfully controlling outbreaks, which is aided through robust awareness. But as the estimates illuminate, people's knowledge on key aspects of the virus remains relatively low in South Sudan. With the emergence of COVID-19, limited attention has been given to other emergencies, suspecting that the level of the EVD knowledge observed in 2019 in South Sudan might have in fact been lost and ought to be immediately revamped.

To prepare for an eventual outbreak of the EVD epidemic in South Sudan, the government of South Sudan, in conjunction with the health partners, is expected to heighten its preparedness and response activities. One of the key pillars of preparedness and response during a disease outbreak is risk communication and community engagement to provide timely and accurate messages, encourage positive health seeking behaviors, address community concerns and rumors that may impact on the control of the outbreak, and raise risk perception and adopt protective behaviors by encouraging people to promptly seek medical care if they experience signs and symptoms associated with the disease. Moreover, a comprehensive strategy and deliberate measures under the Ministry of Health, with support from relevant institutions, such as the ministries of Defense, Interior, and Trade, could be adopted to prevent an EVD outbreak in South Sudan.

To revamp this knowledge and to enhance government's preparedness, new data are required. Insights from these new data can be used to strengthen behavioral and communication interventions for the EVD response in South Sudan. Thus, additional

formative/follow-up research on the EVD knowledge, attitude, practice, and risk perception should be immediately undertaken in specific high-risk counties.

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About Sudd Institute

The Sudd Institute is an independent research organization that conducts and facilitates policy relevant research and training to inform public policy and practice, to create opportunities for discussion and debate, and to improve analytical capacity in South Sudan. The Sudd Institute's intention is to significantly improve the quality, impact, and accountability of local, national, and international policy- and decision-making in South Sudan to promote a more peaceful, just, and prosperous society.

Authors' Biography

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