Mount Saint Vincent University

Department of Applied Human Nutrition

Nutritional Status Among Critically Ill Patients in Rwanda

By

Jolene Bianco

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Mount Saint Vincent University

Department of Applied Human Nutrition

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by

Jolene Bianco

Approved:

Kyly Whitfield, PhD

Thesis Supervisor

Associate Professor, Department of Applied Human Nutrition, Mount Saint Vincent University

---

Bohdan Luhovyy, PhD

Associate Professor, Department of Applied Human Nutrition, Mount Saint Vincent University

---

Jennifer Szerb, MD, FRCPC

Professor, Department of Anesthesia, Pain Management & Perioperative Medicine, Dalhousie University

Abstract

Background: Rwandan hospitals do not currently provide food services to patients, as is seen in most high-income countries, and instead the responsibility lies on the patient's caretaker to provide food for the patient. There may also not be adequate medical nutrition therapy for intensive care unit (ICU) patients at Centre Hospitalier Universitaire de Kigali (CHUK). This is potentially risky given the multitude of factors involved in feeding a critically ill patient in the hospital, including concerns of nutritional adequacy, food safety, and patient-specific nutrient requirements. This is of particular concern given that two recent studies conducted at the CHUK revealed sub-optimal enteral nutrition (EN) feeding practices in the ICU and emergency departments, and malnutrition among the acute care surgery patient population.

Objectives: To describe the food intake and nutrition care of hospitalized patients, and to explore current healthcare practitioner knowledge and practices surrounding nutrition, feeding, and EN, in the CHUK ICU.

Methods: In this hospital-based repeated-measures study, a researcher-administered questionnaire was employed to collect patient demographic, dietary intake, and health information, as well as factors related to their caretaker's role, among hospitalized patients in the ICU at CHUK. Data were collected within 24-hours of ICU admission, and on days 2, 4, 6, and once a week thereafter until discharge (or death). Self-administered questionnaires were completed by CHUK ICU staff to assess healthcare practitioner knowledge and practices surrounding nutrition, feeding, and EN.

Results: Of the 73 ICU patients who participated in this study, 75% were in the Ubudehe 2 category. The mean overall dietary diversity score (DSS) was 4.2 ± 0.1 (out of 9), and the mean protein-DDS was 1.1 ± 0.5 (out of 6). 96% of patient days had a meal containing protein, however, milk made up 76% of the protein sources. Nearly all patient meals were purchased at nearby restaurants (95%). Most patient caretakers (83%) perceived a financial burden in providing food for patients, and 93% reported that they missed work to do so. Of the 27 staff, 74% reported assessing every patient for malnutrition, but only 7% used a malnutrition assessment tool, and 54% felt they needed more EN training.

Conclusion: Patient participants were mainly fed restaurant meals, and had moderate DDS, but were likely not consuming enough protein. Staff participants appear to require more nutrition-related training, but had valuable insights into the EN challenges and opportunities.

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List of Abbreviations

ANOVA	One-way analysis of variance
ASPEN	American Society of Parenteral and Enteral Nutrition
BMI	Body mass index
CAD	Canadian dollar
CBHI	Community based health insurance
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CHUK	Centre Hospitalier Universitaire de Kigali/University Teaching Hospital of Kigali
CI	Confidence interval
DALY	Disability-adjusted life year
DDS	Dietary diversity score
EN	Enteral nutrition
ESPEN	European Society of Parenteral and Enteral Nutrition
FAO	Food and Agricultural Organization of the United Nations
g	Grams
GNP	Gross national product
HDU	High dependency unit
HIC	High-income countries
ICU	Intensive care unit
kcal	Kilocalorie
kg	Kilogram
LMIC	Low-and middle-income countries
LOS	Length of stay
m^2	Square meter
ml	Millilitre
MSVU	Mount Saint Vincent University
MNA	Mini Nutrition Assessment
MNT	Medical nutrition therapy
NPO	Nil per os
NRS-2002	Nutrition Risk Score
NUTRIC	Nutrition Risk in Critically Ill

OR	Odds ratio
TPN	Total parenteral nutrition
RwF	Rwandan Francs
SGA	Subjective Global Assessment
SD	Standard deviation
WaSH	Water, sanitation and hygiene
WHO	World Health Organization
UN	United Nations
USD	United States dollar

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1.0 Introduction

Malnutrition is a contributing factor to morbidity worldwide, but it is of particular concern among the medically vulnerable. It is well established that poor in-patient nutritional status is associated with prolonged length of hospital stay (LOS), worsened perioperative outcomes, increased rates of readmission, as well as increased hospital costs in both high- and low- and middle-income settings. There are numerous causes of poor nutritional status among hospitalized patients, including malnutrition at the time of hospital admittance, inadequate hospital feeding protocols, illness or medication-related loss of appetite, nutrient malabsorption, or increased nutrient needs due to illness.

Centre Hospitalier Universitaire de Kigali (CHUK) is the largest referral hospital in Rwanda with a capacity of 565 beds, 11 of which are located in the intensive care (ICU) and high dependency units (HDU). As a public hospital, the majority of patients have health insurance; food, however, is not currently provided as part of this routine hospital care. Instead, common practice at CHUK, as at all public healthcare centres across Rwanda, is for patients to be fed by caretakers, usually friends or family. This is potentially risky given the multitude of factors involved in feeding a critically ill patient in the hospital, including concerns of nutritional adequacy, food safety, water, sanitation, and hygiene (WaSH), and patient-specific nutrient requirements. At CHUK, the nutritional composition and sanitary quality of the food is currently unknown, and therefore the special dietary needs of sick, immunocompromised patients may not be met. This is of particular concern given that two recent, hospital-based studies in Rwanda revealed sub-optimal enteral nutrition (EN) feeding practices in the ICU and emergency departments, and malnutrition among the acute care surgery patient population at CHUK. The high rate of malnutrition at hospital admission is not surprising considering more than half of Rwandan families either experience food insecurity or are at risk of becoming food insecure.

Given the importance of nutritional status in the health outcomes of hospitalized patients, yet the unknown food and nutrient intake of these patients during their stay in the ICU, the purpose of this study was to assess the current feeding practices of ICU patients at CHUK. We conducted a hospital-based repeated measures study. This included describing food intake of hospitalized patients in the ICU and their perceived nutrition support, as well as comparing outcomes by

various patient sociodemographic and clinical, and caretaker burden characteristics. We also explored current healthcare practitioner practices surrounding feeding and nutrition in the ICU through a survey of ICU staff knowledge and practices. We hope that this study will inform future research and potentially lead to institutional change to feed patients most nutritionally at risk, given the well-established link between malnutrition and increased LOS and other nutrition-related health complications.

2.0 Literature Review

2.1 Rwanda

The Republic of Rwanda is a low-income, landlocked country located in Central Africa, bordered by Tanzania, the Democratic Republic of the Congo, Burundi, and Uganda (see **Figure 2-1**) (1). There are three official languages spoken in Rwanda: Kinyarwanda, English, and French, with Kiswahili also being commonly spoken (2). Known as 'the land of a thousand hills,' Rwanda has a hilly terrain with altitudes ranging from 1000 to 4500 meters above sea level (2). Rainfall averages 1250 millimeters annually between two rainy seasons, often with extreme variances leading to flooding and drought (1). The agriculture sector accounts for 70% of the economic activity and employs approximately 70% of the working population in Rwanda (3). The population resides predominately in rural areas, with only 16% in urban areas, and nearly half of those urban residents in the capital, Kigali (1). Wealth is not equally distributed between urban and rural areas, with 2017 estimates indicating that 73% of individuals in the wealthiest quintile reside in Kigali (1). The national poverty level is 55% (4).

Figure 2-1. Map of Rwanda (public domain (5))

Much of Rwanda's infrastructure and human resources were decimated in 1994, when over one million Rwandans, including many healthcare professionals, were killed during a genocide

against the Tutsi ethnic group (2,6). After this time the country transitioned from a dictatorship to the Government of National Unity, and the country has stabilized with an economic growth rate of approximately 8% per year since 2001 (2). However, the demographic effects of the genocide are still felt, with 43% of the 12.3 million residents of Rwanda (7) under 15 years of age (1), and a low median age of 22.7 years (7).

In 2017, life expectancy for Rwandan females was estimated at 71 years of age, while men lived to be 66 years (8). Across all life stages, the top five highest causes of death and disability in 2019 were neonatal disorders, lower respiratory infections, malaria, diarrheal diseases, and tuberculosis (8). There are a number of both independent and interrelated key predictors of health in Rwanda, such as food security, water-and foodborne illnesses, malnutrition, and co-morbidities, each of which will be outlined below, with a specific focus on the Rwandan adult population. First, however, the cultural and organizational framework of Rwandan communities will be discussed to contextualize these predictors of health.

2.1.4 Ubudehe

Ubudehe is both a Rwandan cultural practice and economic categorization system that is thought to have started more than a century ago, denoting mutual support of the most vulnerable community members, and to eradicate poverty through community development (1,9,10). In 2001, the Ubudehe program was re-institutionalized by the Ministry of Finance and Economic Planning and the Ministry of Local Government in an attempt to reduce poverty in the country through a participatory development approach (1,9). In 2015 households were further re-categorized by their communities into four Ubudehe categories, based on their economic status, to determine eligibility for various social safety net programs (1,9) (see **Table 2-1**). The most recent Comprehensive Food Security and Vulnerability Analysis (CFSVA) reported that 16% of residents were classified in Ubudehe 1, 36% in Ubudehe 2, 45% in Ubudehe 3, 0% in Ubudehe 4, 2% did not know, and 1% were not assigned yet (1).

Table 2-1. Current Rwandan Ubudehe categorization (adapted from (1,10))

Ubudehe category	Household characteristics
1	• Without a house or the ability to rent a house, • Unable to feed themselves without assistance, or • Has a hard time getting basic items
2	• Can afford basic accommodations • Usually works for others, • An employee in a non-permanent job, or • Able to eat at least twice per day
3	• Gainfully employed, or • Employers of labour (e.g. small farmers)
4	• Employed full-time with industries, companies, or organisations, • Government employees, chief executive officers, or • Owners of shops, markets, or commercial transport

The program has faced some criticism surrounding inaccurate categorization of households, with some being categorized as wealthier than they are (11). Others condemn the multiple benefits received in Ubudehe 1 as perpetuating a dependency mindset, rather than providing supports that could enable upward mobility to the next Ubudehe category (12). Some critics believe that households in Ubudehe 2 are truly the most vulnerable, lacking the means to pay for their health insurance fees, that are often affordable or covered by employers among households in Ubudehe 3 and 4, but ineligible for health insurance subsidies available to households categorized as Ubudehe 1 (10,12,13). In an effort to address the issues listed above, starting in October 2020, the Local Administrative Entities Development Agencies began a pilot campaign to regroup households into five new Ubudehe categories, from A (wealthiest) to E (poorest) (14) (see **Table 2-2**), with households to be re-assessed every three years (15). Households in category E are not expected to graduate to the next Ubudehe category because they are aged, more vulnerable, or otherwise do not have the means to improve their living situation, and are expected to indefinitely benefit from full reliance on social protection (16). Those in categories C and D will still benefit from some social protections, however, they will be required to sign household performance contracts to encourage their graduation to the next Ubudehe category within two years. While the full details of the social protections that will be offered to households under Ubudehe C, D and E have not yet been officially released, media announcements indicate that

community-based health insurance will be included under these protections. Households categorized under A and B will be completely self-reliant, expected to stimulate community empowerment, and graduate out of poverty (16).

Table 2-2. New Ubudehe categorization, currently in a pilot phase (adapted from (15))

Ubudehe category	Household characteristics
A	• Cumulative income of RWF 600 000 (about CAD $750 (17)) or more per month (including salaries, pension or other income sources), and • 10 hectares of land or more in rural areas, or • 1 hectare of land or more in urban areas
B	• Cumulative income of RWF 65 000 to 600 000 (about CAD $80-750 (17)) per month, and • 1-10 hectares of land in rural areas, or • 300 square meters to 1 hectare of land in urban areas
C	• Cumulative income of RWF 45 000 to 65 000 (about CAD $55-80 (17)) per month, and • 0.5 to 1 hectare of land in rural areas, or • 100 to 300 square metres in urban areas
D	• Cumulative income of RWF 45 000 (about CAD $55 (17)) or less per month, and • 0.5 hectares or less of land in rural areas, or • 100 square meters or less of land in urban areas
E	• All members of the household are unemployed due to age, major disabilities, or incurable diseases, and • Do not own other assets

While the new Ubudehe categories were expected to be active by December 2021 (18), at the time of data collection for this research study they were not yet operational; however, it is important to give context to the environment in which any future applications from this studies results could be implemented.

2.1.5 Food Security

It is estimated that 690 million people, or 8.9% of the world's population, were hungry last year, an increase of 10 million since 2019 (19). As a social determinant of health, food insecurity can have many deleterious effects on health (20) and is an important contributory factor to

malnutrition (21). Household food insecurity is defined by the United Nations (UN) Sub-Committee on Nutrition as "the limited or uncertain availability of nutritionally adequate, safe foods, or the inability to acquire personally acceptable foods in socially acceptable ways" (22). Households are considered severely food insecure when there are extreme gaps in food consumption, there is an extreme livelihood asset loss that leads to gaps in food consumption, or worse (1). Marginally food secure households are not able to afford some essential food items without engaging in permanent coping strategies, and have minimally adequate food consumption (1); whereas improved household food security and socioeconomic status is associated with greater dietary diversity, as it shows the household's economic ability to access a variety of foods (23).

The CFSVA tool measures the depth and extent of food and nutrition insecurity in households by tracking trends over time and analyzing the demographic and socioeconomic determinants of food insecurity (1). The CFSVA includes four pillars to assess food security: food availability, food access, food utilization, and stability (1). Food availability encompasses having food physically available to the household or to an area, which includes food aid, reserves, domestic production, and commercial imports. Food access is the ability to physically obtain food by having access to markets or road networks, and the economic ability to obtain food through household production, exchange, or purchase of consistently adequate amounts of food for a household. This can include purchases, home production, gifts, barter, food assistance, and borrowing. Food utilization refers to the quality and food safety of food with regards to the health status of the individuals in the household, and the efficiency of absorption and use of the food they have access to. Stability refers to the importance of reducing the risk of adverse effects on food access, availability, or utilization. A household is deemed food secure, via the CFSVA, when they have the capacity to meet essential food and non-food needs without relying on unacceptable coping strategies, they have an acceptable diet, and the portion of their budget used for food needs is less than 50% (1). Nutrition security includes all aspects of food security, with a particular emphasis on the need for foods and beverages that promote health and prevent diseases (24).

The results of the 2018 Rwandan CFSVA found that 19% of households were food insecure, of which one third were in Ubudehe 1, with 2% of food insecure households being severely insecure (1). A further 39% of households were considered marginally food secure, which means that, while they are currently food secure, they were at a high risk of becoming insecure if they encounter any hardships. On average, households spend 46% of their monthly budget on food, with households in the poorest quintile spending 57%, and households in the highest quintile spending 36% (1). Within the 2018 Rwandan CFSVA, dietary diversity is measured by the number of food groups consumed over a 24-hour period of time, with a greater number of food groups consumed equating to greater dietary diversity (23). The administered questionnaire includes 16 food groups, which are then aggregated down to 12 groups for household and 9 for individual dietary diversity scores (23). On average, Rwandan households consumed items from 6 food groups, with people living in Kigali reaching the highest dietary diversity scores, with an average of 7 groups. Assessing by food security status, Rwandan households who were considered to be severely food insecure based on CFSVA scores consumed an average of 3.2 food groups, marginally food insecure households consumed 3.9, marginally food secure 5.4, and food secure 6.6 food groups per day (1).

Although many factors impact the food security status of Rwandan households, food availability and accessibility appear to be the top drivers of CFSVA scores, in part because the agricultural sector makes up 70% of the country's economic activity. This sector, and hence the majority of Rwandan households, are vulnerable to adverse social and economic impacts of weather shocks imposed by five natural hazards: droughts, floods, landslides, earthquakes, and windstorms (1). In the 12 months preceding the 2018 CFSVA data collection, 40% of households reported that at least one of these shocks affected food access (1). As the global temperature rises due to climate change, weather shocks are increasingly common (25,26), with droughts and irregular rains being the most commonly reported in Rwanda (1). The impacts of droughts and other weather shocks can translate into the inflation of staple goods, loss of jobs, and reduced access to food, further exacerbating food insecurity (17). Weather shocks can negatively impact all Rwandans, but the food insecure and the marginally food secure, collectively accounting for 57% of the population, are the most heavily impacted (1). In addition to weather-related shocks, over 60% of Rwandans face further food access issues, and 40% were confronted with seasonal food access

difficulties related to the lean seasons, up 50% from 2012. In agricultural communities, the lean seasons, also known as hungry seasons, are characterized by the periods of time between planting and harvesting, when food has begun to run out (27). In Rwanda the minor lean season runs from May to June, and the major lean season runs from October to December (1,28). Lean seasons can lead to decreased agricultural diversity and a rise in food prices, further compounding food insecurity and contributing to decreased variation in dietary intake (29–31). Rwandans face additional issues accessing foods due to markets being physically inaccessible in some areas, such as the Western Congo Nile Crest, because of the steep geographical terrain (1).

2.1.3 Diet

Starchy foods and vegetables, such as maize, millet, beans, peas, corn, cassava, plantains, sweet potato, and Irish potato provide the basis for the Rwandan diet (1). Traditionally, white sweet potatoes have been consumed in Rwanda; however, orange sweet potatoes, higher in carotenoids, have begun replacing the white variety. Those in food insecure households are more likely to rely primarily on starchy foods and eat a diet void of protein-rich food sources, especially animal source foods. Conversely, people living in Kigali and in the Bugesera district (in the Eastern Province of Rwanda) have a relatively high consumption of animal proteins, such as meat, eggs, and dairy. Fish is consumed most along Lake Kivu, displacing the pulses and beans that are typical of the rest of the country (1).

2.1.2 Food Safety

The World Health Organization's (WHO) Foodborne Disease Epidemiology Reference Group estimates that the global burden of foodborne disease is comparable to that of HIV/AIDS, malaria, or tuberculosis (32), causing illness among approximately 600 million people per year, and leading to death in 420 000 people per year (33). Diarrhea is the most common illness contracted from foodborne-related infections, affecting 550 million people, and causing 230 000 deaths per year (33). These infections often also lead to a cycle of diarrhea and malnutrition (34), more broadly known as the cycle of malnutrition and infection (35). This cycle is bidirectional, whereby infection depletes one's nutrition status, leading to malnutrition, and malnutrition lowers one's immunity, leading to greater susceptibility to infection (36) (see **Figure 2-2**). Regardless of the nutrition status at the outset, infections, such as those that cause diarrhea, can lead to malnutrition due to reduced dietary intake, malabsorption, and catabolism of nutrient

stores for the immune response. Malnutrition can decrease immunity, perpetuating an increased risk of infection (35–37).

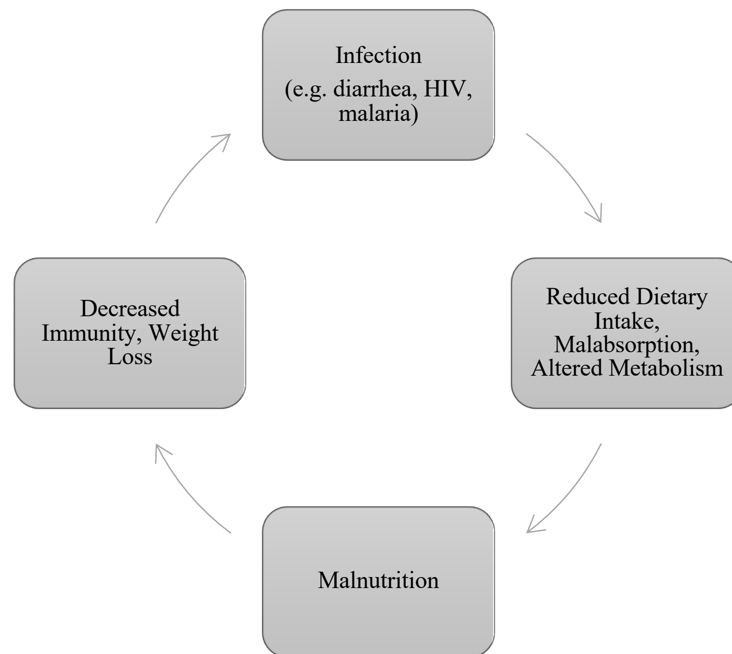

Figure 2-2. Malnutrition-Infection Cycle (adapted from (35,37))

The most common causes of foodborne illness are norovirus and *Campylobacter* spp, but non-typhoidal *Salmonella enterica, S. typhi* and enteropathogenic *Escherichia coli*. lead to the most deaths (32). Vulnerable populations such as those who are malnourished (38), 65 years of age or older, and who are immunocompromised, such as those living with HIV/AIDS, diabetes, renal or liver disease, alcoholism, or receiving chemotherapy (39,40,41), are at an increased susceptibility to contracting foodborne diseases (38), and risk for adverse health outcomes related to foodborne diseases (39,40,41). The vast majority (98%) of the foodborne illness burden falls on low- and middle-income countries (LMIC) (32), with USD$100 billion lost annually in productivity and medical expenses, and USD$15 billion in treatment (33). The most recent such assessment in Rwanda was in 2000, when the estimated costs due to diarrhea were between USD$53 and 106 million, which made up 2 to 5% of the gross national product (GNP) (42).

