

Nutritional Care for Patients with Ebola Virus Disease in Ebola Treatment Units – Past and Current Experiences from Practitioners

Mija Ververs^{1,*}, Puneet Anantharam²

¹Senior Nutritionist/Health Scientist, Emergency Response and Recovery Branch, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

²ORISE fellow Emergency Response and Recovery Branch, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

Abstract

In November 2014, the World Health Organization (WHO), in collaboration with United Nations Children's Fund (UNICEF), and the World Food Programme, produced interim guidelines (iGL) on providing nutritional support to patients in Ebola treatment units (ETUs). They have been translated into French and issued by the Ministry of Health, UNICEF and WHO in adapted versions to be used in the current outbreak in the Democratic Republic of the Congo (DRC). This paper evaluates the use and usefulness of the 2014 iGL in the West Africa and current DRC Ebola virus disease (EVD) outbreaks and identifies experiences and lessons learned from practitioners on the operational aspects of nutritional care and support in ETUs.

Methods

Key-informants (n=26), from 12 organizations (Non-Governmental Organizations, United Nations, Red Cross Red Crescent Movement) were interviewed who were actively engaged in the nutritional and/or clinical care of EVD patients.

Results

There was a consensus among key-informants that the 2014 iGL initially served a guiding purpose. However, the vast amount of learning from the 2014-2016 and current EVD outbreaks indicates that the interim guidelines need to be revised. Practitioners struggled to find operational solutions for nutritional care, and the challenges were plentiful, especially regarding 1) the different perceptions of the importance of nutritional care among ETU staff; 2) the difficulties around food preparation and distribution for EVD patients; 3) how to take into account the patients' dietary preferences; 4) the nutritional care needed in relation to specific EVD symptoms; 5) who assumed roles in nutritional care in ETUs; 6) if and how feeding support was organized; 7) whether malnutrition needed to be addressed and how; and 8) whether the intake of specific nutrients could contribute to improved treatment outcomes. Information from the key-informants interviews resulted in numerous lessons learned and recommendations for nutritional support during current and future outbreaks.

Conclusions

This investigation underscored the importance of documenting experiences of practitioners on nutritional care in emerging infectious diseases for which limited scientific evidence exists and for which interim guidelines are produced to fill in knowledge gaps. It also emphasized the importance of nutritional care in ETUs during treatment.

Corresponding author: Mija Ververs MMed, MPH, RD; Senior Nutritionist/Health Scientist, Emergency Response and Recovery Branch, Centers for Disease Control and Prevention, Atlanta, Georgia, USA.

Keywords: Ebola, hemorrhagic fever, ebola virus disease, nutrition, malnutrition, micronutrients, ebola treatment units, ebola treatment centers, interim guidelines, nutritional support, nutritional care.

Received: Nov 05, 2019

Accepted: Nov 16, 2019

Published: Nov 16, 2019

Editor: Andrea Martins da Silva, FMRP-USP, Brazil.

Background

The World Health Organization (WHO) declared the outbreak of Ebola Virus Disease (EVD) in West Africa from March 2014 until June 2016, affecting multiple countries, in particular, Guinea, Liberia and Sierra Leone [1]. The scale of the outbreak resulted in United Nations agencies issuing new or updated guidelines on care and treatment of EVD patients. In November 2014, the WHO, in collaboration with United Nations Children's Fund (UNICEF), and the World Food Programme (WFP), produced interim guidelines (iGL) on providing nutritional support to patients in Ebola treatment units (ETUs)[2]. Since the onset of the 2018-2019 EVD outbreaks in the Democratic Republic of the Congo (DRC), the 2014 iGL have been translated into French and issued by the Ministry of Health, UNICEF and WHO in adapted versions.

Through key-informant (KI) interviews, Kodish et al. reviewed the use of three interim guidelines co-issued by WHO in Guinea including the iGL. However, the findings were not specifically linked to this 2014 iGL [3]. A previous literature review found a limited number of publications on specific nutritional care in ETUs that often lacked detailed descriptions of the actual nutritional care provided (Ververs and Gabra, accepted for publication). The findings highlighted the importance of reporting on practitioners' experience to revise existing guidelines for increased applicability and acceptability.

This investigation is a follow-up on the previous review with the objectives to a) identify experiences and lessons learned from practitioners on the operational aspects of nutritional care and support in EVD outbreaks and b) evaluate the utilization of the 2014 iGL in the West Africa and current DRC EVD outbreak and

perception of practitioners.

Methods

Between January and May 2019, KI interviews were conducted to collect in-depth information on the nutritional care and support of EVD patients during the 2014-2016 West Africa outbreak and the current DRC outbreak. Initially, KIs were purposively selected according to their position and role in organizations or institutions actively engaged in nutritional care of EVD patients. Snowball sampling was used with KIs to identify additional KIs.

KI interviews followed a semi-structured interview guide with three main sections: general description of the KI's background, experience with the 2014 iGL, and operational aspects of the nutritional care the KI's organization provided.

