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Supplementary file 5 – Learning at the central, regional and district levels during the response to outbreaks in Guinea, 2014 -2021.

(NB: for the central level, all the quotes are from the ANSS representative, a male; all regional health inspectors (RHIs) in Guinea were male at the time of the study)

Learning dimension	Learning aspect	Description and illustrative quotes		
		Central level	**Regional level**	**District level**
Levels	Individual	The ANSS staff has learned through data collection, compilation and interpretation and gained tacit knowledge through experience and interpretation of these knowledge inputs. *"I managed databases, some of which I designed; I coordinated data collection, compilation and interpretation activities at the devolved levels; prepared reports for decision-makers."*	RHIs have learned through diverse ways such as across the process of data collection, analysis and interpretation; across experience; and outbreak alert, investigation and response. *"During the responses to Ebola disease [2014-16], Lassa fever and COVID-19 outbreaks in my region, I have learned through data entry, production of tables and graphs, interpretation and follow-up of contacts, production of databases for cases and contacts."* (RHI #2) *"In my region during the response to COVID-19, I have learned community engagement's importance."* (RHI #1)	District medical officers (DMOs) or their team members have learned across data collection, and gained tacit knowledge through experience and interpretation of these knowledge inputs. *"We determined the target according to the Measles and Polio notified cases; ordered target vaccines, set micro-planning, mobilised and trained staff."* (DMO, male #6)
	Team	o Learning at the team level took place across meetings for data harmonisation and committees to elaborate epidemiological situation reports**.**	o In some health regions (3/5), epidemiological surveillance data were first interpreted by an individual (the one tasked with epidemiological surveillance), then by the team during either crisis, daily or weekly coordination meetings. o In others (2/5), data were interpreted by the regional team for health, led by the person in charge of epidemiological surveillance. o In either scheme, the team interpreted data and shared a common understanding of issues, and collectively found approaches to address them.	o In most health districts (9/13), information was at once interpreted by the district health management teams (DHMTs). o Only in a few health districts that an individual (the data manager or the responsible for epidemiological surveillance) perform the preliminary interpretation before the team interpretation for a shared understanding of issues to find tackling ways. o The data manager or the responsible for epidemiological surveillance interpreted data daily and made a daily synthesis. *"The interpreted data are discussed during weekly coordination meetings and through the development of a newsletter."* (DMO, male #3)

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Organisation/ cross-organisation	o The ANSS integrated the routine learning process by establishing guidelines (and situation reports) taught during the Field Epidemiology Training Programme (FETP) and formulation of verbal recommendations during meetings for epidemiological information. o Learning was institutionalised by applying integrated learning regularly to bring about improvements throughout the ANSS and by sharing/transmitting integrated and institutionalised learning to all the ANSS teams, including the local governing bodies. o Learning was also institutionalised through the FETP by the elaboration of normative documents. o Learning that took place through others' experiences (partners) was applied by putting in place several mechanisms, such as Public Health Emergency Operation Centre (COU-SP), Prefectural Epidemic Alert and Response Team (EPARE), Communal Epidemic Alert and Response Team (ECARE), Regional Epidemic Alert and Response Team (ERARE), Rapid Response Teams for Immunisation (EIRaV), Epidemiological Treatment Centre (CT-Epi) and a training unit.	o The RHIs integrated learning generated by interpreting knowledge as a routine practice through formalising rules and procedures, elaborating guidelines, and making verbal recommendations. For instance, they set guidelines for using rapid diagnostic tests, constantly reviewed and simulated ERARE operations, and developed contingency and district intervention plans. o They reported that the integrated learning was institutionalised along the different epidemics. o An RHI asserted that to ensure that learning is institutionalised, they trained health professionals on procedures and guidelines developed and monitored them in the field. *"After training, we performed a post-training follow-up of agents in the field."* (RHI #4) o Others reported that learning that was applied regularly to bring about improvements throughout the region, was also shared with peers. *"We shared procedures and guidelines developed about outbreak surveillance and response with regional peer directors of health."* (RHI #3) o The RHIs have learned the epidemiological surveillance, investigation, prevention, management of cases, social mobilisation and rapid response to outbreaks from partners. o They applied what they learned from peers or partners by upgrading teams and deploying the gained knowledge in the field.	DHMTs integrated learning generated by interpreting knowledge as a routine practice through formalising rules and procedures, elaborating guidelines, and making verbal recommendations. *"After analysing this information, rules and procedures are defined in order to improve the shortcomings identified in the outbreak surveillance process."* (DMO, male #1) Most DMOs (9/13) reported that the integrated learning was institutionalised along the different epidemics, the majority of which (7/9) applied the integrated learning to drive improvements in the health districts. *"In the health district, thanks to supporting from the ANSS, two health workers were trained as field epidemiologists. The weekly surveillance bulletin is produced to respond effectively in case of an outbreak."* (DMO, male #1) *"When we take the infection control and prevention, the guidelines document is available in all health facilities. We train healthcare workers, and then we assess them regularly to maintain best practices."* (DMO, female #12) The remaining DMOs reported that, beyond applying the integrated learning to drive improvements in their health districts, they shared or transmitted the integrated and institutionalised learning with/to peers (other DMOs) or other organisations. *"We hold regular cross-border meetings with Sierra Leone where experiences are shared."* (DMO, male #7) DMOs have learned the epidemiological surveillance, the "one health" concept, the importance of collaboration, the use of DHIS2, contact tracing and investigation, prevention, management of cases, social mobilisation and