Fresh produce and animal source foods sold in informal markets are thought to be the main culprit for foodborne diseases in LMIC (43,44), and this can largely be prevented through proper

food handling techniques (33). The number of food handling techniques that need to be employed to prevent foodborne illness are extensive and include: washing hands with soap and water prior to touching food, during food preparation, and after defecating; sanitizing all surfaces and equipment that will come in contact with the food; avoiding cross-contamination by separating raw meat, poultry, and seafood from other foods; using separate utensils such as knives and cutting boards for raw and cooked foods, and storing food in containers to avoid contact between raw and prepared foods; cooking foods to an internal temperature of at least 70 degrees Celsius for no less than two minutes; leaving foods at room temperature for no more than two hours; keeping all cooked foods at a minimum of 60 degrees Celsius or refrigerating them to a maximum of five degrees Celsius; using safe water (defined by the United Nations (UN) as, "free from microorganisms, chemical substances and radiological hazards that constitute a threat to a person's health" (45)); washing fruits and vegetables; choosing foods processed for safety, such as pasteurized milk; and not using foods past their expiry dates (34). All practices on this long list are relevant to both households and institutions, such as hospitals, but are challenging to implement in LMIC due to the financial, physical, and educational barriers of accessing safe WaSH, pasteurized foods, and kitchen equipment, such as cooking fuel, refrigerators, and thermometers (43,44).

In hospital environments, food safety is an especially important consideration when providing EN, particularly when using whole foods, rather than commercial formulas (46). This is due to the increased viscosity of foods being susceptible to clogging the tubes, and food residue often being left in the tube, both of which confer significant food safety risks to the patient (46). When using whole foods to tube feed, larger feeding tubes of at least 14 French gauge, are required to decrease the risk of clogging, and foods should be evenly blended using a high-quality blender that can be taken apart and cleaned thoroughly (47,48). Feeding tubes must be flushed with water after every feeding to reduce the risk of clogging, residual food residue, and degradation of the tubes. Further, administering bolus feeds via syringe, rather than continuous gravity feeds, is preferred because the whole foods cannot be at room temperature for more than two hours, and the higher viscosity of the whole foods, compared to commercial formula, slows the rate of continuous feeding (46,47).

2.1.1 Water, Sanitation, and Hygiene (WaSH)

Inadequate access to appropriate WaSH was the third highest risk factor for death and disability globally in 2019 (7), and is estimated to account for 60% of all deaths related to diarrhea (49). It has further been attributed to other infections such as helminth and schistosomiasis, which are etiological factors in the malnutrition-infection cycle (50–52) (see **Figure 2-2**). Inadequate WaSH practices can also lead to environmental enteric dysfunction, a chronic disorder which can cause increased gastrointestinal permeability, systemic inflammation, and nutrient malabsorption (53).

Only 57% of the Rwandan population has access to safe drinking water within 30 minutes of their home (54). Although improved sources of drinking water, such as protected springs and public taps/standpipes, are geographically accessible to 72% of households, of the remaining 28% with access to only unimproved sources, such as unprotected springs and surface water, less than half (44%) use an appropriate method to treat their water before drinking it (2). Untreated, unimproved sources of drinking water can transmit pathogens and cause diseases such as diarrhea, dysentery, polio, schistosomiasis, and typhoid (52,55). Even households in urban areas that have greater access to safe drinking water often need to ration it due to frequent shortages, especially those located at higher elevations (56). These conservation efforts can lead to reducing, or altogether forgoing, proper hand hygiene, as well as inappropriately storing and reusing water, which can collect hazardous pathogens (57–59).

Inadequate sanitation can lead to food and water contamination with pathogen-containing fecal matter, causing illness such as diarrhea and cholera (60,61). Improper waste disposal or sewage systems can also contribute to disease pandemics by contaminating ecosystems (60,61). Basic sanitation, defined as each household having their own toilet, is accessible to 64% of the population in Rwanda (54). Kigali does not have a centralized sewage treatment facility, as such, the majority of households in Kigali use septic tanks with soak away pits and pit-latrines, with untreated sewage being inappropriately disposed of into the environment (62).

Proper handwashing with soap and non-polluted water can reduce people getting sick with diarrhea by 23-40%, which increases to a 58% reduction among immunocompromised

individuals (63). In 2020, authors of a study conducted in Southern Rwanda (n=291 households) found that most (86%) participants understood the need to use soap when washing their hands and agreed that soap should be available for hand washing, but also that most found the cost of soap prohibitory (57). This may explain why only 12% of households in Rwanda have dedicated hand washing facilities, with only one third of those facilities boasting both soap and running water (2). This is a more pressing concern in rural areas where only 25%, as compared to 67% of urban households, have handwashing facilities with both soap and water (2). Additionally, water shortages reduce people's ability to practice proper hand hygiene (64).

2.1.6 Healthcare

Given the impact of the 1994 genocide on the healthcare system (65) and need for emergency services, healthcare was free immediately following the genocide, up until 1997 (66). At this time healthcare user fees were re-introduced and usership took a steep decline (66), as only 7% of the population received health coverage (67). In 1999 the government of Rwanda implemented a pilot program called Mutuelles de Santé (68), now known as Community-Based Health Insurance (CBHI), in three of Rwanda's 30 districts (67,69). In 2005 CBHI was scaled up to include 354 of 366 health centers and their communities, and in 2006 it was implemented nationally (67). The CBHI program provides universal health coverage at 1000 RwF (approximately CAD$1.25 (17)) per person per year (65,68,70). In addition to the 1000 RwF premiums, copayment fees of 200 RwF (approximately CAD$0.25 (17)) plus 10% of the total hospital bill are required (67). In 2006 CBHI became mandatory for all Rwandans (66), with only 74% of the informal sector population receiving coverage by 2013 (67); however, many were finding the 1000 RwF premiums unattainable and prohibitory to its use (66). In 2011 a sliding scale pay program was implemented where premiums for persons in Ubudehe 4 were set at RwF 7000 (nearly CAD $9 (17)), Ubudehe 2 and 3 at RwF 3000 (nearly CAD $4 (17)), and Ubudehe 1 at RwF 2000 (approximately CAD $2.50 (17)), but premiums for those in Ubudehe 1 and with disabilities were fully subsidized with no copayment fees charged at the point of care (66) (see **Table 2-3**). All members of a household must pay their premiums before June 30th each year to maintain enrollment, and new members who join must wait 30 days before benefiting from medical care services (10). While 83% of the 87% insured Rwandans in 2020 used CBHI (71), Rwandans can also gain insurance coverage through companies such as La Rwandaise d'Assurance Maladie, Military Medical Insurance, and private insurance companies (12). There

has been criticism surrounding inaccurate Ubudehe category placement, which has caused the CBHI program to suffer from considerable fluctuations in membership (10). Additionally, some members simply cannot afford the premiums due to seasonal or irregular incomes. Members classified under Ubudehe 2 and 3, particularly Ubudehe 2, have been found to be the least likely to enroll in the program. Since the program relies heavily on enrollment and premiums for revenue, high usership is imperative to maintain the CBHI program (10). Even so, the revenue generated by these premium and copayment fees is insufficient to cover all health care costs, and foreign aid covers approximately 53% of all health expenditures (70).

Table 2-3. CBHI User Fees (adapted from (66))

Premium	RwF	CAD $ [a]	Copayment fee	Subsidized
Ubudehe 1	2000	2.56		Yes
Ubudehe 2 and 3	3000	3.84	200 RWF (CAD $0.26 [a]) + 10% of hospital bills	No
Ubudehe 4	7000	8.96		No

[a] Prices reflective of currency exchange on September 19, 2021 (17)

A Rwandan household survey conducted in 2013 found that CBHI has allowed for relatively equitable access of healthcare services across wealth quintiles, with the poorest quintile accounting for 20% and 19% of visits to outpatient and inpatient facilities respectively, compared to 23% each for the wealthiest quintile (72). However, there does not appear to be an equitable distribution of public hospital outpatient visits, with 25% of the members in the poorest two quintiles accessing these services, compared to 65% of the wealthiest two quintiles (72).

The Rwanda healthcare system employs a pyramid referral system, where persons requiring healthcare treatment will first be sent to a health post (703 nationally), they then can be referred to a health centre (504 nationally), district hospital (36 nationally), and then provincial (four nationally) and referral hospitals (eight nationally) (71,73). In addition to the CBHI pyramid referral system, there is also a private sector that those who can afford private health insurance have access to. These include two general hospitals, two eye hospitals, 50 clinics and polyclinics, eight dental clinics, four eye clinics, and 134 dispensaries (74). There are two levels of adult ICU

(5), of which there are 27 beds total in the entire country (75); the general ICU, which has limited invasive monitoring devices and mechanical ventilators, as well as HDUs, which are used as intermediary units between the ICU and general wards, but patients are still considered critically ill and monitored closely (5,76).

2.1.7 Centre Hospitalier Universitaire de Kigali/University Teaching Hospital of Kigali (CHUK)

CHUK is located in Kigali and is the largest referral hospital in the country, with 565 beds, 11 of which are located in the ICU and HDU (77). Current estimates indicate that the most common diagnoses among acute care patients at CHUK are trauma (30%; n=83), intestinal obstruction (27%; n=76), and peritonitis (18%; n=49) (78). As a public hospital, CHUK provides diverse healthcare services to patients of all ages and Ubudehe categories (70). Food, however, is not currently provided as part of this routine hospital care, so common practice at CHUK, as in all public healthcare facilities across Rwanda, is for patient's caretakers to provide the patient's food (78).

CHUK has four dietitians working in the entire hospital: one for the ICU, Emergency, Neurosurgery, and Gynecology-Obstetrics Departments, one for the Internal Medicine Department and Clinic Pavilion, one for the Surgery Department, "IZERE" (private or premium healthcare patient ward), and HIV Clinics, and one for Ophthalmology Pavilion and Head of Nutrition Services (77). The dietitian's role includes providing nutritional counseling and education to patients and their caretakers, participating in ward rounds as a part of a multidisciplinary team, and providing dietary products to malnourished patients. Therapeutic products that are available for patients at CHUK include: Therapeutic Milk F-75 and F-100, Ready-to-Use Therapeutic Food (RUTF), corn soya blend or SOSOMA (fortified corn soya blend), Biscuit BP100, Resomal, and total parenteral nutrition (TPN) (77). Although these therapeutic foods are available, anecdotal evidence from hospital staff at CHUK indicates that there is not sufficient funding to provide these products for all patients, and supply levels are too unpredictable to be relied upon.

In 2019, there were 33 nurses working in the CHUK ICU (79), but more recent records indicate that there are currently 30 nurses and five physicians on the unit (J Habyramina, personal

communication, May 2021). EN practices among CHUK ICU and emergency department nurses (n=33 adult ICU, n=10 pediatric ICU, n=26 emergency departments) were recently investigated to determine barriers to EN feeding practices (79). This study found that 100% (n=69) of nurses surveyed felt that EN had a positive impact on patients outcomes; however, 83% (n=57) felt that there was a lack of EN guidelines, 73% (n=50) did not understand the language of the guidelines, 71% (n=49) were not familiar with the guidelines, and 78% (n=54) did not feel that the guidelines were easily accessible when they wanted to refer to them (79). While this study provided valuable insight into the barriers to EN feeding practices at CHUK, further investigation is required, such as better understanding the gaps in language (terminology, or dialect/language), and accessibility.

2.2 Malnutrition

Malnutrition is the deficiency or imbalance of nutrients and/or energy, and can be classified as undernutrition (80), micronutrient malnutrition (81), and overnutrition (80); however, this review will only focus on the clinical definition of malnutrition, which includes undernutrition and micronutrient malnutrition (82,83). Malnutrition can be caused by many factors, including inadequate dietary intake (due to a low quantity, quality, or combination of nutrients), malabsorption of nutrients, and/or consuming foods contaminated with pathogens, thus impairing nutrient absorption (84). For example, foods contaminated with pathogens can cause foodborne illness, leading to the malnutrition-infection cycle (34–37) (see **Table 2-1**). There is a strong causal link between food security and malnutrition (19), of which the consequences include increased health care costs, slowed economic growth, and reduced productivity (80).

Undernutrition can further be classified as wasting, stunting, and underweight (80). Wasting, or low weight-for-height, is typically indicative of a recent and severe weight loss due to inadequate calorie consumption, or impaired absorption due to an infectious disease. Conversely, stunting, low height-for-age, is due to chronic or recurrent undernutrition, and often stems from early life undernutrition. Underweight, low weight-for-age, can include stunting, wasting, or both (80). All three classifications of undernutrition put the individual at an increased risk of infection (85). In 2019 the rate of undernutrition in Rwanda was 35%, compared to 21% in Sub-Saharan Africa,

and 29% in low-income countries (86). Those experiencing undernutrition may be at risk for refeeding syndrome (87), which significantly increases morbidity and mortality rates.

Micronutrient-related malnutrition, which is also referred to as hidden hunger, occurs when vitamin and mineral intake is insufficient, and/or there is insufficient micronutrient absorption (80). This type of malnutrition can occur in the presence of sufficient energy intake, for example with an energy-dense, but nutrient-poor diet of insufficient quality to meet micronutrient requirements (81). A nationally representative micronutrient survey has not been conducted in Rwanda to assess micronutrient-related malnutrition since the mid-1990s (88); however, some micronutrient deficiencies of concern have been assessed. It has been reported that 19% of women of reproductive age are anemic (88), and that inadequate dietary intakes among the Rwandan population are estimated at 35% for zinc, 75% for calcium, 60% for vitamin A, 33% for riboflavin, and 55% for vitamin B12 (89).

2.3 Hospital Malnutrition

It is estimated that hospitalized adults worldwide experience malnutrition rates of 19 to 59%, and LMIC settings account for the highest rates (90–97), with Sub-Saharan Africa experiencing rates between 19 and 62% (98–101). Current data also suggest that at least one third of patients in LMIC have some degree of malnutrition upon admission to the hospital, and approximately one third of all those admitted may become malnourished while in the hospital (102).

Malnutrition is a contributing factor to hospital-related morbidity worldwide (103). It is well established that poor inpatient nutritional status is associated with prolonged LOS, worsened perioperative outcomes, increased rate of readmission, increased utilization of resources, as well as hospital costs in both high- and LMIC settings (99,104–112). In Canada, moderately malnourished patients have been found to have an 18% ($p=0.014$) longer LOS, with 23% ($p=0.014$) for medical stays, and 32% ($p=0.015$) for surgical stays compared to well-nourished peers (90). Similarly, in Africa, patients assessed to be at risk of malnutrition on admission had a 15% increased LOS (6.71 ± 5.62 days; n=1183) compared to those not at risk (5.71 ± 5.26 days; n=802; $p<0.001$) (112). The cost of malnutrition in Africa has not yet been studied (112); however, the cost in other countries such as Canada, Mexico and the United States of America is

estimated to be between USD$1200-3800 per patient (91,113,114). Malnutrition is of particular concern for the critically ill, among whom the rates of malnutrition are 38-78%, because they are often in an increased proinflammatory state (115). This state can significantly exacerbate nutrition status, likely magnifying the effects of malnutrition (115), and rapidly taking a patient who initially appeared well-nourished into acute malnutrition (116). Indeed, it has been established that in the presence of malnutrition, ICU patients are more likely to experience increased LOS, readmission rate, risk of infection, dependency on mechanical ventilation, and risk of mortality (115,117). Studies have also shown that mortality rates of patients with the novel coronavirus SARS-CoV-2 (COVID-19) are 10 times more likely (OR=10.14; 95% CI, 6.49-15.82) to occur in the presences of malnutrition (118).

There are numerous causes of poor nutritional status among hospitalized patients, including malnutrition at the time of hospital admittance, inadequate hospital feeding protocols, illness or medication-related loss of appetite, nutrient malabsorption, reduced ability to chew or swallow, and nil per os (NPO) status for diagnostic and therapeutic procedures (104,119). In addition, hospitalized patients may have increased energy, protein, and essential micronutrient needs because of inflammation, infection, or other catabolic conditions (119). People with peritonitis, which is common among ICU patients at CHUK (78), for example, may have a low appetite, increased loss of nutrients through diarrhea and vomiting, and increased calorie and nutrient demands; all of which synergistically increase the risk of malnutrition, infection, and morbidity (109).

There is a dearth of evidence on global malnutrition rates, including from Sub-Saharan Africa, with only one study to date exploring hospital malnutrition in Rwanda, which was conducted at CHUK in 2017 (78). Investigators in this study used the American Society for parenteral and enteral nutrition (ASPEN) diagnostic criteria to assess 279 acute care surgery participants for malnutrition at admission, and once per week thereafter, for a maximum of four weeks (see **Table 2-4**). Evidence of malnutrition was identified in 35% of participants at admission, with rates worsening during their hospitalization. Patients with malnutrition had worse outcomes than those with no malnutrition, as evidence by higher mortality rates (8% versus 0.6%), increased admittance to the ICU (10% versus 4%), and increased LOS (17%; 6 days versus 5) (78). While

the LOS increase of only one day may not appear to be clinically significant, it is consistent with the literature in other African countries (112), and may be attributed to the overall short LOS in acute care surgery wards. Since Rwandan's are heavily reliant on their agriculture sector (3), it is important to note that the minor lean season (1,28), occurred during the latter half of this study (78), which could have impacted study results due to the effects of seasonality on food security and dietary diversity (28,29).

Table 2-4. Malnutrition at CHUK (adapted from (78))

	Patient Malnourished N=99	Patient Not Malnourished N=180	p-value
At admission	35% (n=99)		
At 1 week	41% (n=48)		
At 2 weeks	37% (n=15)		
At 3 weeks	50% (n=13)		
At 4 weeks	43% (n=6)		
Mortality	8% (n=8)	0.6% (n=1)	0.001
Admitted to ICU	10% (n=10)	4% (n=4)	0.041
ICU LOS, days a	6 (3,9)	5 (4,14)	0.044

[a] Continuous variables reported as median (interquartile range)

2.3.1 Medical Nutrition Therapy for Critically Ill Adult Patients

Medical nutrition therapy (MNT) is the complex, evidence-based application of food and nutrition support that uses oral supplements, food by mouth, EN, and TPN for disease prevention, delay, and management in the clinical setting (77,120,121). Nutrition support protocols, which include nutrition screening, assessment, diagnosis, intervention, monitoring, and evaluation of established disease, are all integral pieces of the effective implementation of the MNT care process (122). Successful implementation of MNT in the critically ill is thought to aid in diminishing the metabolic response to stress, improve immune responses, and prevent oxidative cellular injury (123,124). This review will not focus on TPN or diagnosis as they are not directly relevant to the purpose of this study.

Not all critically ill patients are able to eat orally, and often rely on EN or TPN to meet their nutrition needs (125). Among critically ill patients who are unable to consume at minimum 70% of their daily needs by mouth without vomiting or aspiration (126), EN is recommended over

TPN because EN reduces infectious morbidity and reduces ICU LOS (123,127). Compared to delayed EN, early initiation, within 24-48 hours of admission to the ICU, has been associated with significantly lower mortality rates (RR=0.70; 95% CI, 0.49–1.00), and infectious morbidity (RR=0.74; 95% CI, 0.58–0.93) (123). Further, critical illness is associated with complex immunologic, metabolic, and hormonal changes, which require comprehensive, evidence-based nutrition support that is tailored to the individual patient and hospital (128). This nutrition support should be based on several factors, such as patient disease state, current weight, recent weight loss, and recent diet history, as well as hospital resources and training available to staff. For example, critically ill patient's nutrient requirements slowly increase through three metabolic phases. The first is a brief 'ebb' phase, wherein the patient's energy expenditure is lower and endogenous glucose production occurs. During this stage, the delivery of energy to essential tissues is prioritized, and the patient has hormonal changes and haemodynamic instability. During the second, longer 'flow' phase, tissues are catabolized to provide substrates for the fight or flight response, and to reduce bleeding and infection. The third, recently established phase, is for anabolic recovery, where lost tissue is resynthesized, and the body resumes the ability to process delivered nutrients (128). Clinical nutrition support is complex and requires adequate training, education, and resources to be effectively implemented in order to mitigate the negative effects of malnutrition (129). Many LMIC hospitals have limited nutrition-related training, education, and resources, therefore limiting the capacity to avert the negative effects of malnutrition. Conversely, health authorities in high-income countries (HIC) have internal evidence based EN nutrition guideline documents that are well-utilized (129).

Nutrition screening is done to identify patients who are malnourished, or at risk of malnutrition, in order to determine whether a nutrition assessment should then be performed (130). ASPEN defines nutrition assessment as "a comprehensive approach to diagnosing nutrition problems that uses a combination of the following: medical, nutrition, and medication histories; physical examination; anthropometric measurements; and laboratory data" (131).
Nutrition assessments are done with the aim of leading to recommendations for nutrition interventions, such as changes to diet, EN, or TPN (132). Best practice notes that all hospitalized patients should undergo a nutrition screen within 48 hours of admission; however, patients in the ICU require a full nutrition assessment (123). Nutrition in the hospital setting is commonly

assessed using the ASPEN criteria, or validated tools such as the Subjective Global Assessment (SGA) or the Mini Nutrition Assessment (MNA) (76,126,130,132). It is suggested that comorbid conditions, gastrointestinal tract assessment, and risk of aspiration be included in the assessment of ICU patients, rather than traditional indicators or surrogate markers, which are not valid in critical care (123). Traditional indicators, which include serum protein markers such as albumin, prealbumin, transferrin, and retinol-binding protein, are not an accurate representation of ICU nutrition status because they are instead a reflection the acute phase response (76,123,126). Weight changes are the most commonly used anthropometric measurements, namely, to compare current weight to usual or ideal weight (130); however, it is challenging to interpret this information in ICU patients due to edema from underlying diseases, and fluid administration and depletion (76,123,133). ASPEN recommends the use of the Nutritional Risk Score (NRS-2002) and Nutrition Risk in Critically Ill (NUTRIC) score, which show both disease severity and nutrition status for nutrition assessment in the ICU (76,123); however, the European Society for parenteral and enteral nutrition (ESPEN) recommends a general clinical assessment that includes anamnesis, unintentional weight loss, body composition, and evaluation of muscle mass and strength, as well as considering any critically ill patient at risk for malnutrition when their LOS exceeds 48 hours (76,126).