During the interviews, conducted by Skype [4], detailed notes were taken and analyzed using MAXQDA version 2018.2[5]. Within MAXQDA, a coding framework was designed based on four major themes emerging from the interviews, Box 1. Through coding and interpretation of the interview transcripts, information was consolidated into experience-driven understanding of previous and current EVD outbreaks. Informed consent was sought through a verbal consent process during the interviews. This project was reviewed in accordance with the Centers for Disease Control and Prevention human research protections procedures and was determined not to be human subjects research. Participant privacy was assured by de-identifying the project data and quotes. Interviews were conducted until information became repetitive.

Findings

In total, 26 KIs from 12 organizations were

Box 1. Coding framework on four main themes and sub-themes

2014 iGL WHO – awareness and usefulness as perceived by the interviewed practitioners

Nutritional care for EVD patients in ETUs – practical experiences from the interviewed practitioners

Sub-themes

Importance of nutritional care

Food preparation and distribution

– **Food preparation and transport**

– **Meal composition**

Patients' dietary preferences and intake

Nutritional care related to EVD symptoms

Roles in nutritional care

Feeding support

Malnutrition – screening and treatment

Intake of specific nutrients

Lessons learned according to the interviewed practitioners

Recommendations for future and ongoing EVD outbreaks according to the interviewed practitioners

interviewed, Table 1. Sixteen KIs had direct contact with EVD patients in the ETUs. All KIs were international staff. The patient load in ETUs varied between 40 - 200 patients per day, and the majority of patients were adults. There were no refusals among KIs contacted.

Table 1

Interim GL WHO – Awareness and Usefulness as Perceived by the Interviewed Practitioners

Twenty-four KIs were familiar with the 2014 iGL and two only had knowledge of the guidelines issued in 2018 by WHO/Ministry of Health DRC/UNICEF[6]. Most organizations (8 out of 12) developed their own protocol/guidance on nutritional care during the West Africa EVD outbreak. Some aligned their protocols to the 2014 iGL upon publication.

One-third of the KIs found the 2014 iGL not to be sufficiently practical. While the technical aspects were acceptable, the feasibility was questioned. Protocols developed by individual organizations were more detailed on what types of foods to provide and

how. However, at least half of the KIs stated that the 2014 iGL were still useful, especially the decision tree. KIs stated that despite the lack of evidence base for the 2014 iGL, it provided some guidance, especially in the beginning of the West Africa outbreak. Most KIs agreed it was essential to develop the guidance continuously and to contextualize it within the countries affected.

Some KIs questioned the recommended use of therapeutic milk in the 2014 iGL, because the local community was not regularly using milk as part of their diet. This was particularly problematic for adults. Additionally, it was questioned whether milk would aggravate diarrhea.

KIs also recognized limitations in their performance during the West Africa outbreak because of the focus on the use of specialized products (e.g., therapeutic milks, ready-to-use therapeutic foods (RUTF), fortified porridges such as Corn-Soy Blend (CSB)), despite the desire of patients to consume local diets:

'iGL recommended certain specific food products and local foods. 'Patients did not accept the porridge made from specialized products. A lot of food was wasted. Critically sick patients preferred their local food. But local foods are not fortified.'

'We asked initially support from experts who were specialized in acute malnutrition, but we should have asked experts that knew a lot about very sick patients, and not those. We needed rather advice from experts from hospital settings, e.g., perhaps protocols needed as if they were surgical patients'.

Nutritional Care for EVD Patients in ETUs – Practical Experiences from Interviewed Practitioners

Importance of Nutritional Care

KIs and their colleagues perceived the

importance of nutritional care in EVD patients in different ways. Although most KIs noted the importance of the role of nutrition in patient care, some KIs mentioned that clinical staff was predominantly concerned with medical treatment:

'Nutrition wasn't such an issue in Ebola – There were a lot of other clinical issues of concern than the nutritional status of patients. The biggest risk of clinical care was heat stress for patients and staff.'

'There was no focus on food and nutrition. Nobody was checking if people had actually eaten their food.'

'As there was not much malnutrition, staff also did not prioritize nutrition.'

'Teams are under pressure, and they forget that patients need to eat.'

'We had medical doctors from country X; they said 'we are here to save lives', nutrition was not seen as important.'

'Medical doctors stated that nutrition was not important, even if they were malnourished and treated, they might still not survive. They just need to survive EVD.'

Table 1. Characteristics of the Key-Informants, N=26

Number of key-informants listed per organizations for whom they worked at the time of the EVD response, (N=26)	
Non Governmental Organizations: Alliance for International Medical Action (ALIMA) (2), GOAL (2), International Medical Corps (3), <i>Médecins Sans Frontières</i> (Belgium, France, Switzerland)(3), Partners in Health (2) Samaritan's Purse (1), Save the Children (UK, USA) (5)	18
United Nations: UNICEF (4)	4
Red Cross Red Crescent Movement: International Committee of the Red Cross (3), International Federation of Red Cross and Red Crescent Societies (1)	4
Roles of key-informants during EVD outbreak (N=26)	
Medical doctors	6
Nutritional advisors (nutritionists/nurses)	17
Health care managers in ETU (nurses)	3
Geographical location of key-informants during EVD outbreak (N=26)	
Worked in one country only	21
Worked in 2 countries	3
Worked in 3 countries	2
<i>Of which in</i>	
Guinea	1
Liberia	9
Sierra Leone	14
DRC (current outbreak)	9
Duration of work during EVD outbreak (N=26)	
Throughout the West Africa outbreak	4
Varied from 3 weeks to 13.5 months (average six months)	19
Unknown	3
Responsibilities during work (N=26)	
Planning and implementation of nutritional care for EVD patients (protocols, feeding of patients, etc.)	23
Clinical care for EVD patients only	3

Other KIs were members of teams that acknowledged the role of nutrition in the care of the patients. It was seen as a responsibility of the general nursing care.