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					rapid response to outbreaks from partners, e.g. CDC, WHO, Unicef and Amref Health Africa.
					"We have learned a lot with support from partners. For example, regarding Ebola, we did not know many things, but thanks to the WHO and CDC, we learned how to map contacts, do contact tracing, and develop a situation report. It was new for us; it was a new epidemic." (DMO, female #10)
					"We have acquired skills in outbreak response, especially in the investigation, thanks to the WHO's transfer of expertise and experience." (DMO, female #11)
					They applied what they learned from peers or partners by deploying the gained knowledge in the field or during future outbreaks.
					"What we have learned during Ebola, we applied it locally during COVID-19. We put it into practice through weekly meetings, contact tracing, entering data into the DHIS2, producing situation reports." (DMO, female #10)
Means	Information	o ANSS sources of information in response to different outbreaks were paper-based reports and the district health information system (DHIS2). o The frequency of information transmission from the field to ANSS was daily and weekly. o The collection, processing, use and dissemination of information enabled the ANSS to measure the success and failure: *"we monitor trends."* o Learning through information enabled the ANSS to anticipate trends and discover new approaches to solving the problems encountered, as reported.		The RHIs have learned through information. The sources of information of health regions during the response to different outbreaks were paper-based reports and DHIS2. Usually, information transmission from health districts to the regions includes phone calls and emails. *"The health districts call the region as soon as there is a suspected case and send by email the summary of the investigation and the reports. The case is entered in the template designed for this purpose."* (RHI #2) *"The daily reports and the DHIS2 informed us about the indicators in our region."* (RHI #1) The frequency of information transmission from health districts to regions is daily, weekly or monthly, depending on circumstances and the type of information.	DHMTs have learned through information. The sources of information for health districts during the response to different outbreaks were paper-based reports, DHIS2, community feedback and research data. Information was conveyed from the field/health centres to DHMTs through calls and emails. *"We learn through analysis of reports sent by health centres, information collected in the community, and primary data collected during household surveys."* (DMO, male #4) The frequency of information transmission to DHMTs is daily, weekly or monthly, depending on circumstances and the type of information. *"During an outbreak, as soon as the community liaison officer is informed of a case of illness or death, he reports the information directly to his*

			"Reporting is daily for all suspected and positive cases and even instantaneous; Situation reports are daily, epidemiological surveillance reports are weekly, DHIS2 reports are monthly." (RHI #2) The collection, processing and use of information have enabled the RHIs to measure outbreak response success and failure by monitoring performance indicators. *"We monitor the incidence of the disease, the case fatality rate, the spread and contacts."* (RHI #2) *"We review the trends of the epidemic curve to examine whether they are decreasing or increasing."* (RHI #5) Learning through information enabled RHIs to anticipate trends and discover new approaches to solving problems. *"As soon as you see the alert threshold is reached, you go down to investigate on the ground with the epidemic team."* (RHI #5) *"It allowed adapting awareness messages to the population."* (RHI #3)	*health centre manager, who in turn reports the information to the district health management team, which reacts directly by sending a team to the field. However, when there are no outbreaks, reports are made every weekly."* (DMO, female #10) *"Transmission is daily for notifiable disease data and weekly for epidemic thresholds, to monitor weekly trends."* (DMO, female #2) The collection, processing, analysis and interpretation of information did not allow DHMTs to measure the success and failure of the response; however, it enabled them to anticipate trends and find new approaches of solving problems. *"For example, for the COVID-19 vaccination, thanks to the data, we were able to identify the poorly vaccinated areas and increased awareness in these areas to mobilise the population to come and get vaccinated."* (DMO, female #13) *"The information reported was not only about the disease but also cases of reluctance. When we had to go to a locality and were informed that there was reluctance, we took measures to manage these cases. We used lobbying strategies, for example. If there is a native of this locality in the city centre here or Conakry, we will go through him to help sensitise the locality."* (DMO, female #10)
	Deliberation	o The processes of dialogue and reflection to link past actions, the effectiveness or impact of those actions, and future actions were made through team meetings and conferences (face-to-face or online). *"We organised weekly epidemiological briefings and*	The RHIs have learned through various deliberation acts: - Team meeting (all the regions): daily staff meetings - Peer and non-peer engagements, including consultations with stakeholders, engagement with multisectoral coordination and authorities at all levels (3/5 regions)	DHMTs have learned through various deliberation acts: - Team meeting (all the districts): daily staff meetings - Peer and non-peer engagements, including consultations with stakeholders, engagement with multisectoral coordination and authorities at all levels (7/13 districts) - Research collaborations (3/13 districts)