Prior to the initiation of feeding, hospitalized patients, especially those who are critically ill, should be assessed for risk of refeeding syndrome using criteria such as the ASPEN Consensus Criteria for Identifying Adult Patients at Risk for Refeeding Syndrome, which considers patient characteristics such as serum potassium, magnesium, and phosphorus concentrations, diet history, and comorbidities (134). According to ASPEN there are a number of physical signs and symptoms that can be used to indicate severe refeeding syndrome, such as pulmonary edema indicating sodium retention, seizures indication hypomagnesemia, dementia indicating thiamin deficiency, respiratory failure indicating hypokalemia, and seizures indicating hypophosphatemia (134). Refeeding syndrome can occur upon refeeding after there has been a significant and prolonged reduction in food intake (87,134,135), which could occur at admission or as part of a hospital stay. During undernutrition, gluconeogenesis, the synthesis of glucose from non-carbohydrate sources, and proteolysis, the breakdown of proteins, are stimulated by the absence of food, meanwhile vitamins, especially thiamine, and intracellular electrolytes, such as

magnesium, potassium, and phosphorous, and water are depleted. Vitamin and electrolyte depletion is further exacerbated by diarrhea and emesis, or the use of diuretics. Upon the reintroduction of food, blood glucose levels rise, which stimulates the increase of insulin and pushes phosphorous and potassium into the cells. These fluctuations are especially drastic when refeeding includes high quantities of calories and carbohydrate-rich food sources. Plasma magnesium also decreases upon refeeding, but the mechanism by which this happens is not yet well understood. Since glucose-dependent metabolic pathways use thiamine as a cofactor, refeeding considerably increases the demand for thiamine as well. The combination of previous low food intake or background malnutrition, and other factors such as diarrhea, emesis, and diuretic use, causing sodium, potassium, magnesium, and thiamine to be depleted, paired with the high requirements for these nutrients upon refeeding, can lead to heart failure, acute respiratory failure, neurologic disorders, paralysis, hypothermia, coma, death, and more within two to five days of refeeding. As such, feeding critically ill patients necessitates carefully derived diets that adequately address the potential for refeeding syndrome by including increased levels of the abovementioned micronutrients (87,134,135).

Calculating critical care patient energy and protein needs is a complex and multifactorial component of adequate MNT and acute care recovery, and further demonstrates the need for well-established hospital protocols (123,126,129). Accurate calorie calculations prevent overfeeding, which can lead to hyperglycemia, and underfeeding can further compound malnutrition, both resulting in poorer patient outcomes (136). While indirect calorimetry is the most highly recommended method to determine energy requirements (76,126), its use is impeded by its availability and cost, making it infeasible in low resource settings. Therefore, in the absence of indirect calorimetry, predictive equations, or generic formulas such as proposed intakes of 25-30 /kg/day by ASPEN or 20-25 kcal/kg/day by ESPEN should be used and re-evaluated more than once per week (123, 126). When using weight-based calculations for the critically ill who have presence of edema, anasarca, or are following an aggressive volume resuscitation, usual body weight should be used, rather than current body weight. For patients with a body mass index (BMI) of 30-50 kg/m^2, 11-14 kcal/kg/day actual body weight should be used, and for patients with a BMI >50 kg/m^2, 22-25 kcal/kg/day ideal body weight should be used (123). Patients who are at risk for refeeding syndrome should begin with 10-20 kcal/kg for

the first 24 hours, increasing by 33% of their energy requirement goal every one to two days (134). If patients are deemed at risk for refeeding syndrome, thiamine should be supplemented and electrolytes checked prior to the initiation of feeding, calories should be gradually introduced, vital signs should be monitored every four hours, weight should be taken daily, and inputs and outputs should be monitored. High risk patients should continue to have thiamine supplemented for at least 5-7 days, and electrolytes monitored at least every 12 hours for the first three days (134).

Protein is thought to be the most important macronutrient for supporting immune function, healing wounds and maintaining lean body mass in critical care patients (123). To that end, ESPEN recommends using 1.3 g/kg to calculate critically ill patient protein requirements (126), whereas ASPEN recommends using 1.2-2.0 g/kg (123), both of which should be calculated based on actual body weight (123,126), except in the case of obese patients, where calculations should be made based on adjusted body weight because adipose tissue has lower energy expenditure and protein turnover than lean tissue does (126). Energy and protein targets are difficult for ICU patients worldwide to meet due to co-morbidities, gastrointestinal tolerance, staffing numbers and practices, management protocols, and available equipment (137–140). In HIC hospitals there is a wide selection of commercial formulas or hospital-derived diets available to meet patient energy and protein targets, along with other needs, such as immune enhancement; however, in LMIC there is limited access to such products (141). This is true of CHUK where only a few therapeutic foods are available for use, such as F75 (77), and instead patient food intake is reliant on what the patient's caretaker provides for them (78). The issue at CHUK is further exacerbated among patients reliant on EN due to an apparent lack of clear EN guidelines available to staff to help support the patient and their caretaker (79).

Critically ill patients should be frequently monitored to establish that the level of nutrients provided are appropriate (142), EN should be monitored daily for tolerance and aspiration (123), and adjustments should made to both orally and EN fed patient's care plans as needed to maintain optimal nutrition health (142). Clear training, protocols, and resources are required to ensure these practices are done consistently for all patients (129).

2.4 Conclusion

Hospital malnutrition is a global issue (90–97) that can lead to worsened perioperative outcomes, and increased LOS, readmission, and hospital-associated resources and costs (98,104–112). Feeding the critically ill patient is complex, but providing safe and nutritionally adequate food (32–34,109,119), as well as thorough hospital-specific nutrition protocols for critical care healthcare professionals to follow, can help reduce malnutrition rates and the associated consequences (128,129). For food to be safe for consumption there is a long list of proper food handling techniques that must be followed, such as ensuring food is not left at room temperature for more than two hours, safe drinking water that has not been contaminated by poor sanitation is used in food preparation, and proper hand hygiene is followed (34,43,44). Nutritionally adequate food for critically ill patients should be based on several factors, such as patient disease state, current weight, recent weight loss, and recent diet history, and the patient should be frequently monitored to adapt and adjust their care plan to their changing needs over their inpatient stay (128). Food insecure and marginally food secure people, of which 57% of the population in Rwanda are (1), have lower dietary diversity (23), and more difficulty accessing safe and nutritious food (1). Given that patients with complex nutritional needs (126,128,129,136) rely on potentially food-insecure caretaker (78), and also that there appears to be a lack of clear EN guidelines at CHUK (79), research is required to better understand both the usual diet provided to patients in the ICU, and staff perceptions of EN guidelines, in order to optimize nutrition for CHUK ICU patients in the future.

3.0 Rationale

It is unclear what nutrition support potentially already food insecure families, who must travel and stay in- or near- the hospital to feed their loved ones, are able to provide to critically ill patients. Thus, investigating the sociodemographic information of patient's families and assessing patient food intake will provide insight into the nutritional quality of foods currently provided to ICU patients. We hope that this study will inform future research and potentially lead to institutional change to feed patients most nutritionally at risk, as a means of reducing hospital LOS and nutrition-related health complications. Additionally, recent research indicates a lack of clear EN guidelines for ICU staff to follow. We hope the survey of current EN nutrition practices will offer insight into whether policies and guidelines need to be modified to ensure safe and effective EN execution in the ICU at CHUK.

4.0 Objectives

The study objectives are as follows:

1. To describe the food intake and nutrition care of hospitalized patients in the ICU at CHUK.
2. To understand current healthcare practitioner knowledge and practices surrounding nutrition, feeding, and EN in the ICU at CHUK.

5.0 Methods

5.1 Study Design

This hospital-based repeated-measures study describes patient demographic information, food intake, and the perceived nutrition support received by hospitalized patients in the ICU at CHUK. It also documents current healthcare practitioner knowledge and practices surrounding nutrition, feeding, and EN in the ICU at CHUK.

5.2 Research Tools

Objective 1:

The research tools for Objective 1 consisted of a baseline questionnaire and follow-up questionnaire, both of which were administered by the research assistant (RA). The baseline questionnaire (see ***Appendix A***) collects basic patient demographic information. The follow-up questionnaire includes three modules (see ***Appendix B***), including dietary advice given to the caretaker, the patient's dietary intake and mode of food delivery, and the FAO's internationally validated Individual Dietary Diversity Questionnaire (DDS) (23).

Objective 2:

The research tool for Objective 2 consisted of an ICU staff survey of nutrition, feeding, and EN practices, which was self-administered by ICU staff (see ***Appendix C***). This tool included questions regarding demographic information, advice given to patients and their caretakers regarding nutrition, a knowledge survey of current EN practices, and open-ended questions to seek out opinions on the biggest barriers to EN at CHUK, and any suggestions for overcoming these barriers.

5.3 Participants and Sampling

5.3.1 Eligibility Criteria

The study sample for Objective 1 included patients 18 years of age or older who were under intensive care at CHUK for a maximum of 24 hours prior to enrollment, who were expected to stay in the ICU at CHUK for at least 24 hours, who were not exclusively relying on TPN to meet their nutritional needs, and who were willing to provide written informed consent to participate in the study.

The study sample for Objective 2 included CHUK ICU nurses, dietitians, and physicians who were working in the CHUK ICU during recruitment, were 18 years of age or older and were willing to provide written informed consent to participate in the study.

5.3.2 Ethical Considerations

Research ethics was approved by the following research ethics boards (REB)/Institutional Review Boards (IRB): Mount Saint Vincent University (MSVU) Ethics Committee Canada (MSVU REB # 2019-137) (see ***Appendix D and E***), Dalhousie University Ethics Committee Canada (DAL REB # 2020-5053) (***Appendix F and G***), and CHUK Ethics Committee Rwanda (EC/CHUK/1/017/2020) (***Appendix H***). All participants provided written, informed consent to participate (***Appendix I and J***).

5.3.3. Research context: COVID-19 pandemic

COVID-19 is an infectious disease that primarily spreads via respiratory droplets and close contact with infected persons (143), mainly affecting the respiratory system, causing pneumonia and acute respiratory distress syndrome (144). On January 19, 2020, the World Health Organization (WHO) declared COVID-19 as an outbreak, and on March 11, 2020, as a pandemic (145). As of April 22, 2021, Rwanda had 24 262 confirmed cases of COVID-19, and 328 related deaths (146). Data collection commenced on April 18, 2021, during the COVID-19 pandemic.

The COVID-19 pandemic has had an impact on global food security (147). From January 2020 to May 2021, global food prices had increased by 38%, with maize increasing by 80% and wheat by 28%. These food price increases were exacerbated by reduced incomes and disrupted supply chains, with the impact of the pandemic on food security expected to persist for years to come

(147). Through the same time period, in Rwanda, there was a 15% increase in the cost of a nutritious diet in urban areas and 12% in rural areas, and restricted access to Lake Kivu impacted households reliant on fish caught from the lake (148). A sample of Rwandans were surveyed during the COVID-19 pandemic, with 95% of respondents indicating a decline in their income, and 88% reporting that they were food insecure (148). As of March 2021, the approximately 164 000 refugees living in Rwanda were further affected by the COVID-19 pandemic due to a 60% cut in food rations from the World Food Programme, further deepening their food insecurity (149).

5.3.4 Sampling and sample size

Both patient and staff participants were recruited via convenience sampling. All patient participants in the ICU at CHUK who met the eligibility criteria were approached by the RA, at a time deemed appropriate by their healthcare team, who described the study and invited them to participate. All staff participants working in the ICU at CHUK who met the eligibility criteria were approached by the RA at a time when interruption to their daily work tasks was expected to be minimal. Recruitment took place over a three-month period, beginning April 18, 2021 and ending July 13, 2021.

Given the exploratory nature of this study and the lack of peer-reviewed literature on the number of patients who were likely to meet the eligibility criteria, there was insufficient data to inform a sample size calculation. Based on the 11 available intensive care beds (77), and a median LOS of six days previously reported in the literature (78), the maximum number of patients that could be recruited into the study was estimated to be 165. All nurses, dietitians and physicians working in the CHUK ICU were invited to participate in this study. Anecdotal evidence indicated that the expected number of staff participants could be up to 36 (estimated 30 nurses, one dietitian, and five physicians).

5.3.4.1 Data Collection Procedures

To minimize cultural bias and the hegemonic project of whiteness (150) and instead support local Rwandan people's agency by doing research-with them, rather than research-on them (151), all study materials were reviewed and approved by Rwandan contacts who have previously worked in the ICU at CHUK, and a local RA, Mr. Jean de Dieu Tuyishime

Habyramina, whose idea sparked the initial project, was hired to collect the data, speak to participants in their preferred language, and translate consent forms and self-administered questionnaires. To increase reliability, Mr. Jean de Dieu Tuyishime Habyramina was the sole RA who administered all questionnaires and conducted all interviews.

Objective 1:
For patient participants, RA-administered questionnaires were chosen to allow for probing to get more detailed answers, the opportunity for both the RA and the participants to clarify questions and responses, and to minimize the risk of unanswered questions/incomplete questionnaires. All verbal communication with participants was in their preferred language of English, Kinyarwanda, or French, and all consent forms and questionnaires were written in both English and Kinyarwanda.

ICU patients often do not have the capacity to consent or answer a questionnaire (152), therefore in this situation a designated surrogate decision maker consented to and answered the questionnaires on the patient's behalf.

The baseline questionnaire was administered by the RA to consenting patient participants or their surrogate, after the written informed consent was obtained from the participating patients or their surrogate (see ***Appendix A***). The follow-up questionnaire (see ***Appendix B***) was administered by the RA on days 2, 4, 6 and weekly thereafter until discharge (or death) to patient participants or their surrogate. The RA reviewed the patient's medical chart to include any relevant missing details about food, fluids, or reference to/indication that feeding guidelines/protocols were used.

Objective 2:
The CHUK ICU staff survey of practices (see ***Appendix C***) was self-administered by consenting staff participants, after their written informed consent was obtained. Self-administered questionnaires were chosen to minimize participant burden given the staff's busy work schedules. This method was also chosen because the RA is known to the CHUK ICU staff, which could lead to social desirability bias and influence participants answers.

5.4 Data Management

Participants were given an identification code unique to our study. A key linking the participant code to participant information are kept as a password-protected file on a password protected university server (OneDrive, MSVU, Canada). This unique identifier was not derived from personal identifiers. Paper consent forms and questionnaires were scanned and uploaded as password-protected files on the password-protected OneDrive server. The paper files were then stored in a locked cupboard in a locked office at CHUK until they were confirmed as scanned copies. To ensure data safety, these electronic files were downloaded to two separate hard drives in Canada, which are stored in a locked filing cabinet in the locked research office at MSVU. Once data collection was complete and all data were entered into analysis software, the paper copies of the consent forms and questionnaires were destroyed (shredded). The electronic copies of these consent forms and questionnaires on the OneDrive and two hard drives will be retained for at least five years after publication of results, after which the hard drives will be deleted and physically destroyed, and the OneDrive server files permanently deleted.

5.5 Statistical Analysis

Objective 1:

The first objective was to describe the food and nutrient intake of patients in the CHUK ICU, with the primary outcome variable being the patient's dietary diversity score. Given that patient participants were assessed on their individual diet, rather than household, the DDS was utilized: although originally designed for use among women, it can be applied to individuals from other age/sex groups (23). DDS was interpreted as a continuous outcome variable (score 1-9 (23)) in two ways, as a score on the patient participant's day of discharge, and as a mean score over the duration of their ICU stay. In addition, a protein DDS, assessing only protein foods (score 0-6) was calculated as a mean score over the duration of their ICU stay. The protein score was defined as consuming food from one of the following groups: organ meat, flesh meats, eggs, fish and seafood, legumes, nuts, and seeds, and milk and milk products.

Descriptive statistics were computed and presented as mean ± standard deviation (SD) for continuous variables, such as patient's age, and *n* (%) for categorical variables, such as patient Ubudehe classification. While the primary objective was to describe dietary intake, we also computed inferential statistics to understand whether differences existed by the following patient

sociodemographic and clinical, and caretaker burden characteristics: patient Ubudehe category (collapsed categories 1 & 2 and 3 & 4), age (continuous), sex (male or female), education attainment (none, primary/ordinary, secondary, or university), marital status (married, divorced/separated, widowed, or single), residence (Kigali or outside of Kigali), BMI (underweight (≤18.49 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), or obese (≥30.0 kg/m^2)), LOS (continuous), and mortality (yes or no), caretaker's residence (Kigali or outside of Kigali), and caretaker's perceived financial burden of hospital stay (yes or no). BMI was calculated using patient/surrogate-reported weight and height calculated from knee height using the Chumlea stature equation (153).

Mean overall DDS and protein-DDS were both compared as outcome variables by caretaker's residence using an independent t-test, by patient's Ubudehe categories, sex, and residence using a Mann-Whitney U test, by patient marital status and caretaker perceived financial burden with a Kruskal-Wallis test, and by patient education attainment with a one-way analysis of variance (ANOVA).

Mean overall DDS and protein-DDS were also compared as continuous predictor variables for LOS and mortality. A Pearson's correlation coefficient was calculated to assess differences between patient's LOS and mean overall DDS and protein-DDS, and a logistic regression was built to assess differences between patient mortality and mean overall DDS and protein-DDS.

All statical analyses were performed using IBM SPSS software (Version 25; IBM Corp, Armonk, New York) with a significance level of $p<0.05$.

Objective 2:

To explore current healthcare practitioner knowledge and practices surrounding nutrition, feeding, and EN in the ICU at CHUK, descriptive statistics (mean ± SD and *n* %)) of quantitative responses, such as whether and how patients are assessed for refeeding syndrome, and thematic analysis of all qualitative responses, such as the staff's opinions and suggestions to perceived barriers to EN in the CHUK ICU, were employed. Quantitative data analyses were completed using IBM SPSS software (Version 25; IBM Corp, Armonk, New York). Open-ended responses were thematically analyzed using inductive coding, chosen to allow the themes to be driven by

the data through patterns and codes using Microsoft Excel (Microsoft Excel 2016; IBM Corp, Armonk, New York) (154). Inductively coded themes were then arranged into subthemes (155).

5.6 Dissemination of Study Findings

The results of this study will be submitted as a manuscript to a peer reviewed journal related to nutrition, such as *Nutrition in Clinical Practice*, and as an abstract to a relevant academic conference, such as the ASPEN Nutrition Science and Practice Conference. The hospital administration and the Rwandan Ministry of Health will also be apprised of the results. Overall study results will be made available to the public following completion of the research project at www.mamalab.ca.

6.0 Results

Objective 1: Patient participants

Of the 99 patients admitted to the CHUK ICU during the period of April 18 through July 13, 2021, 73 met the eligibility criteria and consented to participate in the study. Reasons that 26 patients were excluded from the study included, 14 patients who were under 18 years of age, five patients who were admitted more than 24 hours before data collection began, five patients who died or were expected to die within 24 hours of admission, one patient who was NPO and excluded in error, one patient who was both admitted to the ICU 24 hours before data collection began and was under 18 years of age, one patient who was discharged within 24 hours of admission, and one patient who was incapacitated and had no caretaker to consent for them. Of the 73 patient participants, 40 were male and 33 were female, with a mean age of 44.0 ± 2.1 years (see **Table 6-1**). Most participants were married (52%), lived outside of Kigali (77%), obtained secondary level education (55%), were classified as Ubudehe 2 (75%), and were farmers by occupation (48%). The average BMI for all participants was 20.3 ± 4.1 kg/m^2, and most patients were admitted for two or more reasons (55%), with the predominant reason being for post-surgery (n=42) (see **Table 6-2**). The average LOS was 4.6 ± 3.9 days, ranging from one to 23 days, with a prevalence of mortality in the ICU of 24%.

Table 6-1. Patient participant characteristics

	All *n*=73 [a]
Sex	
Male	40 (55%)
Female	33 (45%)
Age, *years*	44.0 ± 2.1
Range, years	(18 - 86)
Marital Status	
Married	52 (71%)
Single	18 (25%)
Widowed	3 (4%)
Residence	
Kigali	17 (23%)
Outside Kigali	56 (77%)
Educational Attainment	
None	3 (4%)
Primary/Ordinary	26 (36%)
Secondary	40 (55%)
University	4 (6%)
Ubudehe classification	
1 (lowest economic status)	2 (3%)
2	54 (75%)
3	15 (21%)
4 (highest economic status)	1 (1%)
Occupation	
Farmer	34 (48%)
Seller/retail	18 (25%)
Other	21 (27%)

Data presented as mean ± SD, (range), or *n* (%). Columns may not add to 100% due to rounding.
[a] Missing *n*: Ubudehe classification, missing *n=1* due to one refugee; Occupation, missing *n*=2 due to skipped question.