'Nutrition should go hand in hand with medical treatment; we can see what we can give to reduce vomiting or increase appetite, etc.'

'Balanced nutrition is best for infectious disease; I don't see why it should be different with EVD.'

'Younger male physicians had come to "fight" Ebola. I said we fight Ebola by feeding people and supportive therapy and that was missing among younger male physicians./.../ When in outbreak mode to think about nutrition is really hard. Most are very much focused on medication, vaccination, etc. /../ Now we try to do more evidence-based care, but I don't need to give you evidence of nutrition's influence on EVD patients, it's part of good nursing care. It is evident, just like bedsores or nutrition in HIV or TB, I don't have to provide evidence on why bedsores need prevention!'

Various KIs mentioned the important role of foods for patients' morale. They stated that this possibly contributed to patients' recovery. One medical doctor noted it was also crucial for the morale of health workers: *'The fact we did not look at the nutrition well had a big impact; the health staff asked us why we could not do more for the EVD patients concerning foods. We did not, and this was bad for the staff's morale as well for the patients. It was difficult for the health workers not to provide what the EVD patients wanted. The patients needed to eat, patients wanted to eat certain things, and we didn't give that. It demotivated the staff, and also posed ethical problems*

for them. It was also demoralizing for patients.'

Food Preparation and Distribution

Food Preparation and Transport

Half of the organizations providing food to EVD patients, prepared in onsite kitchens run by the organizations responsible for ETUs; the other half contracted local catering companies. One organization initially ran a kitchen and then transitioned to catering, while a second organization reversed this pattern. Both options had advantages and disadvantages, see Table 2.

Table 2. Perceptions expressed by Key-Informants on advantages and disadvantages of using catering and onsite kitchens in preparation of foods for EVD patients in Ebola Treatment Units.

	Advantages	Disadvantages
Catering – out-sourced	<ul style="list-style-type: none"> Fewer human resources to manage Easy to make culturally appropriate meals More cost-effective Empowerment of the local community 	<ul style="list-style-type: none"> Expensive Transport to ETU not always included Lack of hygiene control Limited choice of catering companies
Onsite kitchen	<ul style="list-style-type: none"> More oversight on quality of food, preparation methods and meal times More flexibility for meeting patients' needs (foods as well as timing) 	<ul style="list-style-type: none"> More staff to manage

Most KIs had experienced challenges in the provision of foods in West Africa and DRC:

'They were constructing the ETU. This included a kitchenette for the staff meals. When I asked about the meals for the patients, everybody remained silent. They had forgotten the issue on meals preparation for patients.'

'Food supplies were probably a greater problems in MoH hospitals where families were normally bringing in support and resources./../One hospital was not able to provide adequate support for nutrition. They mostly had doctors; many nurses had left; they had problems concerning food for patients.'

'We found a major problem in ETUs in terms of food that was provided to patients. In the beginning, food was provided once a day. The food supply was low'.

'Catering was the only option, ... but delivering food is not the same as nutritional care.'

'There were food availability problems in the beginning: Non-Governmental Organizations (NGOs) knew they were not feeding well. Some died maybe because they were not eating well. We knew we had to provide nutritional care.'

KIs noted that foods were transported to the patients in the ETU ward with confirmed EVD patients (Red Zone) through slides, hatches, or staff entrances. Food was primarily provided on hard plastic plates or polystyrene compartment trays. Additionally, plastic cups, sippy cups, bowls, small plastic bags, or mineral bottles were used. Spoons were typically the only utensil provided. However, KIs noted the usefulness of straws, which were less frequently

used. Hard plastic materials were disinfected after use or burned, and all other materials and leftover food were disposed of as hazardous materials. Foods were individually packaged; some ETUs labeled commodities with patient numbers, patient names, or just the composition of the meal. Food was placed on tables or chairs at the bedside or in communal areas for those who could eat at a table. Various challenges were reported:

'We had initially no idea how to get food in the Red Zone except through changing rooms. But we did not want to mix food with health staff; we had to set up a food hatch system. However, one night, a child tried to escape from the Red Zone through the hatch.'

'Food was sitting in big bags. Nurses would give food in polystyrene trays. Soup was in a plastic bag. Adult patients were not able to untie the knot. They were not strong enough to eat with their hands. Food would just stay there. Nurses would be busy. Nobody was checking if people had actually eaten their food.'

'For fluids, big 1-1.5 liter plastic bottles for Oral Rehydration Salts (ORS) were provided, but people were too weak to pick these up. Water was too hot. 40 degrees Celsius.'