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			strategic epidemic response committee meetings.”	- Research collaborations (2/5 regions) - Conferences (2/5 regions)	- Conferences (5/13 districts) *“After noticing the reluctance of the population to apply barrier measures, to be tested and to accept their results when they were positive, we started to organise community meetings to include all community actors in the response.”* (DMO, female #13) Some deliberations, including peers and non-peers, took place outside health districts. *“After the outbreak, UNICEF brought us together to learn from the response. What worked and why? Is it because we used this strategy? The other one did not work because we did not use that strategy. So we have drawn lessons. This workshop which brought together all those who participated in the Ebola response [2014-16], took place in Kindia.”* (DMO, female #10)
	Action	o Learning produced through actions and practice has been repeated and ended up with guidelines elaboration. *“We adapted newsletters and situation reports plans.”* o Learning through actions was shared with other actors within and outside the ANSS. o However, learning generated by the stakeholder consultations has not been captured and codified (translated) into information for future application.	Learning was produced through iteration of tasks (4/5 regions), then specific technical sheets (guidelines) were developed and routinely followed in practice (4/5 regions). o Learning through actions was shared with other actors within and outside the health regions. *“We share learning through action with multisectoral coordination and the hierarchy.”* (RHI #2) *“We share learning through action via online conferences.”* (RHI #3) o Some RHIs (2/5) reported having captured and codified (translated) learning generated by the stakeholder consultations into information for future application. *“We translated lessons learned from the responses to outbreaks into information to tackle future outbreaks effectively.”*	DMOs learned through repetition of tasks (13/13 districts) and projects (5/13 districts) and codified information into guidelines (9/13 districts) *"Every time we wanted to carry out a response activity in a locality, we organised community-based meetings beforehand to be accompanied by all the community players."* (DMO, female #13) *"In our health district, there were projects born after the COVID-19 epidemic based on lessons learned from the response and supported by IOM and other partners. These projects were born because we learned that there were weaknesses in surveillance before the epidemic."* (DMO, female #10) A few DMOs (2/13) shared learning produced through action with other actors within and outside the health districts in diverse ways, such as information meetings and educational talks in health facilities or places of worship.

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			o Some RHIs (2/5) asserted to have taken advantage of "District.Team" experience to respond to outbreaks in their regions. *"Yes, especially in terms of engagement with the different actors."* (RHI #1) *"We trained some young people online who were very active in the outbreak response."* (RHI #2)	*"We shared our experience with the other district health managers during meetings; for example, we carried out a COVID-19 vaccination campaign strategy targeting mosques, churches and big crossroads. Moreover, many have copied this and adapted it in their areas of intervention to achieve a result like ours."* (DMO, female #12) *"The community-based meetings approach was developed and put into practice by us, and we shared it with the other district health management teams."* (DMO, female #13) Some DMOs (4/13) reported having captured and codified (translated) learning generated by the stakeholder consultations into information for future application. *"When we code our weekly results, we put this information into a report with recommendations for future application."* (DMO, female #11) *"If the follow-up of contacts was reserved for only the district health management team in the past, after the training, we decentralised it; we trained the actors at the base. Every time there was a suspected case, they managed it, and we only came for supervision."* (DMO, female #10) Some DMOs (6/13) asserted to have taken advantage of "District.Team" experience to respond to outbreaks in their districts. *"We have learned from District.Team an experience of good collaboration and sharing, which we implement in outbreak response."* (DMO, female #13) *"In our district, we implemented a corollary experience that has benefited the district in the context of maternal deaths."* (DMO, male #4)