Table 6-2. Clinical characteristics of patient participants

	All n=73 [a]
BMI, *kg/m²* [b]	20.3 ± 4.1
Underweight (<18.5 kg/m²)	28 (39%)
Normal (18.5-24.9 kg/m²)	37 (51%)
Overweight (25.0-29.9 kg/m²)	3 (4%)
Obese (≥30.0 kg/m²)	4 (6%)
Reasons for ICU Admission [c]	
Post-surgery	42
Neurological illness	28
Infectious disease	26
Major illness	16
Intestinal obstruction	1
Single reason for ICU admission	33 (45%)
2 or more reasons for admission	40 (55%)
Length of stay in ICU, *days*	4.6 ± 3.9
Range, days	(1 – 23)
Reason for discharge from ICU	
Deceased	17 (24%)
Moved to neurosurgical ward	24 (34%)
Moved to medical ward	14 (20%)
Moved to other hospital ward	16 (23%)

Data presented as mean ± SD, (range), *n,* or *n* (%). Columns may not add to 100% due to rounding.
[a] Missing *n*: BMI missing *n=1* due to one implausible height; Reason for Discharge from ICU missing n=2, unknown discharge location.
[b] Weights are self-reported. Height is calculated using knee height and the Chumlea stature equation (153).
[c] Reasons for ICU admission are not mutually exclusive.

Patient participant dietary diversity scores were 4.2 ± 0.2 on their day of discharge, with a score of 4.2 ± 0.1 over their entire ICU stay (see **Table 6-3**). Patients consumed 1.1 ± 0.5 protein food groups over their entire ICU stay, with 96% of overall days with meals containing a protein of any kind. However, milk made up the majority of the protein in patients' diets: when excluding milk as a protein food, only 22% of meals contained another protein of any kind. Patients received 4.7 ± 1.5 meals daily. One-fifth of patients had an individual day with no protein source foods. The mean protein-DDS of patients in Ubudehe 3&4 (0.83 ± 0.4) was significantly lower compared with patients in Ubudehe 1&2 (1.2 ± 0.5; p=0.002). Beyond Ubudehe classification, patient participant's DDS on day of discharge, overall mean DDS, and protein-DDS did not differ by any other sociodemographic, clinical, or caretaker burden variables described above (all

p>0.05). In addition, there was no association found between either of overall DDS and protein-DDS and LOS or mortality (all p>0.05).

Patients were predominantly fed by nursing staff (77%) via EN (91%) (see **Table 6-4**). The most common meals patients received were potage without any protein food groups (21%) and porridge with milk (20%) (see **Box 6-1)**. Patient meals were primarily sourced from nearby restaurants (51%) or the hospital restaurant (44%), and the water consumed by patients was usually bottled (66%).

The patient caretaker was usually a family member that was not their spouse (42%) (see **Table 6-5**). The majority of caretakers reported that they stayed at the hospital while caring for the patient (80%), missed work to provide food to the patient (93%), missed other obligations such as child or family care for others (99%), and perceived there to be a financial barrier to providing food for the patient (83%).

Table 6-3. Dietary diversity among patient participants

	n [a]	**mean ± SD (range) or *n* (%)**
DDS [b] on day of discharge	73	4.2 ± 0.2
Range		(1 – 6)
Patient's mean DDS over ICU stay [c]	73	4.2 ± 0.1
Range		(1 – 6)
Patient's mean protein-DDS intake over ICU stay [d]	73	1.1 ± 0.5 (0 - 2.5)
Overall patient days with any protein [d]	133	127 (96%)
Overall patient days with protein, [d] excluding milk	133	30 (23%)
Patients who had an individual day with no consumption of protein foods [c]	73	14 (21%)
Number of daily meals [c]	127	4.7 ± 1.5 (0 - 10)

[a] Missing *n*: DDS at Discharge missing n=6, patients were NPO at discharge; Patient's mean DDS Score over ICU stay missing n=4 patients were NPO through entire ICU stay; Individual who fed patient missing n=2 not recorded.
[b] DDS calculated out of 9 food groups, a proxy for micronutrient intakes: starchy staples, dark leafy green vegetables, other vitamin A-rich fruits and vegetables, other fruits and vegetables, organ meat, flesh meat and fish and seafood, eggs, legumes, nuts, and seeds, and milk and milk products.
[c] Excluded n=6 participants with at least 1-day NPO during stay.
[d] Protein-DDS calculated out of 6 food groups: Protein food groups included: organ meat, flesh meat, fish and seafood, eggs, legumes nuts, and seeds, and milk and milk products.

Box 6-1. Common patient meals and their ingredient

Meal type	**Common ingredients**
Potage	collard greens, spinach, tomatoes, onion, Irish potatoes, fish, beef, liver, eggs, oil, salt
Porridge	sorghum, maize, wheat, sugar, milk
Smoothie	banana, passion fruit, orange, mango, beets, tamarillo, pineapple, papaya

Table 6-4. Patient participant's nutrition and feeding during ICU stay

	All n=73
Individual who fed patient	
Nurse	54 (77%)
Patient's caregiver	4 (6%)
Both nurse and patient's caretaker	8 (11%)
N/A: patient fully NPO	4 (6%)
Mode of delivery	
Tube	286 (91%)
By mouth	30 (9%)
Meal types consumed by patients	
Potage	
with protein [a]	23 (6%)
without protein [a]	81 (21%)
Porridge	
with milk	79 (20%)
without milk	46 (12%)
Commercial cow's milk	62 (16%)
Commercial juice	40 (10%)
Smoothie	32 (8%)
Specialty medical foods [b]	18 (5%)
Mixed plate	9 (2%)
Coffee/tea	2 (1%)
Source of patient's meals	
Restaurant	65 (51%)
Hospital restaurant	57 (44%)
Home-cooked meals	7 (5%)
Source of patient's drinking water	
Bottled water	87 (66%)
Boiled tap or well water	28 (21%)
Filtered water	16 (13%)

Data presented as *n* (%) as a proportion of total feedings among all participants. Columns may not add to 100% due to rounding.

[a] Protein food groups included: organ meat, flesh meat, fish and seafood, eggs, legumes nuts, and seeds, and milk and milk products.

[b] Specialty medical foods include: F75, F100, TPN, and RUTF products.

Table 6-5. Burden on patient's caretaker

	All n = 73[a]
Patient caretaker	
Spouse	19 (28%)
Other family member	31 (42%)
Two or more of the caretakers listed above	19 (28%)
Accommodations while caretaking	
Hospital	55 (80%)
Home and travel to the hospital	8 (11%)
With a friend	3 (4%)
Two of the accommodations listed above	3 (4%)
Missed work to provide food to patient	
Yes	65 (93%)
Different answers on different days [b]	1 (1%)
Missed other obligations (e.g. child or family care for others) to provide food for patient	
Yes	69 (99%)
Perceived financial burden to providing food for patient	
Yes	58 (83%)
Different answers on different days [b]	3 (4%)

Data presented as *n* (%). Columns may not add to 100% due to rounding.
[a] Missing n due to skipped questions*:* Patient caretaker n= 4; Accommodations while caretaking n = 4; Missed work to provide food to patient n = 3; Missed other obligations to provide food for patient n = 3; Perceived financial burden to providing food for patient n = 3.
[b] Responses differed during follow-up questionnaire at multiple time points.

Objective 2: Staff participants

Staff participant data were collected during the period of July 5 through July 18, 2021. Self-administered questionnaires were completed by 22 out of 25 nurses, four out of six physicians, and the only dietitian working in the CHUK ICU. Demographic details of these staff participants can be found in **Table 6-6**. Most staff were female (78%) and were nurses (82%). Nurses had been practicing in their profession for 11.6 ± 5.4 years and practicing in the CHUK ICU for 9.9 ± 6.4; however, physicians had only been working in their profession for 2.7 ± 1.2 and the CHUK ICU for 1.9 ± 1.2 years.

Table 6-6. Staff participant characteristics

	All n=27 [a]
Sex	
Male	6 (22%)
Female	21 (78%)
Age, *years*	37.9 ± 6.8
Range, years	(29 - 54)
Profession	
Nurse	22 (82%)
Dietitian	1 (4%)
Physician	4 (15%)
Years working in profession	
Nurse	11.6 ± 5.4
Range, years	(5-22)
Dietitian	26
Physician	2.7 ± 1.2
Range, years	(2 - 4)
Years working at CHUK ICU	-
Nurse	9.9 ± 6.4
Range, years	(3 - 22)
Dietitian	16
Physician	1.9 ± 1.2
Range, years	(1 - 3)

Data presented as mean ± SD, (range), or *n* (%). Columns may not add to 100% due to rounding.
[a] Missing *n*: all missing due to skipped questions: age n=2; Years working in profession (nurse and physician) n=2; and Years working at CHUK (physician) n=1.

Most staff reported that they assess every patient for malnutrition (74%), but most did not report using a malnutrition assessment tool (78%) (see **Table 6-7**). When asked how they assess for malnutrition, answers varied from visually seeing that the patient looks malnourished, to the presence of edema, use of biochemical markers such as albumin, prealbumin, transferrin, retinal-binding protein and C-reactive protein, assessment of diet history, and consideration of patient-reported weight loss. Most staff reported that they never assessed patient weight (85%), swallow/dysphagia (56%), or refeeding syndrome (42%), they never performed energy (88%) or protein calculations (92%), nor did they check biochemical lab values prior to initiating EN (62%). Every staff participant reported that they recorded fluid intake and output for every patient, and most reported that they recorded bowel function for every patient (89%). Half of the

staff participants believed that physicians usually decided whether a patient should receive EN, with 100% of physicians reporting that they are the ones to make the decision (See **Table 6-8**). Most staff felt they did not receive EN-specific training (56%), that they needed more EN training (54%), and were not aware of written guidelines used in the CHUK ICU (70%). Most of the CHUK ICU staff participants reported that bolus or continuous feed selections for EN patients were made on a case-by-case basis (59%), and that they always flushed EN-fed patient's tubes between feedings/medications (93%).

Table 6-7. Staff self-reported malnutrition-related assessments performed in the CHUK ICU

	All *n*=27				
	Never	**Some patients**	**Most patients**	**Every patient**	**I do not know**
Malnutrition	3 (11%)	1 (4%)	3 (11%)	20 (74%)	-
Malnutrition Assessment Tool	21 (78%)	4 (15%)	-	2 (7%)	-
Weight [a]	22 (85%)	2 (7%)	1 (4%)	1 (4%)	-
Swallow/dysphagia	15 (56%)	8 (30%)	1 (4%)	3 (11%)	-
Refeeding syndrome [a]	11 (42%)	5 (19%)	-	4 (15%)	6 (23%)
Energy calculations [a]	23 (88%)	1 (4%)	1 (4%)	1 (4%)	-
Protein calculations	25 (92%)	1 (4%)	-	1 (4%)	-
Biochemical lab values [a]	16 (62%)	1 (4%)	5 (19%)	4 (15%)	-
Fluid intake	-	-	-	27 (100%)	-
Fluid output	-	-	-	27 (100%)	-
Bowel function	-	2 (7%)	1 (4%)	24 (89%)	-

Data presented as *n* (%). Rows may not add to 100% due to rounding.
[a] Missing n: n=1 nurse missing from weight, n=4 nurses from refeeding syndrome, n= 1 nurse from energy calculations and biochemical lab values, due to skipped question.

Table 6-8. Staff self-reported EN practices in the CHUK ICU

	All *n*=27
Person who usually decides whether a patient will receive EN [a]	
Nurse	2 (8%)
Dietitian	1 (4%)
Physician	13 (50%)
Dietitian and physician	5 (19%)
Nurse, dietitian, and physician	5 (19%)
Received EN-specific training	
No	15 (56%)
During nursing/dietetic/medical degree	8 (30%)
During training at CHUK or continuing education	3 (12%)
During degree and continuing education	1 (4%)
Inadequate training to provide EN care to patients [b]	7 (54%)
Aware of written guidelines for EN	8 (30%)
Usual Method of EN	
Bolus	9 (33%)
Continuous	2 (7%)
Decision made on a case-by-case basis	16 (59%)
Tube flushed between feedings/medications	
Every patient	25 (93%)
Most patients (>50%)	1 (4%)
Some patients (<50%)	1 (4%)

Data presented as *n* (%). Columns may not add to 100% due to rounding.
[a] Missing n: n=1 nurse missing due to skipped question.
[b] Of n=15 participants who selected a 'no' response to the previous question were directed to skip this question and were not included in the results.

Nutrition advice given by staff to patient's caretakers, as well as reported by caretakers, is summarized in **Figure 7-1**. The predominant theme emerging from staff member participants was that they instructed caretakers regarding bringing/preparing a balanced diet/nutrition (n=16), with smaller numbers of staff participants noting that advice varied depending on the patient's clinical condition (n=3), then porridge and milk (n=2). The predominant themes for advice that patient caretakers reported receiving from staff were to provide protein-rich foods (n=74), specific foods (n=59), foods rich in vitamins (n=47), and specific drinks (n=43).

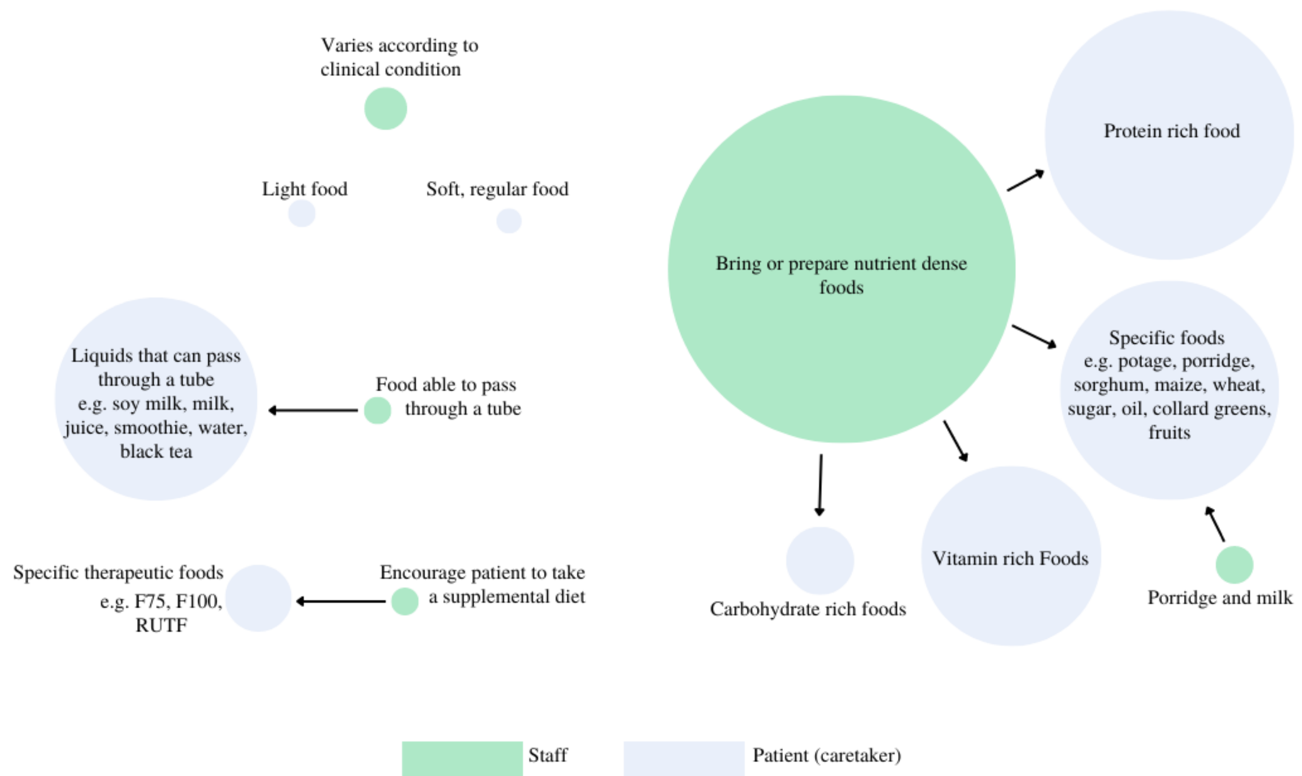

Figure 7-1. Food advice given by staff and interpreted by patient caretakers

Open-ended responses were grouped into themes of similar responses. Overall frequency of each category is represented by the size of the circles, while the colours represent staff (green) or caretaker (blue).

Figure 7-2 shows the challenges and opportunities that staff identified with regards to EN in the CHUK ICU. The most reported challenges that impact hospital or patient/caretaker resources include poverty, the hospital not providing food to the patients, and limited caretaker knowledge. Challenges that impact staff training included limited staff knowledge, scarcity of policies and protocols, and the ability to know nutrition orders and teach preparation to caretakers. The most common opportunities to improve EN at CHUK ICU that staff identified included support to pay for patient food, establishing a hospital kitchen to provide food and materials to patients, EN training, EN guidelines, and advocacy.

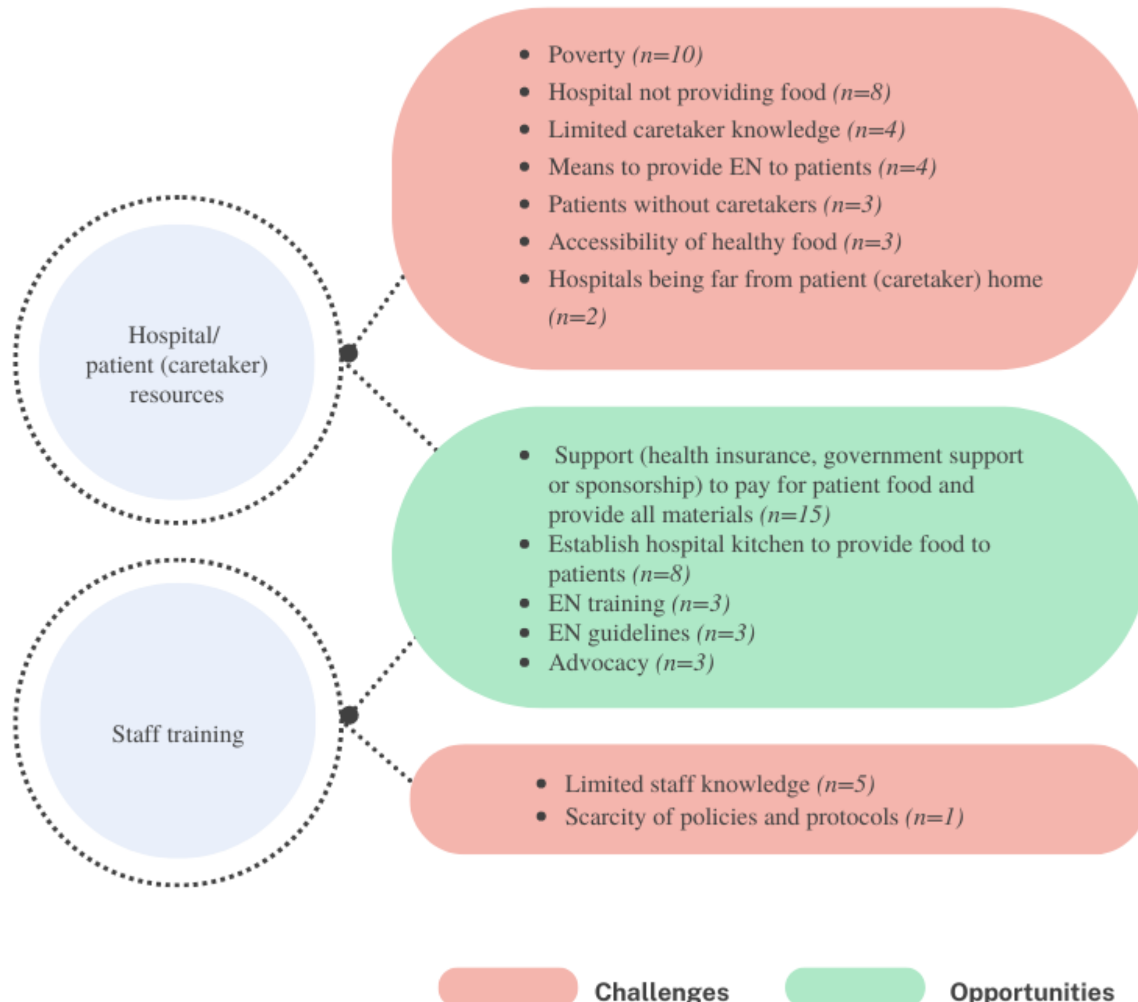

Figure 7-2. Staff reported EN challenges and opportunities in the CHUK ICU

Open-ended responses were grouped into themes of similar responses. Colours represent either challenges (red) or opportunities (green) identified by the staff.

7.0 Discussion

The outcomes of this hospital-based repeated-measures study describe patient demographic information, food intake, and the perceived nutrition support received by hospitalized patients in the ICU at CHUK. It also documents current knowledge and healthcare practitioner practices surrounding nutrition, feeding, and EN in the ICU at CHUK. We found that most of our patient participants were classified as Ubudehe 2, had a mean overall DDS of 4.2 out of a possible 9 food groups, 76% of the protein included in their meals was derived from milk, and most meals were purchased from the hospital or local restaurants. Our staff participants were primarily nurses with a mean of 10 years of experience working in the CHUK ICU. Most staff participants were not aware of any written guidelines for EN and felt that they needed more EN training.