Meal Composition

KIs agreed that the provision of meals and snacks evolved over time with much trial and error. There was little standardization across organizations and menus and approaches varied. Some organizations were limited on the types of foods available, which led to the use of specialized products (RUTF, High Energy Biscuits, therapeutic milks, ready-to-use supplementary foods (RUSF), and/or CSB). The ease of use of the products by

staff was also a factor in their selection. All organizations attempted to provide a balanced diet through the aid of specialized products. These specialized products were generally the recommended commodities in the 2014 iGL. KIs mentioned that the rationale behind the use of RUTF and therapeutic milks was the nutrient density of the products, easier consumption for patients with difficulty swallowing, and consumption without utensils.

Overall, three meals and 2 to 3 snacks were

provided in most ETUs. Meals were provided in different consistencies: standard, soft/semi-solid, and liquid. Typical meals were as follows:

Breakfast

Porridges (often made from CSB), RUTF, therapeutic milks, fruits/juices, bread, local doughnuts, eggs

Lunch

Often of a standard 'family' meal made from staple foods and meat/fish/chicken, sauce, beans, oil, local soup

Dinner

Similar to lunch or breakfast

Snacks were provided upon request or followed

fixed schedules and included bread, fruits, biscuits, RUTF, RUSF, crisps, sweets, etc. Liquid diets for very sick and young children were mainly therapeutic milks, soups, or RUTF diluted with water. Semi-solid/soft foods mainly consisted of mashed regular meals (listed above), RUTF, RUSF, porridges, or soups.

Patients' Dietary Preferences and Intake

The majority of adult patients in ETUs covered by the KIs did not prefer specialized products. Reasons given for the dislike of the products included the monotony of diet and lack of palatability. Similar experiences were captured in both West Africa and DRC. This resulted in patients not consuming the supplied foods, but also significant wastage in the Red Zone, which created a health hazard. KIs mentioned numerous challenges:

'At arrival, the food systems and how they were organized were based on the use of RUTF, RUSF; Many people did not like this and wanted to have "family" meals.'

'These specialized products, patients did not eat it. This was piling up in the Red Zone, and health workers told me it was becoming a health hazard inside, and leftover food had to be burnt.'

'Adults in critical stage got RUTF, but the feedback was not positive, so we continued with local foods.'

'Adults, receiving RUTF, were not happy. They wanted local food. We saw that patients weren't eating and food was rotting at the bedside. We organized more rigorous criteria for who got therapeutic milks or RUTF, the dosage, and even local food; but I still pushed for patients to eat RUTF packets.'

'In DRC we have many fruits; the nutritional care should not be with these specialized products. It works maybe well in other African countries. Some organizations insist on giving 2 RUTF sachets/day and leaving meals as secondary. This is problematic for both patient and health workers.'

Many KIs were torn between what they thought was best in the given context and the reality of the refusal of foods by adults. Some organizations shifted to a more patient-centered approach, taking into account the patients' preferences for local foods. However, other organizations continued to provide only standard menus with limited flexibility to meet patient preferences. As one KI stated: *'Not eating by patients was a big problem; that was less a problem later when we gave them what they wanted. We had to individualize care because some were not eating, and many were dying from hypoglycemia.'*

Liquid diets were problematic for some patients.

This was likely a combination of the commodity (therapeutic milks) and the patients' weakness, lack of appetite, and the monotonous diet. Providing sufficient nutrition to critically ill patients was a significant issue. Nausea, vomiting, anorexia, weakness, and hiccups led to difficulty in consuming foods, which resulted in weight loss in some cases. KIs stated that once patients began to recover, and their appetite returned, patients could consume large amounts of food.

The West Africa outbreak identified two local foods which were preferred and consumed by adults, including extremely ill patients: pepper soup and coconut water. In West Africa, various KIs mentioned

that pepper soup was the preference of very sick patients, with fever, in a catabolic state, anorectic, and/or unwilling to eat. One KI stated: *'As they were sick, nothing worked so we changed the whole menu to pepper soup because the patients did not want anything else'*. One KI who oversaw a relatively large ETUs stated: *'It was in hospital X where it began, by accident. The hospital had a certain moment no access to potable water, they were buying water in plastic bags, but patients weren't able to hold plastic bags. One family brought coconuts and patients were able to drink the coconut water and hold the coconut. The flesh was soft and culturally accepted. We started to buy between 200-300 coconuts each day. We hired someone to cut coconuts for patients. However, coconuts were only in season until November, and we got through the urgent phase before November. By December we ran out of coconuts. Coconuts were burned (after use), the husks helped to burn the other plastics and waste. I think it had a positive impact on mortality, but I don't have enough detail to publish./.../ 'We worked with one of the WHO experts on the use of coconuts and diarrhea. Coconut water as a replacement for ORS. I didn't see that it had an impact until the change in the case fatality rate. There was no way to identify the coconuts were having an impact. Self-administering of fluids was important and beneficial. Patients were taking in much more fluid, so I feel the consumption of coconuts had a tangible difference.*

Keeping patients hydrated seemed to be having them recover quickly'.