Loops	Single loop	o Everyday routines and practices in terms of outbreak response within the ANSS were adjusted by adapting the integrated disease surveillance and response (IDSR) guide to national needs and developing the concepts of operations (ERARE/EPARE/ECARE employment guide and COU-SP guide).	o The regional health teams adjusted normal routines and practices in epidemic response. o Some examples of how they performed corrections or adjustments were applying guidelines from the central level, training, activation of the emergency operations centre in response mode, Handwashing and infection control and prevention (ICP) compliance.	Customary routines and practices in outbreak response were adjusted within the DHMTs. Some examples of how they performed corrections or adjustments in regular actions and routines were adapting the integrated disease surveillance and response (IDSR) guide to the national context, routine vaccination, investigations, contact identification and tracking, and effective communication. *"At the very beginning of the Public Health Emergency Operation Centre's meetings, there was a lack of analytical and interpretative capacity. Over time, there were better organised and more problem-specific recommendations to solve."* (DMO, male #7) *"Each case was treated differently, but we knew what to do when we came across a case we had already encountered. For Ebola and COVID-19, for example, we targeted water points near the home of a confirmed case, and all those who came to draw water were considered contact cases. This new approach allowed us to quickly identify contact cases, most of whom tested positive."* (DMO, female #13)
	Double loop	o During the response to outbreaks, assumptions around problems encountered have been questioned to find the underlying root causes. *"We conducted a survey on persistence factors in measles outbreaks in 2017."* o Assumptions around solutions to the problems were questioned, and the correction plan to the identified factors was developed. Assumptions about the problems and their solutions have been tested.	o Double-loop learning occurred in health regions; however, only one health region fully implemented this aspect of learning. o The RHIs reported having questioned assumptions to the problems encountered to find the underlying root causes. In some cases, assumptions about the problems and their solutions were tested. *"During Ebola disease (2014-16), COVID-19 and measles outbreaks in my region, we questioned communities' belief in false rumours."* (RHI #3) *"In the course of outbreak investigations, assumptions are made and verified."* (RHI #4)	Double-loop learning occurred in health districts. Almost all DMOs reported having questioned assumptions around the problems encountered. *" Each problem encountered during the various activities was analysed in-depth to see the possible underlying causes, and we tried to find hypotheses for solving that problem. For example, regarding the COVID-19 vaccination, the craze at the vaccination sites was due to political pressure because as soon as this stopped, attendance dropped. We set up mobile teams and conducted awareness campaigns in mosques and churches to mobilise*

		"We observed a decrease in measles cases in locations where the plan has been implemented." o Learning through hypothesis testing has influenced practices and frameworks, leading to changes in objectives and approaches. *"We adapted the content of the Field Epidemiology Training Programme."*	o Then, only one director questioned assumptions around solutions to problems. *"We interpreted solutions to problems."* (RHI #5) o In contrast, the other directors did not question solutions; they were limited to questioning problems. o In some regions (3/5) and in some cases, assumptions about the problems and their solutions were tested. *"For instance, regarding the Lassa fever in my region, we formulated many hypotheses and verified; in the end, it was an isolated case of Lassa fever. (RHI #2)* o In some regions (2/5), learning through hypothesis testing has influenced practices, frameworks and models, leading to changes in objectives and approaches. *"We changed response strategies to outbreaks over time by adapting response plans."* (RHI #3)	*communities to get vaccinated."* (DMO, female #12) *"During COVID-19 in our health district, contact cases were giving wrong information; this was due to the stigmatisation of Covid cases by communities."* (DMO, male #9) However, not all assumptions around problems were questioned during responses to outbreaks in health districts. Most DMOs (10/13) asserted to have questioned assumptions about solutions to the problems. *"In our health district, having more than 70% of children who had measles because they were not vaccinated made us question the vaccination coverage that the centres send each month through their activity reports."* (DMO, male #4) In most health districts (9/13), assumptions about the problems and their solutions were tested. *"We hypothesised that if more than 95% of children are actually vaccinated measles will have been prevented, which was the case."* (DMO, male #4) *"During the COVID-19 outbreak in our health district, when we identified the problems, we hypothesised the causes and proposed solutions. When these solutions were implemented, we saw an improvement in results that had been worsening before."* (DMO, female #12) In half of the health districts (7/13), learning through hypothesis testing has influenced practices, frameworks and models, leading to changes in objectives and approaches. *" Learning through hypothesis testing has enabled us to have regular communications through rural radio, which led to community*

				adherence to outbreak control measures." (DMO, female #6) *"Vaccination provision monitoring in our health district is a strategy that has proven results [end of measles] and for which we have redefined policies to achieve objectives."* (DMO, male #4)
	Triple loop	Triple-loop learning was missing at the ANSS level. The very basis (frameworks and assumptions) through which single and double-loop learning occurred was not questioned to influence it to change. Therefore, the ANSS did not improve how it was learning, as learning structures and processes remained identical.	It was missing.	It was missing.