8.1 Food intake and nutrition care of hospitalized patients in the ICU at CHUK

Overall, we found patient participants were fed a fairly diverse diet with micronutrient-rich fruits and vegetables (overall mean DDS of 4.2 out of 9); however, the mean protein-DDS (1.1 out of 6) was low. Given this diet, there is ample opportunity to increase patients' dietary diversity as a means of improving nutrition-related outcomes. In particular, adequate protein consumption, which appears to be lacking in these participants, is paramount to supporting the immune function, healing wounds, and maintaining lean body mass in critically ill patients (123).

There was very little variation in the overall DDS amongst patient participants, as evidenced by the very narrow SD of 0.1, nor in the protein-DDS (SD of 0.5), indicating that meals in the ICU are fairly uniform. Although various sociodemographic factors were explored, protein-DDS only differed by Ubudehe status, and not as expected. Throughout LMIC, protein foods, especially animal-source protein foods, are generally more expensive than other food groups like fruits, vegetables, and starchy staples, so are usually consumed in higher amounts by wealthier individuals (156). The most recent CFSVA found that 29% of severely food insecure Rwandan households had not consumed any protein-rich foods in the last seven days (1). As such, it was surprising that the mean protein-DDS of higher socioeconomic status patients (Ubudehe 3&4) were significantly lower than patients of lower socioeconomic status (Ubudehe 1&2) (0.83 ± 0.4 versus 1.2 ± 0.5; $p=0.002$). We do note that while statistically significant, this difference is unlikely to be clinically meaningful given the very low protein intake across this entire patient population and the high number of patients in Ubudehe 2, as discussed in depth below.

In general, while 96% of patient participant's had a day with a meal containing protein, 76% of the protein sources were milk. This paired with the average protein-DDS of 1.1 ± 0.5 gives us the clear picture that patient participant meals were heavily reliant on milk as a protein source. While milk is a nutritious beverage, it may not be sufficient to meet critically ill patients' protein needs on its own. There is no food composition database for East Africa, but the Western Africa Food Composition Table shows that whole, pasteurized cow's milk contains only 3.4g of protein per 100g, compared to lean, boiled beef at 36.2g per 100g, or even boiled soya beans, a non-animal source, at 13.9g per 100g (157). Compared to a commercial formula more common among EN patients in a HIC ICU, whole milk would offer about 8.2g protein per 235 ml serving, compared

to 20g for Ensure Protein Max (158). For instance, per ESPEN guidelines (1.3g protein per kg of body weight) (126), a 70kg critically ill person, the average reported weight of our participants, is estimated to need 91g of protein per day. This example patient would need to drink 11.1-235ml servings of whole milk to reach their protein target for the day (157), compared to 4.6 235ml-bottles of Ensure Protein Max (158). However, consuming this much milk would result in an energy intake of 1740 kcal, nearly all of the recommended energy intake of the 1400-1750 kcal per day recommended by ESPEN, coming from milk alone. Our study did not show that patients consumed the large quantities of milk discussed here, instead, most milk was consumed in the patient participant's porridge or replaced one of their meals in a day. With this, milk is not the ideal sole protein food in this setting, and it illustrates the likely low protein intake of this group. While it is important to acknowledge that some protein can be found in foods outside of the protein food groups (for instance 100g each of boiled tomatoes and boiled whole-grain sorghum would contain 1.3 and 4.4g of protein, respectively (157)). Such foods are likely not substantial enough to meet the protein needs of these critically ill patients, and could also impact micronutrient needs because they are less micronutrient-dense than protein foods (1). Given this, ICU staff should emphasize the provision of other, non-milk protein source foods in the future, which may need to be accompanied by recipes or ideas of how to include non-liquid protein foods into tube feeds.

Vulnerable populations such as those who are malnourished or immunocompromised (38, 39, 40), are at an increased susceptibility to contracting foodborne diseases (38), and an increased risk for adverse health outcomes related to foodborne diseases, such as diarrhea (39,40), and entering the malnutrition-infection cycle (see **Figure 2-2**) (38). These risks can negatively impact health outcomes, and ultimately, increase LOS and mortality (39,40). While there is no direct cost associated with a bout of foodborne illness, the most recent health service costing done in Rwanda in 2009 established that diarrhea costs CHUK an average of 99 883 RWF (approximately CAD$126 (17)) per patient, and malnutrition costs 143 769 RWF (approximately CAD$181(17)) per patient (159). Since 91% of patient participants were fed via tube, food safety is a substantial concern and requires a great deal of vigilance to prevent clogged tubes and residue build-up, and to ensure food is not at room temperature for more than two hours, including feeding time (45). This concern is compounded by the staff results showing that some

patients are continuously fed, compared to being bolus fed via syringe. Continuous feeding of whole foods puts the patient at a higher risk of contracting a foodborne illness due to the viscosity of the food slowing the time it takes for food to be gravity fed through the tube, and requires increased vigilance to ensure the bag of food is changed and the tube flushed at a maximum of every two hours (46,47). While these findings, alongside the staff-reported need for EN training, indicate an increased risk for patient foodborne illness, future work should include foodborne illness as an outcome of interest.

8.2 Economic burden of caretaker's providing food to patients

The economic burden of patient caretakers missing work to provide food for patients, which the vast majority (93%) of caretaker's reported, is sizeable when you consider the number of days per year Rwandans had to miss to provide this service to patients. This impact is further exacerbated by 99% of caretakers reporting that they missed other obligations, such as child or family care, to provide care for patients. Since 77% of the patient participant's meals were fed to the patient by a nurse, it is not an efficient use of resources to have patient caretakers missing work and other obligations to pick up and drop off food when a hospital food service system could provide the food to the patient for the nurse or another staff member to administer. The hospital creating a food service system to provide food to patients could not only alleviate the economic burden associated with caretakers missing work and other obligations, but it could boost the economy by providing jobs and supporting the local food system by utilizing local foods in the recipes.

While the latest 2018 Rwandan CFSVA estimated that only 36% of the overall Rwandan population is classified in the vulnerable Ubudehe 2 category (1), 75% of those in the current study were in Ubudehe 2. Previous research has indicated that individuals classified in Ubudehe 2 may actually be more vulnerable than those in Ubudehe 1, as Ubudehe 2 does not provide much of the low cost, preventative and acute healthcare subsidies, while at the same time most individuals in Ubudehe 2 cannot afford health coverage more commonly seen among those in Ubudehe 3 and 4 (9,11). For example, a study on peritonitis patients seeking and reaching care identified those with no health insurance and those with incomes below 10 000 RWF were more likely to have delayed access to appropriate care (160). Given this gap, it could be that a lack of

preventative healthcare could lead to worsening symptoms and increased admittance to the ICU among those in Ubudehe 2. Further, the most recent CFSVA found that households classified as Ubudehe 1 and 2 were more reliant on crisis strategies and emergency strategies, such as purchasing food on credit, borrowing food, or spending savings, than those in Ubudehe 3 and 4 (1). As also stated by the CFSVA, a household's livelihood and resilience to shock may be permanently impacted by these situations (1). Given that 78% of our patient participants are in Ubudehe 1 or 2, they may have a harder time affording hospital bills and nutrient-dense foods. In addition, the majority of patients and their caretakers had to travel from their rural homes to CHUK in Kigali, and the caretakers had to take accommodations at the hospital while they were caring for the patients. Taken together, the high number of ICU patients in the Ubudehe 2 classification indicates that patients and their caretakers may have had to resort to potentially irreversible crises and emergency strategies for the patient to receive the healthcare they needed.

Of our 73 patient participants, 17% resided in Kigali. With most patient participants coming to Kigali from rural areas, most caretakers were required to secure accommodations at the hospital, typically an empty communal room outside of the ICU with no beds (J Habyramina, personal communication, July 2021). We speculate that caretakers did not have access to food preparation facilities, driving the heavy reliance on purchasing patient meals (95%) from the hospital restaurant (44%) and other nearby restaurants (51%). While purchasing restaurant meals can be costly and limits the patient intake to what can be found at these restaurants, this could indicate a potentially untapped area for intervention; ensuring the nutrient and food safety adequacy of meals sold by the hospital restaurant could assist with optimizing patient's dietary intakes, including protein intakes. Additionally, interventions could focus on working with nearby restaurants to develop nutritionally adequate and appropriate items for patients, such as adding protein source foods to items already on the menu, increasing the diversity of foods offered, ensuring appropriate viscosity of foods for tube fed patients food, and ensuring proper food safety and WaSH standards are met. Since it is possible that the restaurants already have protein source options other than milk, and these options may just not be affordable for patient's caretakers, or the caretakers may be concerned about tube clogging, there is also an opportunity to work with the restaurants to offer affordable protein options with satisfactory viscosity for tube feeding (e.g. legume recipe). One example could be adding kidney beans, a legume

commonly consumed by Rwandans (161), to a typical potage meal consumed by patient participants. For example, one such recipe could include 50g dry weight kidney beans, 200g boiled spinach, 200g boiled tomatoes, and 50g cooked onions, which yields 664 kcal and 23.8g of protein (157, 161). This same meal would yield 522 kcal and 9.1g of protein without the kidney beans (157). While a more comprehensive analysis would need to be calculated to factor in daily micro- and macronutrient targets and product viscosity, this cursory look at the increase in protein, by adding one staple ingredient into one meal highlights the opportunity for potential future interventions.

The average LOS for patients in this study was 4.6 ± 3.9 days, which is lower than the total average LOS of 6 (IQR 4, 11) days reported in a 2017 study conducted in acute care surgery wards at CHUK (78). However, LOS did not include time spent in other hospital wards, of which patients typically would have spent time in before and/or after the ICU. A 2013/14 study found that ICU patients at CHUK and CHUB had a LOS of 5 days (IQR 6-28), which is consistent with our findings (162). That same study found that overall hospital LOS was 13 days (IQR 6-28) in Rwanda, compared to the United States with an ICU LOS of 2 days (IQR 1-4) and overall hospital LOS of 7 days (IQR 4-14) (162). HIC studies have indicated that a prolonged overall hospital LOS (> 7 days) causes a decline in nutrition status, while appropriate nutrition care may ameliorate declines in nutrition status, and reduce LOS, mortality, and readmission (104, 163).

This exploratory study found that 24% of patient participants died during their ICU stay, which is a lower mortality rate than the 44% of 422 patients found in another study conducted in the CHUK ICU (164), and 49% of 427 patients conducted in the CHUK and CHUB ICUs in 2013/14 (162). The mortality rate may be lower in our study for several reasons, such as a smaller sample size, five patients not meeting the eligibility criteria because they died or were expected to die within 24 hours of admission, and improvements in hospital care in the last 8 years, but ultimately, the reason is unknown. ICU mortality rates in other sub-Saharan countries range from 24-41% (165-168), compared to the US with 8% (162), and an average of 19% among 17 countries in Europe (169).

8.2 Current healthcare practitioner practices surrounding feeding and nutrition in the ICU at CHUK

The majority of staff participants told us that they need more EN training and that they are not aware of any written EN guidelines. This shone through in the responses throughout the questionnaire, where there was very little consensus amongst staff on the responsible parties for certain tasks and whether other tasks should be performed at all. For example, all four physicians thought that physicians were the only ones to decide whether a patient will receive EN, but most of the rest of the staff thought that the decision was made collaboratively, and some by only the nurse or dietitian. As previously discussed, assessing critically ill patients for refeeding syndrome is an essential element of medical nutrition therapy, and is a necessary component of keeping potentially malnourished patients safe during the initiation of feeding (87, 134, 135). However, in the current study, only 15% of staff assessed every patient for refeeding syndrome, and 23% did not know whether refeeding syndrome was assessed or not. While most staff did indicate that they assess every patient for malnutrition, a validated tool is not usually used for their assessments. Most of the reported biochemical assessments employed, including the use of albumin, prealbumin, transferrin, and retinol-binding protein, are inappropriate to use in an ICU setting because they reflect the acute phase response to infection or inflammation, rather than accurately indicating malnutrition (76,123,126). Others reported simply looking at the patient, which is not an adequate means of assessing malnutrition. Instead, ASPEN recommends using the NUTRIC score or NRS 2002 (76,123), and ESPEN recommends a general clinical assessment that includes anamnesis, unintentional weight loss, body composition, and evaluation of muscle mass and strength, as well as considering any critically ill patient at risk for malnutrition when their LOS exceeds 48 hours (76,126). The International Working Group for Patient's right to Nutrition Care recognizes clinical nutrition as a fundamental human right, where the ill who are malnourished should be automatically given access to nutritional care (170). They argue that in order to reduce the high rates of hospital malnutrition, nutrition screening, assessment, and diagnosis are fundamental, and if nutritional therapy is provided in a timely manner, it can help reduce the morbidity and mortality associated with hospital malnutrition (170). Efforts should be made to integrate the use of a validated malnutrition assessment tool (76, 123, 126) into future assessments in the CHUK ICU.

Other critical components of medical nutrition therapy, such as assessing for dysphagia and performing energy and protein calculations, do not appear to be performed by the majority of staff. While patients currently on EN, as were most of our patient participants, do not need to be assessed for dysphagia, it is critical to assess patients transitioning from EN to food by mouth for dysphagia, and for critical care patients only eating by mouth to be assessed for any swallowing difficulties that may cause aspiration or choking that can cause pneumonia, decreased food intake, decreased quality of life, and mortality (171). Energy and protein calculations should be performed to prevent over- or under-feeding, and to support immune function, maintain lean body mass, and decrease the overall risk of malnutrition in patients (123, 126, 136). While we know the benefits of these calculations in theory, the real-world application is more challenging in the CHUK ICU setting, where patient caretakers bring their own food, providing a barrier to determining exactly what and how much the patient has consumed. However, data from our study indicate that most patients consume either potage, porridge, or smoothies and all three meals tend to have similar ingredients. Hospital resources could be generated with these meals and ingredients in mind to guide such calculations.

The majority of the staff working in the CHUK ICU at the time of data collection participated in this study. The average years working in their profession for the four physician participants was very low, at 2.7 ± 1.2 for their overall career, and only 1.9 ± 1.2 in the CHUK ICU. Retention of healthcare workers overall has been a long-standing issue in Rwanda, due largely in part to the destruction of the health infrastructure during the 1994 genocide (172). The WHO recommends an ideal staffing of 134 healthcare professionals per 10 000 population in order to attain 70% or more of the universal health coverage service targets in the African Region (173). In 2017 Rwanda reported 10.9 healthcare workers per 10 000 population (174). Also, in 2017 the turnover rate for physicians was 21.8% compared to 7.6% for nurses (175). While there is a lack of formal research directly examining the high turnover of physicians in the CHUK ICU, some academic and media resources indicate that Rwandan physicians leave public hospitals to work in private institutions, neighbouring countries, or leave the career entirely because they are paid a low salary, are expected to work overtime, have limited medical equipment, and do not have the opportunities for career growth or further training (172, 175, 176). The 2019 health and labour force market analysis found that 51% of the physician labour force were employed by the private

sector, where they earn two to three times higher wages than those in the public sector; however, many physicians work in both private and public sectors and the impact from this has not yet been officially quantified (175). This high turnover in physician staff could mean that healthcare resources that could be reallocated elsewhere, such as to feeding patients or developing clear training and guidelines for each healthcare professionals, are not being efficiently utilized. Instead, they are used to continually train new staff and pay existing staff overtime to cover gaps in shifts (177, 178). It could also lead to burnout to existing staff, and gaps in care for patients (177, 178). High turnover and limited years of experience in their role could contribute to a lack of clarity in delineations in roles, as we can see from our results, that roles surrounding malnutrition and EN do not appear to be clearly defined or understood by CHUK ICU staff. While some tasks do appear to be universally understood, such as whether fluid intake and output are recorded, other tasks, such as whether patients are assessed for malnutrition, swallow/dysphagia, or refeeding syndrome, do not appear to have a clear consensus amongst staff. Our results also indicate that there may be confusion amongst staff as to who is responsible for particular tasks, such as deciding whether a patient will receive EN. These results appear to have persisted through time and are consistent with a previous finding in Rwandan healthcare centers in 2011, which found that staff, who are not qualified or trained, were performing tasks because there were no clear definitions of roles or delineations of services (179). In 2010, a study conducted in the CHUK ICU found that 75% of medical and nursing staff did not receive hospital-provided in-service training (180). Other global studies comparing HIC and LMIC, where the burden of critical illness along with mortality and long-term morbidity of critical illness is the highest in LMIC, found that formal training, a lack of nurses, and low wages were the biggest staff-reported barriers in LMIC healthcare settings (181).

There was consistency between advice staff reported providing to patient caretakers, and advice retained by patient caretakers, indicating appropriate communication and engagement between these two groups. These results are encouraging, as they suggest that an intervention targeting dietary suggestions for patient caregivers, such as integrating more protein into meals, could be successful.

Overall, the staff had very valuable insight into barriers to EN in the CHUK ICU, including further training to staff about EN, how, when, and why to use a malnutrition screening tool, and ensuring all staff know where to find written guidelines to refer to and how to interpret them.

8.4 Strengths and Limitations

To the best of our knowledge, this was the first study to describe the food intake and nutrition care of hospitalized patients in the CHUK ICU. Following up with patient caretakers longitudinally provided insights into dietary diversity and common foods (and food sources) among these critically ill patients. Another notable strength of this study was employing a local RA for data collection; this RA spoke three relevant languages fluently and understood cultural context, which was a major asset.

There are several limitations to this study, one of which is the use of surrogate caretakers to answer questions on behalf of the patient. Surrogates may have answered differently than the patient would have, or their answers may have been influenced by the surrogate's own personal bias; however, excluding patients who did not have the capacity to consent or answer a questionnaire would likely bias the results by excluding the most sick and vulnerable patients (154). While the use of self-administered questionnaires for the staff participants may have increased the risk of unanswered questions/incomplete questionnaires, less detailed answers, and misinterpretation of answers (153), this method was essential to minimize participant burden in this busy sample. At the same time, the strength of self-administration was limiting the potential for social desirability bias (153). A further limitation of this study is the use of DDS as a proxy for nutrient adequacy of the nutrient adequacy of an individual's diet (23). Given that dietary intake was reported by patient caretakers, and food was often purchased rather than homemade, it was not possible to complete a nutrient analysis. Additionally, it was beyond the scope of this study to follow patients throughout the entirety of their hospitalization, therefore, LOS was calculated based only on their ICU stay. Finally, patient BMI was calculated using knee height measurements and self-reported weights at the time of the baseline data collection. A systematic review of critically ill American patients found that it is common practice to estimate heights and weights for ICU patients, however, these estimates are often inaccurate (182). Although this is routine practice, this is a limitation because the majority of ICU patients are unable to leave their

beds and thus cannot undergo anthropometric assessments, and other special considerations such as fluctuations in the accuracy of weight (e.g. edema) are common for critical care patients.

8.5 Recommendations for future research

Through this study we have identified that only a few meals, often purchased at hospital or nearby restaurants, are fed to patients, and that these meals are likely too low in protein to support critically ill patient's nutrient needs. While the development of a hospital food service department could likely improve patient nutrition and health outcomes, a less cost-intensive solution, such as working with local restaurants, may be an ideal short-term solution. Such an interim intervention could assess the impact of improved restaurant meals and patient caretaker education on various patient outcomes including protein intake, LOS, and mortality. However, in the longer term, research should include a cost-benefit analysis of improvements to patient diets on benefits such as reduced LOS (cost of bed per day), mortality, readmission, burden on patient caretakers, and the overall positive economic impacts on the country by reducing caretaker missed days of work, employment opportunities for foodservice staff, and supporting local food systems by utilizing local foods to create patient foods. Additional follow-up studies could explore the impact of further EN training for CHUK ICU staff, as well as the impact of such training on EN-related food safety (e.g. time for room temperature food storage, the frequency of clogged tubes, and monitoring food residue left in tubes).

9.0 Conclusion

This study was the first to provide insight into patient diet and feeding environments in the CHUK ICU, alongside staff nutrition, feeding, and EN practices. We found that most of our patient participants were classified as Ubudehe 2, had low protein-DDS, and that patient caretaker burden was high. Most patient participant meals were purchased from the hospital restaurant and other nearby restaurants, providing a unique opportunity to combine a dual interim intervention targeting education with both patient caretaker and restaurants to improve patient food quality and safety. Staff participants were able to provide valuable insights into the EN challenges and opportunities in the CHUK ICU, but appear to require more nutrition-related training. Given the well-established links between poor patient nutrition and worse health outcomes, improving staff competency around malnutrition, and ensuring that patients receive

high quality and safe foods while in the ICU, has the potential to improve hospital and health outcomes.