Nutritional Care Related to EVD Symptoms

Some KIs mentioned that there was an unwritten rule that the first 7-10 days after admission to ETUs were crucial. Regarding nutritional support, one KI stated, *'If they survive the first week and especially the first few days, nutritional support is very important for survival. Exactly then we need to listen and give them what they want.'*

In the West Africa outbreak, anorexia, vomiting, and diarrhea were particularly severe[7]. As one KI indicated: *'Symptoms of diarrhea and vomiting was what was killing them. We saw that (once the patient was admitted in the ETU) we needed to intervene earlier before the vomiting/diarrhea would start. We stopped waiting for the transition phase with foods/drinks. We didn't wait until the critical stage to start with foods/drinks/fluids. Once diarrhea or vomiting is present, it is difficult to reverse it. Once the patients got critically ill, then dehydration went so fast.... There were four men, still walking into the clinic but diagnosed with EVD, then the vomiting and diarrhea started; then all died at day 3.... I learned to put in foods/drinks/fluids before diarrhea began. I cannot directly link to outcomes, but I felt it was working'*. KIs stated that the use of intravenous (IV) fluids was hotly debated. KIs had specific opinions on the use of ORS, IV fluid, and the use of foods during rehydration:

'IV fluid provision is a double-edged sword: It helps the patient to reduce shock. But when not well nourished it is more difficult to hold on to fluids. Overall, IV fluid did not impact mortality. There were mixed results for both adults and children. IV fluid could increase and decrease mortality'.

'ORS and its importance are forgotten. ORS would be enough for EVD maybe, and IV fluids are overrated.'

'Adults who received IV fluids had little to no oral intake. Once they were off the IV they were given foods. I am convinced we can get them eating earlier if people had looked into nutrition sooner.'

Some KIs worked diligently to improve oral fluid intake by EVD patients. As one KI stated: *'Patients would take ORS, but would come to ask for soda and coconuts (which we gave). The self-administration, acceptance, and willingness to take in fluids were important!'* Some organizations ensured that there was

cold water, especially in the context of the hot climate of West Africa: *'Plastic packets of water, we stuffed the fridges full of those. We threw them over the fence for people to drink. They were nice and cold and appreciated.'* Others organized to have ice for patients with sore throats.

The use of sodas was discouraged in the 2014 iGL. "Owing to the high osmolarity of sugary carbonated beverages or juices, it is important that they are not given to patients with diarrhea. These products are low in electrolytes and nearly all essential nutrients"[2]. However, some KIs argued that they were useful, including for patients with diarrhea, frequently requested by patients, and helped to increase/maintain fluid intake. As one KI stated: '*Fizzy drinks were used and received well. They cheered people up.*' At least half of the organizations in this investigation reported the use of soda.

Sip feeds, designed for specific medical purposes, were included as an option for liquid diets in the 2014 iGL. Sip feeds often have a low renal solute load, low osmolarity, and come in lactose-free options. However, no KIs reported having used these products in ETUs but some stated that it might have been a missed opportunity. Sip feeds, though not ideal, may be more acceptable to adult patients than therapeutic milks or RUTFs. Various reasons of non-use were reported: unavailability of product in organization supply catalogs, unfamiliarity with product, substantial lead time for ordering and receipt, customs issues, the expense of

product, and limited shelf life.

Roles in Nutritional Care

Generally, clinical staff determined what was provided to patients, including the type and consistency of food. Most KIs noted that there was no recording of information on dietary needs or preferences, only verbal sharing of information.

In the West Africa outbreak, many organizations had nutritional staff. However, nutritionists were not always allowed in ETUs, which was perceived as an impediment to improving the nutritional care of patients. Feedback from patients and health staff to nutritional managers was minimal. Only two KIs stated that they were able to monitor the content and quantity of food consumed by patients through a recording chart they developed. Their system monitored improvement or decline in appetite and provided insight into patient status with regard to nutrition: '*We knew who was deteriorating as they were not eating (anymore)*'. Others tried but did not have the capacity for monitoring.

Some KIs also mentioned the clinical staff's nationality/background resulted in different perceptions of nutritional care.

'Western staff isn't used to nutrition being a priority in their country as there is less malnutrition.... they are wrapped up in details which made them lose sight of providing care.'

'The perspective on nutrition is very different for Western-trained staff and national staff; Western-educated staff just refer to a dietitian in hospitals'.

Some KIs resorted to training of staff on the basics of nutritional care. However, over time in DRC, various KIs mentioned that the role and importance of

nutritionists have increased, sometimes because some clinical staff strongly advocated for nutritional care.

'In many ETUs in DRC, they have now nutritionists but still no real discussion with medical teams.'

'Nutritionists didn't enter the area where the patients are. They were NOT there to follow and see how the patients are eating. Only to help in food preparation system. Now there are discussions on how nutritionists can be more involved.'

Feeding Support

Three KIs estimated that at any time during the height of the outbreak in West Africa, an ETU would have approximately 40% severely ill, 20% moderately ill and 40% ambulatory patients. Feeding support provided to patients varied by ETU, as well as by organization. Patients in need of support were assisted by different types of staff:

nutritional support staff, nutritionists, nursing aides, community members, community health workers, general infection prevention and control staff and sometimes nurses, doctors as they had increased access to the patients. Patients also supported each other. Some KIs mentioned it was often a collaborative

effort at the meal times. Whoever was present assisted. However, many KIs stated that in the beginning there was simply not enough staff to effectively provide support for feeding in light of the essential tasks to run the ETU. As the response matured, EVD survivors started to play a significant role in some ETUs as feeding support 'staff', often receiving a per diem. At least six out of the 12 organizations 'employed' EVD survivors to provide feeding support. While some EVD survivors found this role to be psychologically difficult, others appreciated the opportunity to be useful while delaying their return to their communities and the associated stigma. Two KIs described the construction of simple furniture, wooden triangle or 'pillows', which enabled patients to sit upright to help with the feeding process.

Malnutrition – Screening and Treatment

KIs stated that very few EVD patients were acutely malnourished upon admission. Some patients lost weight and possibly developed malnutrition during their stay. KIs stated that though most intended to perform anthropometric measurements at admission, this was infrequently implemented because of the 'no touch policy' or lack of time. At best, weight was measured. Some organizations only screened children at discharge for referral purposes or provision of food upon discharge. One organization only measured mid-upper

arm circumference (MUAC) when children <5 years of age were suspected to be acutely malnourished. However, this was still limited by the need to sterilize tapes after each measurement. If needed, most organizations had the means to treat malnutrition as products used for the treatment of malnutrition were recommended for EVD patients in WHO's 2014 iGL. Overall, KIs stated that malnutrition was not a significant issue; however, no prevalence data were available, as no data were collected.

One KI questioned the use of therapeutic milks, normally used for treatment of SAM, for non-malnourished children: *'In DRC, every child is prescribed F75 or F100, we don't find this is appropriate. If a child is not malnourished it can eat normal food, and they want that! ...There is no reason to take these specific products from other sites where they need it, away from community management of acute malnutrition programmes. Therapeutic milks are still limited in availability./...../ And children do not necessarily like these milks, they want real food: cassava leaves, rice, chicken/meat and fufu.'*

Intake of Specific Nutrients

Four KIs (3 medical doctors, 1 nurse/nutritional manager) expressed significant concerns on hypo-albuminemia in EVD patients. The following captures the concern of practitioners:

'EVD patients are all low in protein (hypo-albuminemia). In DRC, we have constant lab analyses; we see the biochemistry constantly and see this disaster of lack of albumin.'

'We found that albumin is very low in EVD patients; almost no patients have normal albumin levels. We have no scientific evidence concerning albumin, but we know for a fact it is low (for all patients not only the very sick) and it has a link with nutrition. And we know high energy/protein intake can help.'

'They had low proteins, inadequate stores. IV fluid can make hypo-albuminemia worse esp. because we don't give fluids with it, such as blood.'

'Patients have hypo-proteinemia – it will aggravate the fluid loss. We lost a few patients because they did not get the food they wanted and were not eating in a week. Many doctors want the patients to be fasting because of vomiting, diarrhea, risk of sepsis, but if they don't eat the drugs won't work enough. Those doctors want the gastro-intestinal tract to be empty, then they give IV and then re-evaluate but often forget that the patients need to eat, so for one week they won't get enough. This focus on fasting paralyzes the nutritional care and follow up of the patient. The new slogan here is aggressive rehydration, referring to intense fluid management – so we give a lot of fluid but patients still loose water within tissues, and hypovolemia is present, capillary leak and edema exists; in fact the patient is dehydrated. Therefore the patient needs food and needs the proteins to reduce the hypo-albuminemia.'

KIs mentioned the need for specific micronutrients, such as magnesium, potassium, zinc, and vitamins A and K. Concerning the 2018-19 DRC outbreak, 2 KIs reported that laboratory analyses are increasingly assisting in determining the dietary needs of patients.

Lessons Learned According to the Interviewed Practitioners

There was a general consensus among KIs that the 2014 iGL, though initially useful for some organizations providing some kind of guidance, became less useful because of the focus on specialized products and did not evolve over time.

KIs were asked what they perceived as lessons learned based on the experiences they had on nutritional care for EVD patients in ETUs. Box 2 describes the most important reported lessons learned as expressed by the KIs on the nutritional care for EVD patients in ETUs.

Recommendations for future and ongoing outbreaks concerning nutritional care according to interviewed practitioners

KIs were asked what they would do differently in the context of ETUs and working on nutritional support for EVD patients in a subsequent outbreak. Answers were expressed as recommendations for current and future outbreaks.

KIs recommended that greater concerted action is required to work collaboratively to develop context-specific guidance on nutritional care for EVD patients in ETUs. This guidance should address past lessons learned and include more practical guidance on implementation. Box 3 lists the main recommendations related to nutritional care for EVD patients in ETUs, according to KIs.

Discussion

This investigation is the first attempt to better understand how nutritional support was managed in ETUs and the operational challenges faced by practitioners during the 2014-2016 outbreak in West Africa, as well as in the current outbreak in DRC. Practitioners struggled to find operational solutions for nutritional care, and the challenges were plentiful. Though released just after the peak of the outbreak, the

2014 iGL served a guiding purpose in the few months following its publication. However, the vast amount of learning from the 2014-2016 and current EVD outbreaks indicates that the interim guidelines need to be revised.