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11.0 Appendices

Appendix A – Patient Baseline Questionnaire

PATIENT BASELINE QUESTIONNAIRE

IDENTIFICATION INFORMATION	
Participant Identification	**Interviewer Record**
Subject ID: __ __ __ __	Research Assistant Remarks:
1) Date of Hospital Admission: *DD/MM/YYYY*	____/_____/______
2) Date of ICU Admission *DD/MM/YYYY*	____/_____/______
3) Date of Interview: *DD/MM/YYYY*	____/_____/______
4) Interview Start Time:	___ ___ : ___ ___
5) Interview End Time:	___ ___ : ___ ___
6) Height of Patient	__________cm
7) Method of measurement	1. Standing height 2. Knee height 3. Forearm length 4. Arm span 5. Demi span
8) Usual weight of Patient	__________kg
9) What is the main reason for the patient's stay in intensive care unit (ICU)? *Check chart rather than asking patient*	1. Trauma 2. Infectious Disease 3. Post-Surgery 4. Major illness-such as unstable cardiac disease 5. Neurological illness 6. Other: __________________
10) When did the patient last eat? *By mouth or tube feed*	_______________hours ago
MODULE 1: DEMOGRAPHIC INFORMATION	

Question	Response
11) Who is being interviewed?	1. Patient 2. Family member ___________ 3. Other___________
12) What is the **patient's** date of birth? (DD/MM/YYYY)	__ __ / __ __ / __ __ __ __
13) What is the **patient's** gender?	1. Male 2. Female 3. Other__________
14) What is the **patient's** marital status?	1. Married 2. Divorced/Separated 3. Widowed 4. Single
15) Where is the **patient's** home?	District: ___________ Village: ___________
16) What is the highest level of school the **patient** has attended?	
17) What is the **patient's** occupation?	1. Homemaker 2. Farmer 3. Seller 4. Government 5. Other: _________
18) Who is the main wage earner in the family?	1. Patient → skip to Q21 2. Other: ___________
19) What is the highest level of schooling the **main wage earner** has attended?	
20) What is the occupation of the **main wage earner** in the family?	1. Homemaker 2. Farmer 3. Seller 4. Government 5. Other: __________________________
21) What is the **patient's** Ubudehe Category?	____________________________
MODULE 2: FOOD INSECURITY EXPERIENCE SCALE. In the last 12 months was there a time when…	
22) The patient or others in their household worried about not having enough food to eat because of a lack of money or other resources?	0. No 1. Yes 98. Don't Know 99. Refused
23) The patient or others in their household were unable to eat healthy and nutritious food	0. No 1. Yes 98. Don't Know

because of a lack of money or other resources?	99. Refused
24) The patient or others in their household ate only a few kinds of foods because of a lack of money or other resources?	0. No 1. Yes 98. Don't Know 99. Refused
25) The patient or others in their household had to skip a meal because there was not enough money or other resources to get food?	0. No 1. Yes 98. Don't Know 99. Refused
26) The patient or others in their household ate less than they thought they should because of a lack of money or other resources?	0. No 1. Yes 98. Don't Know 99. Refused
27) The patient's household ran out of food because of a lack of money or other resources?	0. No 1. Yes 98. Don't Know 99. Refused
28) The patient or others in their household were hungry but did not eat because there was not enough money or other resources for food?	0. No 1. Yes 98. Don't Know 99. Refused
29) The patient or others in their household went without eating for a whole day because of a lack of money or other resources?	0. No 1. Yes 98. Don't Know 99. Refused

Appendix B – Patient Follow-up Questionnaire

PATIENT FOLLOW-UP QUESTIONNAIRE

IDENTIFICATION INFORMATION	
Subject ID: __ __ __ __	Research Assistant Remarks:
1) Date: *DD/MM/YYYY*	___ ___ / ___ ___ / ___ ___ ___ ___
2) Interview Start time:	___ ___ : ___ ___
3) Interview End time:	___ ___ : ___ ___
4) Will participant be discharged today?	0. No 1. Yes
5) If discharged, where have they been discharged to? *Specify which ward if moved within the hospital*	1. Home 2. Ward______ 3. Deceased

MODULE 1: PATIENT MEALS			
6) Please describe the foods and drinks the patient received in the last 24 hours. Start with the first food or drink of the morning. *Write down all foods and drinks mentioned. When composite dishes are mentioned, ask for the list of ingredients. When the respondent has finished, probe for meals and snacks not mentioned.*			
Food and drink: *In each section write what the meal is (e.g. porridge), followed by the ingredients.* *Only answer the mode of delivery and how it was made once for each meal.*	Estimated volume: *Based on number of syringes filled and administered for tube feeding* *Or* *Based on the number of cups/home measuring device for non-tube feeds*	Mode of delivery:	How was it made?
Meal: Ingredients:		1. Tube 2. By Mouth	1. Blender 2. Mashed by hand 3. Nothing is done 4. Other: _____

Meal: Ingredients:		1. Tube 2. By Mouth	1. Blender 2. Mashed by hand 3. Nothing is done 4. Other: ______
Meal: Ingredients:		1. Tube 2. By Mouth	1. Blender 2. Mashed by hand 3. Nothing is done 4. Other: ______
Meal: Ingredients:		1. Tube 2. By Mouth	1. Blender 2. Mashed by hand 3. Nothing is done 4. Other: ______
7) a) How many meals were given to the patient in the last 24 hours?	________		
b) Of the meals given in the last 24 hours, how many were **paid for** by the patient's caretaker?	________		
c) Of the meals given in the last 24 hours, how many were **made by** the patient's caretaker?	________		
d) Of the meals given in the last 24 hours, how many were **brought to the patient's bedside by** the patient's caretaker?	________		
e) Please list who administered each of the patient's meals in the last 24 hours.	________ ________ ________ ________ ________ ________		
8) Approximate patient intake of water (mL) *Including tube flushing and intravenous administration*	________ mL (oral/tube) ________ mL (intravenous)		
9) If water is given, where is it from?	1. Bottle 2. Tap 3. Well 4. Boiled tap 5. Boiled well 6. Filtered 7. Other: ______		
10) Where is the food prepared?			

11) Where did the patient's food provider get the food from?	1. Home 2. Market in Kigali 3. Grocery Store 4. Friend/Family Member 5. Other: _____
12) a) Is the food immediately given to the patient after it is prepared?	0. No 1. Yes → skip to Q13 98. Don't Know 99. Refused
b) **If no**, where is it stored between preparation and administration?	______________________________
c) **If no**, approximate time (minutes) since preparation?	_____ minutes
13) Once the above is complete, fill in the food groups below based on the patient information collected. For any food groups not mentioned, asked the respondent if a food item from this group was consumed. Remind respondent of 24-hour timeframe.	

Question number	Food group	Examples	YES=1 NO=0
1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + *insert local foods e.g. ugali, nshima, porridge or paste*	
2	WHITE ROOTS AND TUBERS	white potatoes, white yam, white cassava, or other foods made from roots	
3	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrot, squash, or sweet potato that are orange inside + *other locally available vitamin A rich vegetables (e.g. red sweet pepper)*	
4	DARK GREEN LEAFY VEGETABLES	dark green leafy vegetables, including wild forms + *locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach*	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) + *other locally available vegetables*	
6	VITAMIN A RICH FRUITS	ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + *other locally available vitamin A rich fruits*	
7	OTHER FRUITS	other fruits, including wild fruits and 100% fruit juice made from these	
8	ORGAN MEAT	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	
10	EGGS	eggs from chicken, duck, guinea fowl or any other egg	
11	FISH AND SEAFOOD	fresh or dried fish or shellfish	
12	LEGUMES, NUTS AND SEEDS	dried beans, dried peas, lentils, nuts, seeds or foods made from these (eg. hummus, peanut butter)	
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	SWEETS	sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
16	SPICES, CONDIMENTS, BEVERAGES	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	

14) Once the questionnaire is complete, please review the patient's chart to include relevant details for:

a) Other food intake:

b) Other fluids intake:

c) Reference to / indication that feeding guidelines / protocols were used:

MODULE 2: NUTRITION SUPPORT	
15) Would it be helpful for the patient's caretaker to know what foods to bring for the patient?	0. No 1. Yes 98. Don't Know 99. Refused
16) Has anyone in the hospital advised the patient's caretaker what food to bring for the patient?	0. No → skip to Q19 1. Yes 98. Don't Know 99. Refused
17) If yes, who was this person?	1.Nurse 2.Dietitian 3.Doctor 4. Other__________
18) If yes, what was their advice?	
19) Why did the patient's caretaker choose to give the meals given in the last 24 hours to the patient?	1. The only food the patient can tolerate 2. The only food the caretake can afford 3. The caretaker believes the food is healthy/will help the patient recover 4. Convenience: the caretaker made this meal for themselves and made extra to give to the patient 5. Other__________
20) a) Does the patient take any micronutrient supplements?	0. No 1. Yes 98. Don't Know 99. Refused
b) If yes, please list which ones.	_________ _________ _________ _________ _________ _________ _________ _________ _________ _________
c) If yes, who provides them for the patient?	1. Hospital 2. Patient/patient caretaker 3. Other_________

MODULE 3: CARETAKER ABILITY TO PROVIDE FOOD FOR PATIENT IN HOSPITAL	
21) Who is the patient's caretaker?	1. Spouse 2. Parent 3. Child 4. Other relation from their household (e.g. aunt who resides in the SAME household) 5. Relation from outside their household (e.g. aunt who DOES NOT reside in the same household) 6. Friend 7. Volunteer

	8. Hospital 9. Other: _______________
22) Does the **patient's caretaker** live in Kigali?	0. No 1. Yes → skip to Q23 98. Don't Know 99. Refused
23) If the **patient's caretaker** is not from Kigali, where do they stay?	1. With a friend 2. Hospital 3. Hotel or rooming house 4. Home and travel to hospital 5. Other: _________
24) If the **patient's caretaker** has to travel to bring food, how long does it take them to get to the hospital from their home/temporary lodging?	________minutes ________ hours
25) Has the **patient's caretaker** missed work in order to provide food for them?	0. No 1. Yes 98. Don't Know 99. Refused
26) Has the **patient's caretaker** missed other obligations *(e.g. child or family care for others)* in order to provide food for them?	0. No 1. Yes 98. Don't Know 99. Refused
27) Does the **patient's caretaker** feel that there is a financial burden to them providing food for the patient in hospital?	0. No → skip to end 1. Yes 98. Don't Know 99. Refused
28) If yes, why do they feel that there is a financial burden to them providing food for the patient in hospital?	1. Buying the food 2. Travel 3. Missed Work 4. Childcare 5. Other: _________

Appendix C – Enteral Nutrition: ICU Staff Survey of Practices

ENTERAL NUTRITION: ICU STAFF SURVEY OF PRACTICES

IDENTIFICATION INFORMATION	
Subject ID: _ ___ ___	
1) Profession/***Umwuga:***	1. Nurse 2. Dietitian
2) Date: (DD/MM/YYYY)/	___ ___ / ___ ___ / ___ ___ ___ ___
MODULE 1: DEMOGRAPHICS	
3) What is your date of birth? (DD/MM/YYYY) **Italiki y' amavuko**	__ __ / __ __ / __ __ __ __
4) What is your gender?/***Igitsina***	1. Man/ **Gabo** 2. Woman/ **Gore** 3. Other: ________
What is the highest level of schooling you have completed?/ **Amashuri yo hejuru wize**	1. Certificate diploma 2. Advanced diploma 3. Bachelor's degree 4. Master's degree 5. Other _________________
5) How long have you been working as a nurse/dietitian?/ **Igihe umaze ukora nk' umu nurse cg umshinzwe imirire**	________years/ **Imyaka**
6) How long have you been working as a nurse/dietitian at Centre Hospitalier Universitaire de Kigali (CHUK)?/ **Igihe umaze ukora nk' umu nurse cg umshinzwe imirire mu bitaro bikuru bya CHUK**	________years/ **Imyaka**
MODULE 2: SURVEY OF PRACTICES	
7) a) Do you usually assess your patients for malnutrition?/ **Ujya usuzuma abarwayi imirire mibi?**	0. Patients are **never** assessed for malnutrition in the **CHUK ICU→** skip to Q9/ **Nta narimwe** 1. I never assess them, but **another healthcare team member does →** skip to Q9/ **Nta narimwe ariko undi arabikora** 2. Yes, **every** patient / **Yego buri murwayi** 3. Yes, **most** patients/ **Yego bose** *More than 50%/* ***Abarenze 50%*** 4. Yes, **some** patients/ **Yego, bamwe na bamwe** *Less than 50% /* ***Munsi ya 50%***
b) **If yes,** when are they usually assessed?/ **Niba ubasuzuma, ni ryari ubikora?**	1. At admission/ **Kuri admission** 2. Whenever we have the time/ **Igihe dufite umwanya**

	3. After exhibiting a sign of malnutrition/ **Bamaze kugira ibimenyetso by' imirire mibi** 4. Other: ________________
c) How do you usually decide which patients should be assessed for malnutrition? *Please mark all that apply*/ ***Se ni gute ubusanwe uhitamo umurwayi usuzuma? Hitamo ibisubizo byose bishoboka.***	1. The patient looks malnourished/ **Mbona umurwayi ameze nk' ufite imirire mibi** 2. Presence of edema/ **Abyimbye** 3. Albumin → state cut-off value used/ ***Igipimo cya Albumin gikoreshwa*** ________ 4. Prealbumin → state cut-off value used________***Igipimo cyibanziriza albumine*** 5. C-reactive protein (CRP) → state cut-off value used________/***Izindi proteins zindi*** 6. Transferrin→ state cut-off value used________/**Taransiferine** 7. Retinol-binding protein (RBP) → state cut-off value used________ 8. Diet history/ ***Amakuru ku mirire*** 9. Patient reported weight loss/ ***Umurwayi avugako yatakaje ibiro*** 10. Other________→ state cut-off value or calculation used as applicable________
8) a) Do you usually use a **nutrition assessment tool** with your patients?/ ***Ujya ukoresha ibyabugenewe mugusuzuma imirire?***	0. Nutrition assessment tools are **never** used in the **CHUK ICU**→ skip to Q10/ ***Nta narimwe*** 1. I never use assessment tools, but **another healthcare team member does** → skip to Q12/ ***Nta na rimwe, ariko abandi barayikoresha*** 2. Yes, **every** patient/ ***Yego, kuri buri mu rwayi*** 3. Yes, **most** patients/ ***Yego ku barwayi bamwe*** *More than 50%*/ **Abarenze 50%** 4. Yes, **some** patients/ ***Bamwe na bamwe*** *Less than 50%*/ ***Munsi ya 50%***
b) **If yes,** what **nutrition assessment tool** do you usually use?/ ***Niba ari yego, ukoresha ubuhe buryo mu kubasuzuma?***	1. ASPEN (American Society for Parenteral and Enteral Nutrition) 2. SGA (Subjective Global Assessment) 3. Other: __________________
9) Do you usually weigh your patients?/***Ese mupima abarwayi buri gihe?***	0. Patient weights are **never** taken in the **CHUK ICU**→ skip to Q11/ ***Nta narimwe*** 1. I never take patient weights, but **another healthcare team member does** → skip to

	Q11/ ***Nta narimwe mbikora ariko undi muganga arabikora*** 2. Yes, **every** patient/ ***Yego, kuri buri murwayi*** 3. Yes, **most** patients/ ***Abarwayi hafi ya bose*** *More than 50%/* ***Abarenze 50%*** 4. Yes, **some** patients/ **Yego kuri bamwe na bamwe** *Less than 50% /* ***Munsi ya 50%***
10) Do you usually perform swallow/dysphagia assessments on your patients?/ ***Ese ujya usuzuma ubushobozi bwo kumira cg kubabara mu muhogo umira ku barwayi bawe?***	0. Swallow/dysphagia assessments are **never** done in the **CHUK ICU**→ skip to Q12/ ***Nta narimwe*** 1. I never use assessment tools, but **another healthcare team member does** → skip to Q14/ ***Nta narimwe mbikora ariko undi muganga arabikora*** 2. Yes, **every** patient/ ***Yego, buri murwayi*** 3. Yes, **most** patients/ ***Yego, ku barwayi benshi*** *More than 50%/* ***Abarenze 50%*** 4. Yes, **some** patients/ ***Yego, bamwe na bamwe*** *Less than 50%/* ***Munsi ya 50%***
11) Who usually decides whether a patient will receive enteral nutrition?/ ***Ninde ufata umwanzuro ko umurwayi agaburirwa binyuze mukanwa?***	1. Nurse/ ***Umuforomo*** 2. Dietitian/ ***Mirire*** 3. Doctor/ ***Dogiteri*** 4. Other/ ***Und***i ________________
12) How and when is the decision to put a patient on enteral nutrition usually made?/ ***Ni gute kandi ni ryari hafatwe icyemezo ko umurwayi agaburirwa mu kanwa?***	
13) a) **Have you received enteral nutrition specific training?** ***Please mark all that apply/ Wigeze uhugurwa kubijyanye no kugaburira abarwayi byumwihariko ibinyura mu nda?***	0. No → Skip to Q15/ **Oya→*komeza kuri 17*** 1. Yes, during my nursing/dietetics degree/ ***Yego, mu gihe nigaga*** 2. Yes, during my training at CHUK/ ***Yego, mugihe nahugurwaga muri CHUK*** 3. Yes, through a continuing education course I took through CHUK/ ***Yego mu mahugurwa ahoraho muri CHUK.*** 4. Yes, through a continuing education course I took on my own time/***Yego mu mahugurwa ahoraho muri CHUK*** 5. Other________________
b) Do you feel that this training adequately prepared you to provide enteral nutrition care to	0. No, I feel like I need more training/ No, numvako nkeneye andi mahugurwa

your patients?/ ***Ese utekerezako amahugurwa yagufashije gusobanukirwa neza ibijyanye n' imirire?***	1. Yes, I feel well trained/ ***Yego, numva maze guhurwa neza***
14) a) Are you aware of any written guidelines for enteral nutrition that are used at CHUK?/ ***Ese hari amabwiriza agenga imirire waba uzi muri ICU-CHUK?***	0. No → skip to Q16 ***Ntayo*** 1. Yes, CHUK has written guidelines created for our specific hospital/ **Yego, Ibitari bafite amabwiriza yihariye** 2. Yes, the Rwanda Ministry of Health has written guidelines that are used in all hospitals across the country/ ***Yego, Minisiteri y' ubuzima yanditse amabwiriza azajya akoreshwa.*** 3. Yes, there are other written guidelines that we use → Please specify who wrote these guidelines___***Hari andi mabwiriza dukoresah. Tanga ingero hano***_____________
b) **If yes**, what do the written guidelines for enteral nutrition contain information about?/ ***Niba aribyo amabwiriza yanditse agendanye n' imirire avuga kuki?*** *Please mark all that apply*	1. Deciding whether the patient should receive enteral nutrition/ ***Agena niba umurwayi agomba kugaburirwa mu kanwa.*** 2. Telling you how to start enteral nutrition/ ***Akubwira uko watangira kugaburira abarwayi*** 3. Telling you how to monitor enteral nutrition/ ***Akubwira ugenzura imirire*** 4. Other: ________________
c) **If yes,** where can they be found?/ ***Niba ari byo, twayakura he?***	________________
d) **If yes**, do you understand the language of the guidelines?/ ***Niba aribyo se urayumva neza***?	1. No / ***Oya*** 2. Yes → skip to Q16/ ***Yego***
e) **If no**, why do you not understand the language/ ***Niba ataribyo se kuki utabyumva?***	1. I cannot read them because they are in English/ **Simbasha kuyasoma kuko ari mu cyongereza?** 2. I cannot read them because they are in French/ ***Simbasha kuyasoma kuko ari mu gifaransa.*** 3. I do not understand the terminology/ **Ntabwo numva icyo avuze** ***4.*** There is poor grammar and sentence structure, making it difficult to understand/ ***Yanditse nabi kuburyo bigoye kuyasoma*** 5. Other: ________________
15) a) Who usually makes the decision to give therapeutic foods to the patient?	1. Patient or patient's caretaker/ ***Umurwayi cg umurwaza*** 2. Nurse/ ***Umuforomo***

F75, F100, RUTF/ ***Ninde muri rusange ufata umwanzuro wo gutanga ibyo kurya by' umuti?***	3. Dietitian/ ***Ushinzwe imirire*** 4. Doctor/ ***Umuganga*** 5. Other: ________________
b) Are therapeutic foods available for patients **when they need them**?/ ***Ese ibiryo bivura biraboneka iyo abarwayi babikeneye?***	0. **Never**/ ***Nta na gato*** 1. Yes, they are **always** available when the patients need them/ ***Yego, biraboneka buri gihe iyo abarwayi babikeneye.*** 2. Yes, they are available for **most** patients that need them *More than 50%*/ **Yego biraboneka ku barwayi babikenera hejuru ya 50%** 3. Yes, they are available for **some** patients that need them *Less than 50%* **Yego biraboneka ku barwayi babikenera munsi ya 50%**
c) Does CHUK usually pay for and provide the therapeutic foods that are given to patients?. ***Ese ibitaro byishyura ibiryo bivura ku barwayi?***	0. No, the **patient or their caretaker pays** for and provides the therapeutic foods → skip to Q17/ ***Oya, abarwayi cyangwa abarwaza barishyura kandi bakanatanga ibyo kurya bivura*** 1. **CHUK provides** the therapeutic food, but the patient or their **caretaker must pay** for it → skip to Q17/ ***Ibitaro bitanga ibyo kurya bivura hanyuma hanyuma abarwazwa bakishyura*** 2. Yes, **CHUK usually provides and pay**s for the therapeutic foods/ ***Yego, ibitaro ubusanzwe bitanga kandi bikishyura ibiribwa bivura.*** 3. I do not know / ***Ntago mbizi***
d) Why are therapeutic foods paid for and provided to the patient by the hospital?/ ***Kuki ibyo kurya bivura byishyurwa kandi bigatangwa n' ibitaro ku murwayi?***	1. Medical insurance at CHUK pays for them because they are an essential medicine/ ***Ubwishingizi burabyishyura kuko n' umuti nkiyindi*** 2. CHUK receives donations to supply them/ ***Ibitaro bibona inkunga zo kwifashisha.*** 3. I do not know/ ***Ntago mbiziz*** 4. Other ________________
16) Who usually provides the materials needed for enteral nutrition? / ***Ninde utaanga ibikoresho bikenewe?*** *Syringes, tubes, bags, etc.*/ ***Amaserenge , udupira,..***	1. Hospital/ ***Ibitaro*** 2. Patient or patient's caretaker/ ***Umurwayi cyangwa abarwaza.*** 3. Other: ________________
17) Who usually administers the food for the enteral nutrition into the tube feed?/ ***Ninde utanga ibyo kurya bica mu kanwa mu ga tube?***	1. Patient or patient's caretaker/ ***Abarwayi cg abarwaza*** 2. Nurse/ Abaforomo 3. Dietitian/ **Mirire**