Very few studies have described the actual nutritional care provided in ETUs and the experiences Trehan et al. described the nutritional care in detail for pediatric patients based on his experience in ETUs. However, this was aimed for a minority of the caseload in ETUs and had a significant focus on the use of specialized products, generally used for the treatment of severe acute malnutrition [8]. Kodish et al. interviewed key-informants to describe the acceptability and effectiveness of nutrition-specific response among community members and health professionals, but this was not related to care within ETUs itself [3].

While waiting for more scientific evidence to be generated on what nutritional support should be provided, there is a need for continuous monitoring of practice and generation of lessons learned. What may work in DRC may not translate to other outbreaks. However, from this investigation, it is clear that some nutritional care practices are universal and relate more to the disease than the geographical locations (e.g., preference for local foods by adults, the importance of feeding support).

Additionally, it is essential to obtain information on the perspectives of EVD patients themselves on the nutritional care they receive or have received. If future research findings are able to inform metabolically optimal nutritional care protocols, but the patients themselves do not consume what is recommended, treatment outcomes might be negatively impacted.

A step for the near future would be to share the recommendations expressed by the practitioners with a broader audience and assess the support and feasibility of their implementation. While good nutrition cannot cure EVD, it is believed that maintaining the nutritional status of the people affected could improve their response to the treatment.

Limitations

Limitations of this investigation included a sample size that does not allow the representation of all practitioners working in nutritional care in ETUs. However, most international organizations that have

Box 2. Lessons learned as expressed by the practitioners on the nutritional care for EVD patients in ETUs

Importance of Nutritional Care

Nutritional care and/or its management is everybody's responsibility and can impact treatment outcomes.

Food helped patients to survive, and it was important for morale and comfort. As one KI stated, '*The importance of the psychological function of food; we did not imagine how important that was at the time*'.

The care for children with EVD was specific and challenging, including those that were dependent on breast-feeding. Many children were scared, needed affection, psycho-social support, and encouragement to eat. Though children were in the minority, it required much additional support which was not always provided in the beginning.

Food preparation and distribution

Outsourced food preparation through catering or kitchen had advantages and disadvantages. Regardless of the different options, essential was having quality control on what was prepared, how it was delivered, and adherence to high hygienic standards.

Uneaten foods at the patient's bedside became a health hazard in the ETUs.

Patients' dietary preferences and intake

The majority of patients in ETUs, and especially adults, did not like to eat specialized products, such as therapeutic milks, RUTFs, fortified porridges (CSB), regardless of their state of disease.

Local foods were preferred and consumed over specialized products.

Nutritional care related to EVD symptoms (and in general)

Transmission of messages related to nutritional care and general communication on nutritional needs was problematic within the ETU.

Roles in nutritional care

The turnover among clinical staff and the limited interest and knowledge on nutrition was not conducive for the patients' care and nutritional needs (especially among foreign medical staff). There was a need for constant (re) training on nutritional care and food hygiene. It was felt that the presence of nutritionists had been essential for improved nutritional care, and those that directly accessed the patients within the ETU were able to adjust initial protocols that were inadequate.

Feeding support

At the beginning of the West Africa outbreak, feeding support to very sick and pediatric patients was problematic. This improved when EVD survivors became available for feeding support and when nutritional care was seen as part of nursing care.

Malnutrition – screening and treatment

It was felt like a missed opportunity not to have collected data on patients' nutrition, anthropometry, and patients' treatment outcomes, though the reasons were recognized as justified in the West Africa outbreak (e.g., workload of ETU staff).

Intake of specific nutrients

Hypo-albuminemia is an important problem in many EVD patients and is/was not necessarily addressed.

Box 3. Recommendations as expressed by the practitioners on the nutritional care for EVD patients in ETUs

Importance of nutritional care

The treatment of EVD patients should be regarded in a more holistic way where nutritional care plays (also) an important part. Many KIs recognize the responsibility of most staff in the nutritional care plan. Doctors, nurses, other support staff as well as nutritionists, all have a role to play.

If the scale of the EVD outbreak is sufficiently large, establishing specific pediatric units should be considered. In addition to pediatric medical care, psycho-social, psycho-motor, nutritional support should be provided.

Food preparation, distribution, and patients' dietary preferences and intake

Local foods should form the basis of all meals and snacks, and specialized products can be used, but should not be the default option. It is recommended to:

Assess all possibilities of using local foods while taking into account local perceptions of comfort/medicinal foods.

Provide meals that allow adjustments for the individual patient (consistency and taste preference, as well as nutritional specific needs; e.g., increased intake of protein, potassium). It is helpful to have some kind of meal standardization to use as a base with additional adjustments and possibilities of choice.

Attempt to have a nutritionally balanced diet via local foods. If specialized products can help and are accepted, they can be used as such or altered with taste adjustments (e.g., CSB porridge mix with local fruits).

Ensure snacks are available any time, including nighttime, especially in hot climates.

Ensure a participatory approach with EVD patients on nutritional care.

Evaluate nutritional care regularly, especially in a rumor sensitive context.

Nutritional care related to EVD symptoms (and in general)

The use of sip feeds could be considered for the very sick. However, this must be cautiously explored (taking into account palatability, acceptability by the patient, and logistical constraints).

Roles in nutritional care

Training on nutritional care and operational aspects should be provided to new staff working in ETUs regularly.

Feeding support

Feeding support in ETUs is an essential part of the care in ETUs. All small children and all critically ill patients need some feeding support, ideally by EVD survivors or vaccinated staff in the ETU. The use of specialized products should not replace feeding support to adults or children. Feeding support for children also provides critical psycho-social care. As one KI stated: '*EVD survivors were important for playing, affection and helping children to eat*'.

Malnutrition – screening and treatment

Screening and monitoring of the nutritional status are essential in ETUs. This is particularly important, but not limited to children. Additional resources need to be mobilized for this activity.

Intake of specific nutrients

If possible, continue enteral feeding during treatment and ensure protein intake orally.

Ensure timely feeding (before the patient becomes catabolic) and if possible and acceptable provide protein containing foods during rehydration with IV fluid and/or ORS (despite diarrhea, vomiting). Efforts should be made, especially for the very sick, to provide preferred foods that also include proteins. This is particularly important to address hypo-albuminemia.

It is worthwhile to explore how metabolic conditions, such as hypoglycemia, hypo/hypercalcemia, hypo/hyperkalemia, and the use of laboratory analyses can help to refine and improve nutritional care and outcomes.

responded or are currently involved in EVD have been represented. Nevertheless, the experiences from Ministries of Health have not been documented through this investigation and therefore findings are skewed towards lessons learned recorded from international staff. This investigation did not specifically assess the challenges around infant feeding in the EVD context in ETUs. This topic merits more in-depth studies. While findings from West Africa response outbreak cannot necessarily be extrapolated to the context in DRC, this investigation did not find striking differences in practitioners experiences between those that worked in DRC or West Africa.

Conclusions

This investigation underscored the importance of documenting experiences of practitioners on nutritional care in emerging infectious diseases for which limited scientific evidence exists and for which interim guidelines are produced to fill in knowledge gaps. It also emphasized the importance of nutritional care in ETUs during treatment. In the absence of rigorous scientific research on the specific role of macro- and micronutrients, documenting both patients' as well as practitioners' experiences are essential and should guide adjustments for interim guidelines and standard operational procedures for nutritional care in ETUs.

Abbreviations

CSB, Corn-Soy Blend; DRC, Democratic Republic of the Congo; ETU, Ebola treatment units; EVD, Ebola virus disease; iGL, interim guidelines; IV, Intravenous; KI, Key-informants; MUAC, Mid-upper arm circumference; NGO, Non-Governmental Organizations; ORS, Oral rehydration salts; RUSF, ready-to-use supplementary foods; RUTF, Ready-to-use therapeutic foods; UNICEF, United Nations Children's Fund; WFP, World Food Programme; WHO, World Health Organization.

Competing Interests

The authors declare that they have no competing interests.

Funding

No funding was provided for this project. It was done as regular work under CDC (MV) and as a student (PA).

Authors' Contributions

MV designed the project; MV and PA conducted and analyzed the interviews; and MV wrote the paper and had primary responsibility for final content. All authors read and approved the final manuscript.

Acknowledgements

We would like to acknowledge all practitioners who agreed to participate to the interviews for their time and insightfulness.

Disclaimer

The views expressed in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

References

1. Centers for Disease Control and Prevention, 2014-2016 Ebola Outbreak in West Africa. <https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html> (accessed 28 May 2019).
2. World Health Organization/UNICEF/World Food Programme, Interim Guideline: Nutritional care of children and adults with Ebola virus disease in treatment centres. https://apps.who.int/iris/bitstream/handle/10665/137425/9789241508056_eng.pdf?sequence=1&isAllowed=y (accessed 31 May 2019). 2014.
3. Kodish, S.R., et al., Implications of the Ebola virus disease outbreak in Guinea: Qualitative findings to inform future health and nutrition-related responses. *PLoS One*, 2018. **13**(8): p. e0202468.
4. Skype Communication tool, <https://www.skype.com/en/> (accessed 12 June 2019).
5. MAXQDA Software, <https://www.maxqda.com/> (accessed 12 June 2019).
6. World Health Organization/République Démocratique du Congo Ministère de la Santé Publique/UNICEF, Protocole de soins nutritionnels chez les adultes et les enfants avec maladie à virus Ebola (MVE) hospitalisés aux centres de traitement (CTE). Directives élaborées avec l'appui de l'UNICEF-RDC (Adaptés du « Clinical Management of patients with viral haemorrhagic fever (fev 2016-WHO) et du Nutritional care of children and adults with Ebola

- virus disease in treatment centres (WHO-2014). Beni, Nord Kivu, Le 24 août 2018 (not available online). 2018.
7. World Health Organization, Clinical management of patients with viral haemorrhagic fever: a pocket guide for front-line health workers: interim emergency guidance for country adaptation. https://apps.who.int/iris/bitstream/handle/10665/205570/9789241549608_eng.pdf;jsessionid=420DF1894522CE887A0B31290D73B661?sequence=1 (accessed 26 May 2019). 2016.
 8. Trehan, I., et al., Moving Towards a More Aggressive and Comprehensive Model of Care for Children with Ebola. *J Pediatr*, 2016. 170: p. 28-33 e1-7.