	4. Doctor/ **Muganga** 5. Other: ________________
18) Are patients usually fed bolus or continuous feeds?/ ***Ese abarwayi bahabwa ibyo kurya ingunga imwe cg gahoro gahoro?***	1. Bolus/ ***Ingunga*** 2. Continuous/ ***Gahoro gahoro*** 3. It depends – the decision is made on a case-by-case basis/ ***Biterwa, icyemezo gifatwa hakurikijwe buri murwayi*** 4. I do not know because the patient and their support person are responsible for the feeding/ ***Ntabyo nzi kuko umurwayi n' abamufasha bishingira ibyo kurya*** 5. I do not know because another hospital staff member is responsible for the feeding/ ***Ntabyo nzi kuko hari undi muntu ubishinzwe*** 6. Other: ________________
19) Is the tube usually flushed with water between feeds or after medications?/ ***Ese mujya mushyiramo amazi hagati yo kugabura cyangwa nyuma yo gutanga imiti?***	0. No/ Oya 1. Yes, **every** patient/ ***Yego, buri mu rwayi*** 2. Yes, **most** patients *More than 50%*/ ***Yego, abarwayi benshi barenga 50%*** 3. Yes, **some** patients *Less than 50%*/ ***Yego, abarwayi benshi barenga 50%*** 4. I do not know because the patient and their support person are responsible for the feeding/ ***Ntabyo nzi kuko umurwayi n' abamufasha bishingira ibyo kurya*** 5. I do not know because another hospital staff member is responsible for the feeding ***Ntabyo nzi kuko hari undi muntu ubishinzwe***
20) a) Do you usually give any micronutrient supplements to patients?/ ***Ese waba ujya utanga ongera ku barwayi?*** *Please mark all that apply*/ **Hitamo byose bishoboka**	0. No/ Oya 1. Yes, through IV/ ***Yego, binyuza mu gapira.*** 2. Yes, orally/ **Yego, mu kanwa**
b) **If yes,** how often?/ ***Niba ari yego, ka ngahe?***	1. Always/ **Buri gihe** 2. Most patients ***More than 50%/Abarwayi benshi barenga 50%*** 3. Some patients ***Less than 50%/ Abarwayi bamwe bari munsi ya 50%***

c) **If yes**, what are the most common supplements given?/ ***Niba ari yego nibihe by' ingenzi ahabwa?***	________ ________ ________ ________
d) **If yes**, how do you usually make the decision to give them?/ ***Niba ari yego, ni gute hafatwe ibyemezo byo kubikora?***	
e) **If yes**, do you ever add anything to them?/ ***Niba ari yego, hari ibyo ujya wwongeramo?*** *e.g. milk, oil/ Amata, amavuta?*	0. No/ ***Oya*** 1. Yes → Please list/ ***Yego. Bivuge*** ________ ________ ________ ________
21) a) Are patients usually assessed for refeeding syndrome?/ ***Ese abarwayi basuzumwa ingaruka ku miririe?***	0. Patients are **never** assessed for refeeding syndrome in the CHUK ICU→ skip to Q23/ ***Ntibajya basuzumwa*** 1. I do not assess them, but **another healthcare team member does** → skip to Q25/ ***Simbikora ariko undi muganga arabikora.*** 2. Yes, **every** patient/ ***Yego buri murwayi*** 3. Yes, **most** patients *More than 50%/* ***Abarwayi benshi barenga 50%*** 4. Yes, **some** patients *Less than 50%/* ***Abarwayi benshi bari munsi 50%*** 5. I do not know → skip to Q23/ Ntabyo nzi
b) **If yes,** when are they usually assessed?/ ***Niba ari yego, ni ryari basuzumwa.***	1. At admission/ ***Bakiza mu bitaro*** 2. Before enteral nutrition begins/ ***Mbere y' uko hatangira ibijyanye no kugaburirwa mu kanwa.*** 3. Whenever we have the time/ ***Igihe cyose hari umwanya*** 4. When the patient shows a sign of refeeding syndrome/ ***Umurwayi agize ingaruka ku mirire*** 5. Other: ________________
c) **If yes**, how are they usually assessed?/ ***Niba aribyo se ni gute bikorwa?***	
22) a) Has it ever been a part of your job at CHUK to perform energy calculations for patients?/ **wigeze ukora mu kazi kawe ibijyanye no guteranya ingufu umubiribi ukenera?**	0. **No** → skip to Q24/ Oya 1. Yes, **I used to, but I no longer do**→ skip to Q26/ ***Yego, Najyaga mbikora ariko sinkibikora*** 2. Yes, **every** patient/ ***Yego kuri buri murwayi*** 3. Yes, **most** patients

	More than 50%/ ***Abarwayi benshi barenga 50%*** 4. Yes, **some** patients *Less than 50%/* ***Abarwayi benshi bari munsi 50%***
b) **If yes**, what calculation do you use?/ ***Niba ari yego, ukoresha iki?***	___________________
23) a) Has it ever been a part of your job at CHUK to perform protein calculations for patients?/ ***Ese wigeze wita kubyo kumenya protein umurwayi akenera?***	0. **No** → skip to Q25/ **Oya** 1. Yes, **I used to, but I no longer do**→ skip to Q25/ ***Yego narabikoraga, ariko sinkibikora.*** 2. Yes, **every** patient/ ***Yego kuri buri mu rwayi*** 3. Yes, **most** patients *More than 50%/* ***Abarwayi benshi barenga 50%*** 4. Yes, **some** patients *Less than 50%/* ***Abarwayi benshi munsi ya 50%***
b) **If yes**, what calculation do you use?/ Niba ari yego, ukoresha iki?	___________________
24) a) Are biochemical (blood or urine) lab values usually taken before patients start enteral nutrition? *e.g. Na, K, creatinine/* ***Ese hari ibizamini bifatwa mbere yo kugaburira umurwayi?***	0. Patients **never** have their biochemical lab values tested in the CHUK ICU→ skip to Q26/ ***Ntibijya bifatwa na rimwe.*** 1. I do not assess them, but **another healthcare team member does** → skip to Q28/ ***Sinjya mbasuzuma, ariko undi muntu arabasuzuma*** 2. Yes, **every** patient/ ***Yego kuri buri mu rwayi*** 3. Yes, **most** patients *More than 50%/* ***Abarwayi benshi barenga 50%*** 4. Yes, **some** patients *Less than 50%/* ***Abarwayi benshi munsi ya 50%***
b) **If yes**, please list the most common ones here:/ ***Niba aribyo, tanga ingero hano***	__________ __________ __________ __________ __________ __________ __________ __________

25) Do you usually record fluid intake?/ **Ese mujya mwandika amazi muha abarwayi?**	0. **Never/ *Nta nagato?*** 1. Yes, **every** patient/ Yego, buri murwayi 2. Yes, **most** patients *More than 50%/Yego, benshi mu barwayi hafi abarenga 50%* 3. Yes, **some** patients *Less than 50%/ Yego, bamwe na bamwe bari munsi ya 50%*
26) Do you usually record fluid output? *e.g. amount of urine output/* ***Ese ujya wandika ibyo umurwayi asohora?***	0. **Never** / ***Nta narimwe*** 1. Yes, **every** patient/ ***Yego, buri mu rwayi*** 2. Yes, **most** patients *More than 50%/ Yego, benshi mu barwayi hafi abarenga 50%* 3. Yes, **some** patients *Less than 50%/ Yego, benshi mu barwayi hafi abari munsi 50%*
27) Do you usually record bowel function?/ ***Ese waba wandika burigihe ko umurwayi yitumye?***	0. **Never**/ ***Nta narimwe*** 1. Yes, **every** patient/ ***Yego, kuri buri murwayi*** 2. Yes, **most** patients *More than 50%* ***Yego, kuri benshi barenga 50%*** 3. Yes, **some** patients *Less than 50%/* ***Yego, kuri bamwe munsi ya 50%***
28) a) Do you usually give advice to patient's or their caretakers on what food to bring for the patient while in hospital?/ ***Ese mutanga inama buri gihe kubarwayi cg abarwaza kubijyanye nibyo bazana byo kugaburira abarwayi igihe bari mu bitaro?***	0. **Never** → Skip to Q30/ **Nta narimwe** 1. Yes, **every** patient/ ***Yego, buri murwayi*** *2.* Yes, **most** patients *More than 50%/* ***Yego, kuri benshi barenga 50%*** Yes, **some** patients *Less than 50%/* ***Yego, kuri bamwe munsi ya 50%***
b) If yes, what advice do you usually give/ ***Niba ari yego, mubabwira ngwiki?***	
MODULE 3: CHALLENGES AND OPPORTUNITIES	
29) a) In your opinion, what are the biggest barriers to enteral nutrition at CHUK?/ ***Ku bwawe, ni izihe mbogamizi nyamukuru ubona zijyanye no kubaburira abarwayi muri CHUK?***	

b) How do you think this/these barrier(s) could be overcome?/ ***Utekerezako izi mbogamizi twazirenga gute?***	

Appendix D – Mount Saint Vincent University Certification of Research Ethics Clearance

University Research Ethics Board (UREB)

Certificate of Research Ethics Clearance

☒	Clearance	☐	Secondary Data Clearance	☐	Renewal	☐	Modification	☐	Change to Study Personnel

Effective Date	**March 3, 2020**	**Expiry Date**	**March 2, 2021**

File #:	**2019-137**
Title of project:	Nutritional Status Among Critically Ill Patients in Rwanda: Is It Feasible to Take a Novel Approach to Enteral Feeding?
Researcher(s):	Kyly Whitfield
Supervisor (if applicable):	n/a
Co-Investigators:	See Appendix 1
Version :	1

The University Research Ethics Board (UREB) has reviewed the above named research proposal and confirms that it respects the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and Mount Saint Vincent University's policies, procedures and guidelines regarding the ethics of research involving human participants. This certificate of research ethics clearance is valid for a period of **one year** from the date of issue.

Researchers are reminded of the following requirements:	
Changes to Protocol	Any changes to approved protocol must be reviewed and approved by the UREB **prior** to their implementation. **Form: REB.FORM.002** **Info: REB.SOP.113** **Policy: REB.POL.003**
Changes to Research Personnel	Any changes to approved persons with access to research data must be reported to the UREB immediately. **Form: REB.FORM.002** **Info: REB.SOP.113** **Policy: REB.POL.003**
Annual Renewal	Annual renewals are contingent upon an annual report submitted to the UREB **prior** to the expiry date as listed above. You may renew up to four times, at which point the file must be closed and a new application submitted for review. **Form: REB.FORM.003** **Info: REB.SOP.116** **Policy: REB.POL.003**
Final Report	A final report is due on or before the expiry date. **Form: REB.FORM.004** **Info: REB.SOP.116** **Policy: REB.POL.003**
Privacy Breach	Researchers must inform the UREB immediately and submit the Privacy Breach form. The breach will be investigated by the REB and the FOIPOP Officer. **Form: REB.FORM.015**
Unanticipated Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within seven (7) working days of the event. **Form: REB.FORM.008** **Info: REB.SOP.115** **Policy: REB.POL.003**
Adverse Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within two (2) working days of the event. **Form: REB.FORM.007** **Info: REB.SOP.114** **Policy: REB.POL.003**

*For more information: http://www.msvu.ca/ethics

Dr. Daniel Séguin, Chair
University Research Ethics Board

Halifax Nova Scotia B3M 2J6 Canada
Tel 902 457 6350 • msvu.ca/ethics

Appendix E – Mount Saint Vincent University Certification of Research Ethics Clearance (Modification)

University Research Ethics Board (UREB)

Certificate of Research Ethics Clearance

☐	Clearance	☐	Secondary Data Clearance	☐	Renewal	☒	Modification	☐	Change to Study Personnel

Effective Date	**March 4, 2021**	**Expiry Date**	**March 2, 2022**

File #:	**2019-137**
Title of project:	Nutritional Status Among Critically Ill Patients in Rwanda: Is It Feasible to Take a Novel Approach to Enteral Feeding?
Researcher(s):	Kyly Whitfield
Supervisor (if applicable):	n/a
Co-Investigators:	See Appendix 1
Version :	2

The University Research Ethics Board (UREB) has reviewed the above named research proposal and confirms that it respects the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans* and Mount Saint Vincent University's policies, procedures and guidelines regarding the ethics of research involving human participants. This certificate of research ethics clearance is valid for a period of **one year** from the date of issue.

Researchers are reminded of the following requirements:	
Changes to Protocol	Any changes to approved protocol must be reviewed and approved by the UREB **prior** to their implementation. **Form: REB.FORM.002 Info: REB.SOP.113 Policy: REB.POL.003**
Changes to Research Personnel	Any changes to approved persons with access to research data must be reported to the UREB immediately. **Form: REB.FORM.002 Info: REB.SOP.113 Policy: REB.POL.003**
Annual Renewal	Annual renewals are contingent upon an annual report submitted to the UREB **prior** to the expiry date as listed above. You may renew up to four times, at which point the file must be closed and a new application submitted for review. **Form: REB.FORM.003 Info: REB.SOP.116 Policy: REB.POL.003**
Final Report	A final report is due on or before the expiry date. **Form: REB.FORM.004 Info: REB.SOP.116 Policy: REB.POL.003**
Privacy Breach	Researchers must inform the UREB immediately and submit the Privacy Breach form. The breach will be investigated by the REB and the FOIPOP Officer. **Form: REB.FORM.015**
Unanticipated Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within seven (7) working days of the event. **Form: REB.FORM.008 Info: REB.SOP.115 Policy: REB.POL.003**
Adverse Research Event	Researchers must inform the UREB immediately and submit a report to the UREB within two (2) working days of the event. **Form: REB.FORM.007 Info: REB.SOP.114 Policy: REB.POL.003**

*For more information: http://www.msvu.ca/ethics

Brenda Gagné

Brenda Gagné,
Research Ethics Coordinator

Halifax Nova Scotia B3M 2J6 Canada
Tel 902 457 6350 • msvu.ca/ethics

Appendix F – Dalhousie University Research Ethics Letter of Approval

Research Services

Health Sciences Research Ethics Board
Letter of Approval

March 10, 2020

Jennifer Szerb
Medicine\Anesthesia, Pain Management and Perioperative Medicine

Dear Jennifer,

REB #: 2020-5053
Project Title: Nutritional Status Among Critically Ill Patients in Rawanda: Is it Feasible to Take a Novel Approach to Enteral Feeding?

Effective Date: March 10, 2020
Expiry Date: March 10, 2021

The Health Sciences Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans.* This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Sincerely,

Lori Weeks

Dr. Lori Weeks, Chair

FUNDED
Jewish Community Foundation of Montreal
Anesthesia Research Fund

1

Appendix G – Dalhousie University Research Ethics Amendment Approval

Research Services

Health Sciences Research Ethics Board
Amendment Approval

March 11, 2021

Jennifer Szerb
Medicine\Anesthesia, Pain Management and Perioperative Medicine

Dear Jennifer,

REB #: 2020-5053
Project Title: Nutritional Status Among Critically Ill Patients in Rawanda: Is it Feasible to Take a Novel Approach to Enteral Feeding?

The Health Sciences Research Ethics Board has reviewed your amendment request and has approved this amendment request effective today, March 11, 2021.

Effective March 16, 2020: Notwithstanding this approval, any research conducted during the COVID-19 public health emergency must comply with federal and provincial public health advice as well as directives from Dalhousie University (and/or other facilities or jurisdictions where the research will occur) regarding preventing the spread of COVID-19.

Sincerely,

Lori Weeks

Dr. Lori Weeks, Chair

Appendix H – CHUK Research Ethics Review Approval Notice

Quality Health Care
Training & Research

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Ethics Committee / Comité d'éthique

19,Mar,2021 *Ref.:EC/CHUK/1/017/2020*

Review Approval Notice

Dear Jean de Dieu TUYISHIME,

Your research project: ***"NUTRITIONAL STATUS AMONG CRITICALLY ILL PATIENTS IN RWANDA: NOVEL APPROACH TO ENTERAL FEEDING OPTIMIZATION "***

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 19,Mar,2021 to evaluate your request for ethical approval of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your renewal to this research project.

You are required to present the results of your study to CHUK Ethics Committee before publication by using this link:www.chuk.rw/research/fullreport/?appid=286&&chuk.

PS: Please note that the present approval is valid for 12 months.

Yours sincerely,

Dr Emmanuel Rusingiza Kamanzi
The Chairperson, Ethics Committee,
University Teaching Hospital of Kigali

ETHICS COMMITTEE
CHUK

Scan code to verify.

" University teaching hospital of Kigali Ethics committee operates according to standard operating procedures (Sops) which are updated on an annual basis and in compliance with GCP and Ethics guidelines and regulations "

B.P. :655 Kigali- RWANDA www.chuk.rw Tél. Fax : 00 (250) 576638 E-mail :chuk.hospital@chukigali.rw

Appendix I – Patient (Surrogate) Consent Form

Nutritional Status Among Critically Ill Patients in Rwanda/ Imiterere y' imirire mu nzu y' indembe

PATIENT (SURROGATE) CONSENT FORM/ UBURENGANZIRA BW' UMURWAYI

Principal Investigators:	PI Rwanda: Dr. Bonaventure Uwineza *Head of the Department of Intensive Care, Centre Hospitalier Universitaire de Kigali* Co-PI Canada: Dr. Jennifer Szerb *Department of Anaesthesia,* Nov*a Scotia Health Authority* Co-PI Canada: Dr. Kyly Whitfield *Department of Applied Human Nutrition, Mount Saint Vincent University*
Co-investigators:	Ms. Jolene Bianco *Department of Applied Human Nutrition, Mount Saint Vincent University* Dr. Bohdan Luhovyy *Department of Applied Human Nutrition, Mount Saint Vincent University*
Research Assistant:	Dr. Jean de Dieu Tuyishime *Ministry of Health /Kibungo Referral Hospital*
Contact:	If you have questions you can ask the research assistant, Dr. Jean de Dieu Tuyishime, while he is interviewing you or at +xxx-xxx-xxx-xxx. ***Ufite ikibazo wabaza Dr. Jean de Dieu TUYISHIME mugihe muri kuganira cyangwa kuri telephone: +xxx-xxx-xxx-xxx***

Introduction

You are invited to take part in the research study entitled *Nutritional Status Among Critically Ill Patients in Rwanda.* This form provides information about the study. Before you decide if you want to participate, it is important that you understand the purpose of the study, the risks and benefits, and what you will be asked to do. We will provide you with all of this information before asking for your authorization to participate. A member of the research team will be available to answer any questions you have. You may decide not to participate, or you may withdraw from the study at any time. Participation is entirely voluntary, and will in no way affect your medical care and treatment.
Tugutumiye kuba mu bushakashatsi cyangwa igenzura ryitwa "imiterere y' imirire mu nzu y' indembe mu Rwanda. Uru rupapulo ruriho amakuru yose agendanye nubu bushakashatsi. Mbere yuko ufata umwanzuro wo kwitabira, ni ngombwa ko wumva neza icyo iri genzura rigamije, ibyiza, ingaruka ndetse nibyo uzasabwa gukora. Umwe mu itsinda ry' abashakashatsi azajya aba ahari kugira ngo asubize ikibazo cyose mwagira. Ushobora guhitamo ko utajya mu bushakashatsi cyangwa ukaba wabivamo igihe icyo aricyo cyose. Kwitabira n' ubushake kandi ntacyo bizahungabanyaho serivisi z' ubuvuzi n' imiti bikugenewe.

Potential Conflict of Interest/ ***Imbogamizi***
The investigators have no conflict of interest to report./ ***Itsinda ry' abashakashatsi nta mbogamizi rifite***

Who is conducting the study? ***Ninde ukora ubushakashatsi?***
This study will be completed by the researchers listed on this page./ ***Ubu bushakashatsi buzakorwa n' impuguke zigaragara hano ku rupapulo.***

Purpose of the research/ ***Ubushakashatsi bugamije iki?***
Patients who are in the intensive care unit sometimes need to be fed through a tube in their nose or mouth when they cannot swallow. Intensive care unit (ICU) patients may be very sick or recovering from surgery. They might not feel like eating and when they do eat, they might feel sick or their stomach might hurt. It

has been shown that sick patients in the hospital get better faster and have shorter hospital stays when they get nutritious food made under sanitary conditions.
Nutritious food means getting a mixture of foods made specifically to meet a person's energy, protein, fat, vitamin, and mineral needs. Sanitary conditions mean using clean hands, surfaces, water and temperatures to make the food, and making sure that once the food is made, it is stored properly before being served. Right now, in Centre Hospitalier Universitaire de Kigali (CHUK) and across Rwanda, patient's families have to give them all of their food. The problem is that we do not know if it is nutritious or made under sanitary conditions.
Abarwayi bo mu nzu y' indembe bakenera kugaburirwa binyuze mu gapira ko mu zuru cyangwa ko mu kanwa igihe badashobora kumira. Mu nzu y' indembe abarwayi bashobora kuba barembye cyangwa baje nyuma yo kubagwa. Bashobora kumva badashaka kurya, cyangwa banarya igifu kikabarya. Ubushakashattsi bugaragaza ko indembe mu bitaro zoroherwa byihuse ndetse zikamara igihe gito mu bitaro iyo zagaburire indyo yuzuye kandi ifite isuku.

Indyo yuzuye bavuga amafunguro arimo intungamubiriri zose; ibitera imbaraga, ibyubaka umubiri, ibirinda indwara, amavuta n' imyunyungugu. Isuku bavuga gukaraba intoki, aho utegurira amafunguro, amazi meza n' ubushyuhe mu guteka ndetse no kuzirikana ko amafunguro yatunganijwe abiikwa neza mbere yo guhabwa uyakeneye.
Muriki ighe, mu bitaro bikuru bya Kigali CHUK ndetse n' ahandi mu Rwanda, abarwaza nibo bazana ibyo kurya bihabwa abarwayi. Ikibazo twibaza n' intungamubiri bazana ndetse n' isuku mu itegurwa ryayo mafunguro.

We would like to figure out what family foods are being fed to patients. First, we would like to get information about patients, such as age, education, income, and ability to both get food when they are healthy and when they are in hospital. We would also like to find out if the patient's family is getting enough help from a nutritionist to figure out what to feed their loved ones.
We will invite 100 CHUK ICU patients to take part in this study. Participants in this study will help us better understand what patients are being fed and what kind of nutrition support they are getting. This could help us improve nutrition support for patients in the future.
Twifuza kugenzura ibyo kurya abarwaza bazanira abarwayi. Icyambere tugakusanya amakuru yose, urugero imyaka, amashuri, inyungu babona n' uburyo bwo kubona indyo yuzuye. Twifuza no kugenzura niba abarwaza babona ubufasha buhagije mu kugaburira, buturutse kuri "mirire", cyangwa umukozi ushinzwe imirire mu bitaro. Tuzakenera nibura abarwayi ijana (100) mu nzu y' indembe muri CHUK bakwitabira iri suzuma. Abazitabira ubushakashatsi bazadufasha kumva neza ibyo abarwayi bagaburirwa ndetse n' ubufasha bw' imirire bahabwa. Ibi bizadufasha guteza imbere "imirire" ndetse n' inyunganizi ku mirire muri rusange mu gihe kizaza.

Study Procedure/ Uko bizakorwa
Who can participate?/ ***Ni nde wajya mu isuzuma?***
To participate in this study, you must be a patient, 18 years or older, under intensive care at CHUK and expected to stay in the ICU for at least 24 hours. If you are too sick to be able to provide consent, we will be asking for consent from your family member or someone who is making decisions about your medical treatment on your behalf.
Kujya mu bushakashatsi, ugomba kuba ufite imya 18 kuzamura, uri mu nzu y' indembe muri CHUK kandi uzayimaramo nibura amasaha . Uramutse urembye cyane kuburyo udashobora kudusinyia uburenganzira, tuzasaba abo mu muryango wawe cyangwa undi muntu ufata ibyemezo mu muryango kudusinyira mu mwanya wawe.

What will participation in this study look like?/ ***Uzajya mu bushakashatsi asabwa iki?***

Taking part in this study is voluntary. Whether you choose to participate in this study or not, your medical care and treatment will remain the same. You may choose not to take part or may leave the study at any time and do not have to give a reason for your decision.
Kuzamo ni ubushake. Uhisemo kuzamo cyangwa kutazamo, ntacyo bihindura ku buvuzi n' imiti uhabwa. Ushobora guhitamo kutajya mu bushakashatsi cyangwa ukavamo igihe icyo aricyo cyose kandi nta bisobonuro utanze.

After you have given consent to participate in this study, the research assistant will ask questions of you and your family every other day for the first week, and once a week after that. On the first day, we will ask questions about you, such as your age, where you live, and who makes and brings you your food. On every other visit, we will ask you about what types of food you have been fed since your last visit and about any nutrition support you might have had from hospital staff. The research assistant may also access your medical chart to find out information about your food and fluid intake, food tolerability and hospital feeding guidelines.
Nyuma yuko wemeye kujya mu bushakashatsi, ubishinzwe azakubaza ibibazo byawe n' umuryango wawe nibura buri minsi 2 mu cyumweru cya mbere. Hanyuma rimwe mu cyumweru. Ku munsi wa mbere, tubaza ibibazo byawe, imyaka, aho uba, ukora akagaburira urugo. Ikindi gihe tukubaza ubwoko bw' ibyo kurya wariye kuva aho duhuriye, ubufasha wawa wahawe n' umukozi w' ibitaro mubijyanye n' imirire. Uhagarariye iri genzura azareba no mu mpapulo zawe zo kwa muganga kugira ngo arebemo ibyo wagaburiwe, amazi wanyoye, uburyo byakuguye neza cyangwa nabi; ndetse n' amabwiriza agenga imirire mu bitaro.

Confidentiality/ ***Ibanga***

Your confidentiality will be respected. You will be assigned a unique study number as a participant in this study. Only this number will be used on any research-related information collected about you during the course of this study, so that your identity [i.e. your name or any other information that could identify you] as a participant in this study will be kept confidential. Information that contains your personal information (such as this consent form) will remain only with the Principal Investigator. The list that matches your name to the unique study number that is used on your research-related information will not be removed or released.

Uzagirirwa ibanga. Uzahabwa numero y' igenzura yawe bwite. Iyo numero niyo izakoreshwa gusa mu bushakashatsi n' ibigendanye nabwo byose mu gihe cy' iri genzura kuburyo nta mazina yawe azagaragara. Amakuru ndetse n' ibyo wasinye byose, biguma mu maboko y' uhagarariye ubushakashatsi. Lisiti ihuza amazina yawe n' umubare bwite nta muntu numwe uzabibona.

Risks/ ***Ingaruka***
We believe there is minimal risk to participating in this study since we will simply be asking about the food you would normally be receiving from your family anyways. Your medical treatment will remain the same, regardless of whether you choose to participate or not.
Twizerako nta ngaruka wagira igihe witabiriye ubu bushakashatsi kuko tuzaba tukubaza ibibazo bigendanye n' imirire gusa. Ubuvuzi uhabwa buzakomeza hatitawe ko uri mu bushakashatsi cyangwa utaburimo.

Benefits/ ***Inyungu***

There are no direct benefits to your participation in this study. We believe that information gathered in this study could lead to research future studies, and potentially hospital policies to provide sick patients with hospital-prepared food.

Nta nyungu zihariye ziteganyijwe kuzajya mu bushakashatsi. Twizerako amakuru dufata muri iri genzura, azashingirwaho mu gukora ubundi bushakashatsi mu minsi iri imbere ndetse no gushyiraho ibigenderwaho mu kugaburira indembe amafunguro yateguriwe mu bitaro

What happens after the study finishes?/ ***Bizagenda gute igenzura rirangiye?***

The results of this study will be gathered and shared with the CHUK hospital administration team, as well as submitted for publication in order for healthcare providers and researchers around the world to learn about the results.

If you have any questions or would like further information concerning this study, please do not hesitate to contact Dr. Jean de Dieu Tuyishime, the Research Assistant, by phone at +xxx-xxx-xxx-xxx.

Ibizavamo bizatangarizwa ikipe y' abayobozi ba CHUK ndetse binandikwe ku rwego mpuzamahanga (publication) kugiran go bifashe abaganga ndetse n' abashakashatsi ku rwego mpuzamahanga .

Niba hari ikibazo ufite kerekeranye niri genzura, wishidikanya baza cyangwa uhamagare Dr. Jean de Dieu TUYISHIME, uhagarariye ubushakashatsi; +xxx-xxx-xxx-xxx

Consent Form for Research Participation/ *Urupapulo rw' uwemeye kujya mu bushakashatsi.*

- I have listened to, or read, and understood the information provided on this consent form/ ***Nakurikiye, ndasoma ndetse numva neza amakuru ari muriyi nyandiko***
- I have had sufficient time to consider the information provided and to ask for advice (if needed)/***Nabonye igihe gihagije cyo gutekereza kumakuru nahawe ndetse mbaza n' inama.***
- I have had the opportunity to ask questions and have received a satisfactory response to my questions/ ***Nabonye igihe cyo kubaza ibibazo ndetse nanyuzwe n' ibisobanuro nahawe ku bibazo nabajije.***
- I understand that all of the information collected will be kept confidential and that the results of this study will only be used for scientific objectives/ ***Nasobanukiwe ko amakuru yose natanze azakomeza kuba ibanga ndetse ko umwanzuro w' ibyavuye mu bushakashatsi bizakoreshwa gusa mu bijyanye n' iterambere***.
- I understand that participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time/ ***Numvise ko kujya mu bushakashatsi ari kubushake, ndetseko mfite uburenganzira busesuye bwo kubyanga cyangwa kubivamo igihe icyo aricyo cyose.***
- I understand that my choice of whether or not to participate in this study will in no way impact the medical care and treatment I will receive as a patient at CHUK/ ***Numvise neza ko kuba nahitamo kujya cyangwa kuva mu bushakashatsi ntacyo bizabangamiraho ubuvuzi n' imiti nahabwaga nk' umurwayi wa CHUK.***
- I understand that I am not waiving any of my legal rights as a result of signing this consent form/ ***Ndumva neza ko ntawe nahaye uburenganzira bwanjye kugira ngo abe yasinya uru rwandiko.***
- I have listened to, or read, the information on this form and I freely consent to participate in this study/ ***Nakurikiye ndetse nsoma neza amakuru ari muri iyi nyandiko ndetse nsinyiye kujya mu bushakashatsi ku bushake.***
- I have been told that I will receive a dated and signed copy of this form. ***Nabwiwe ko mpabwa urupapulo rusinye kandi ruriho n' Italiki.***

________________________________ ____________________________________

Participant's Name OR Surrogate Medical Decision Maker, ***if applicable***
Ukorerwaho ubushakashatsi ***Uhagarariye umurwayi***

____

Signature of: □ participant, or □ Surrogate Medical Decision Maker
Umukono w' umurwayi cyangwa uhagarariye umurwayi
Date: ______________________________
Italiki

Name of Person Obtaining Consent____
Amazina n' umukono by' uwakiriye uburenganzira
Signature of Person Obtaining Consent_________________________________

____

Appendix J – ICU Staff Consent Form
Nutritional Status Among Critically Ill Patients in Rwanda
ICU STAFF CONSENT FORM

Principal Investigators:	PI Rwanda: Dr. Bonaventure Uwineza *Head of the Department of Intensive Care, Centre Hospitalier Universitaire de Kigali* Co-PI Canada: Dr. Jennifer Szerb *Department of Anaesthesia,* No*va Scotia Health Authority* Co-PI Canada: Dr. Kyly Whitfield *Department of Applied Human Nutrition, Mount Saint Vincent University*
Co-investigators:	Ms. Jolene Bianco *Department of Applied Human Nutrition, Mount Saint Vincent University* Dr. Bohdan Luhovyy *Department of Applied Human Nutrition, Mount Saint Vincent University*
Research Assistant:	Dr. Jean de Dieu Tuyishime *Ministry of Health /Kibungo Referral Hospital*
Contact:	If you have questions you can ask the research assistant, Dr. Jean de Dieu Tuyishime, while he is interviewing you or at +xxx-xxx-xxx-xxx.

Introduction

You are invited to take part in the research study entitled *Nutritional Status Among Critically Ill Patients in Rwanda.* This form provides information about the study. Before you decide if you want to participate, it is important that you understand the purpose of the study, the risks and benefits, and what you will be asked to do. We will provide you with all of this information before asking for your authorization to participate. A member of the research team will be available to answer any questions you have. You may decide not to participate, or you may withdraw from the study at any time. Participation is entirely voluntary, and will in no way affect your job.

Turagutumira Kwitabira ubu bushakashatsi bwiswe "Imiterere y' imirire no kugaburira abarwayi mu nzu y' indembe mu Rwanda". Uru rupapulo ruratanga amakuru yose y' ubushakashatsi. Mbere yo gufata icyemezo cyo kwitabira, ni ngombwa kumva neza icyo ubushakashatsi bugamije, ingaruka n' inyungu zabwo ndetse nicyo usabzwa gukora. Urahabwa amakuru yose yingenzi mbere yuko witabita ubushakashatsi. Umwe mubagize itsinda ryabakora ubushakashatsi arahari buri gihe kugira ngo asubize ikibazo cyose mwagira. Ushobora guhitamo kutajya mu bushakashatsi cyangwa ukaba wavamo igihe cyose ubishatse. Kwitabira ubushakashatsi ni kubushake kandi ntibihungabanya akazi kawe.

Potential Conflict of Interest

The investigators have no conflict of interest to report./ ***Abakora ubushakashatsi nta mbogamizi bafite.***

Who is conducting the study?/ **Ni bandi bari gukora ubushakashatsi?**
This study will be completed by the researchers listed on this page./ ***Ubu bushakashatsi mukorwana naba bavuzwe haruguru.***

Purpose of the research/ ***Icyo bugamije***
Hospital patients who receive nutritious foods recover from illness quicker, have shorter hospital stays, and have a lower mortality risk. Given this, it is important to understand how and what patients are being fed while in intensive care. We also want to gain a better understanding of what other nutrition care patients are receiving while in the intensive care unit (ICU) at Centre Hospitalier Universitaire de Kigali (CHUK). ***Abarwayi bari mu bitaro bagaburirwa neza boroherwa vuba, bityo bakamara igihe gito mu bitaro n' ibyago byo gupfa bikagabanuka. Ugendeye kuribyo, ni ingenzi cyane gusobanukirwa ibyo abarwayi bagaburirwa nuko bagaburirwa mu nzu y' indembe. Dushaka no gusobanukirwa neza iby' imirire y' abarwayi bo mu nzu y' indembe mu bitaro bikuru bya CHUK.***

We will invite ICU nurses and dietitians at CHUK to participate in this study. Information collected through this study will help us better understand the current practices, challenges and opportunities related to: screening or assessment of malnutrition, nutrition monitoring, enteral feeding decision making, and current enteral nutrition protocols. Your responses could offer insight into what policies and guidelines can be created to support ICU staff at CHUK to ensure safe and effective nutrition practices./ **Turasaba abaforomo, abaforomokazi ndetse n' abashinzwe imirire kwitabira ubu bushakashatsi. Amakuru tuzavanamo azadufasha kumva neza imikorere, imbogamizi ndetse n' inyugu mu gusuzuma neza imirire mibi, gukurikirana imirire, ibyemezo byo kugaburira abarwayi biciye mugifu uko bifatwa ndetse no kureba porotokole z' imirire, mubijyanye no kugaburira abarwayi bo munzu y' indembe. Ibisubizo byanyu muduhaye bizafasha mugukora amabwiriza no gufasha abakozi kugira ngo habeho imirire iboneye mu barwayi bo mu nzu y' indembe.**

Study Procedure/ Uko bizakorwa?

Who can participate? / Ni bande bazitabira?

To participate in this study, you must currently work full or part-time as a nurse or dietitian in the ICU department at CHUK./ **Kugira ngo uge mu bushakashatsi ugomba kuba ukora muri ICU nk' umu nurse cg ushinzwe imirire mu bitaro bikuru bya CHUK.**

What will participation in this study look like?/ ***Ese kuba mu bushakashatsi bizaba bimeze gute?***

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time and do not have to give a reason for your decision. Whether you choose to participate in this study or not, your job will not be affected. / ***Kujyamo ni ku bushake. Ushobora no guhitamo kutajyamo cyangwa ukavamo igihe ubishakiye kandi nta busobanura utanze bw' icyemezo wifashe. Wajya mu bushakashatsi cyangwa wabyihorera, ntacyo bizangiza ku kazi kawe.***

After you have given consent to participate in this study, the research assistant will ask questions about you, such as your age and how long you have been working at CHUK. Then they will ask you about current nutrition practices, followed by your opinions about barriers and opportunities to enteral nutrition at CHUK./ ***Nyuma yo Kwemera kujyamo, uhagarariye ubushakashatsi azakubaza ibibazo bijyanye nawe ubwawe, nk' imyaka ufite, igihe umaze ukora muri CHUK. Hanyuma akubaze ibijyanye n' imirire, ugire icyo uvuga ku mbogamizi ubona, ndetse nibyiza byo kugaburira abantu biciye mukanwa.***

Confidentiality/ ***Ibanga***

Your confidentiality will be respected. You will be assigned a unique study number as a participant in this study. Only this number will be used on any research-related information collected about you during the course of this study, so that your identity [i.e. your name or any other information that could identify you] as a participant in this study will be kept confidential. Information that contains your personal information (such as this consent form) will remain only with the Principal Investigator. The list that matches your name to the unique study number that is used on your research-related information will not be removed or released./ ***Uzagirirwa ibanga. Urahabwa***

numero bwite yawe, niyo yonyine izakoreshwa kugira ngo haboneke amakuru ajyanye nubu bushakashatsi. Amazina cyangwa andi makuru yakugaragaza muri ubu bushakashatsi, azabikwa mw' ibanga. Irisiti ihuza amazina yawe na nimero yawe bwite, bizaguma ari ibanga ntago bizajya mu ruhame.

Risks/ Ingaruka

We believe there are no risks to you participating in this study because we will just be asking you questions about your job. Again, your participation in this study will in no way affect your job at CHUK./ ***Twizerako nta ngaruka mbi waterway no kujya muri ubu bushakashatsi. Tuzakubaza gusa ibijyanye n' akazi kawe, ndetse kuba wajyamo nta kibazo na kimwe byatera mu bijyanye n' akazi kawe.***

Benefits/ ***Inyungu***

There are no direct benefits to your participation in this study. We think information gathered through this study could lead to improved nutrition practices at CHUK, and potentially elsewhere./ **Nta nyungu zihariye ubona kubera ko wagiye mu bushakashatsi. Turatekerezako amakuru azatangwa binyuze mu bushakashatsi azatuma habaho iterambere mu kugaburira abarwayi muri CHUK ndetse n' ahandi.**

What happens after the study finishes? ***Bizagenda gute ubushakashatsi burangiye?***

The results of this study will be gathered and shared with the CHUK hospital administration team, as well as submitted for publication in order for healthcare providers and researchers around the world to learn about the results./ ***Ibisubizo by' ubushakashatsi bizahabwa abayobozi bakuru b' ibitaro bya CHUK, ndetse binagezwe n' ahandi kugia ngo abaganga ndetse n' izindi mpuguke ku isi bige ibyavuyemo.***

If you have any questions or would like further information concerning this study, please do not hesitate to contact Dr. Jean de Dieu Tuyishime, the Research Assistant, by phone at +xxx-xxx-xxx-xxx./ ***Ikibazo cyose wagira cyangwa ukeneye andi makuru ajyanye n' ubu bushakashatsi, wahamagara Dr. Jean de Dieu TUYISHIME, umuganga uhagarariye ubu bushakashatsi. Numero ye niyi: +xxx-xxx-xxx-xxx.***

Consent Form for Research Participation/ Kwemera kuba mu bushakashatsi

- I have listened to, or read, and understood the information provided on this consent form./ **Numvise kandi nasomye nzirikana ibikubiye muri iyi nyandiko**
- I have had sufficient time to consider the information provided and to ask for advice (if needed***)./ Nagize igihe gihagije cyo kumva amakuru arimo, no kugisha inama***
- I have had the opportunity to ask questions and have received a satisfactory response to my questions./ ***Nagize amahirwe yo kubaza ibibazo, no guhabwa ibisubizo binyuze.***
- I understand that all of the information collected will be kept confidential and that the results of this study will only be used for scientific objectives./ ***Nasobanukiwe ko amakuru atanzwe yose azabikwa mu ibanga, ndetse ibisubizo by' ubushakashatsi bikazakoreshwa gusa mubijyanye n' ubuhanga bwa siyansi.***
- I understand that participation in this study is voluntary and that I am completely free to refuse to participate or to withdraw from this study at any time./ ***Ndumva neza ko kuba mu bushakashatsi ari ubushake, kandi mfite uburenganzira buhagije bwo kubyanga cgangwa nkaba navamo igihe icyo aricyo cyose.***
- I understand that my choice of whether or not to participate in this study will in no way impact my job at CHUK./ **Ndumva neza ko amahitamo yanjye yo kuba cyangwa kutaba mu bushakashatsi, ntacyo bizabangamira mu kazi kanjye.**
- I understand that I am not waiving any of my legal rights as a result of signing this consent form./ ***Ntawe nahaye ububasha cyangwa uburenganzira bwanjye bwo gusinya iyi nyandiko.***
- I have listened to, or read, the information on this form and I freely consent to participate in this study. ***Numvise kandi nsoma neza ibyiyi nyandiko none ndasinya kubwanjye kuba mu bushakashatsi.***
- I have been told that I will receive a dated and signed copy of this form./ ***Nabwiweko mpabwa kopi nanyeho kandi iriho n' itariki***

____
Participant's Name/ ***Amazina y' ukorerwaho ubushakashatsi***

Signature: ____________________________________
Umukono
Date: ________________________________
Italiki

Name of Person Obtaining Consent____
Amazina y' ufata aya masezerano

Signature of Person Obtaining Consent____
Umukono w' ufata aya masezerano