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Introducing a nutritional risk screening tool in a South African hospital

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INTRODUCING A NUTRITIONAL RISK SCREENING TOOL IN A SOUTH AFRICAN HOSPITAL

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ABSTRACT

Background: Nutritional screening facilitates the early identification of hospitalised children at risk of malnutrition. Screening tools have scarcely been evaluated in the developing world where the burden of malnutrition is greatest.

Methods: This was a retrospective study of 113 patients admitted to the general paediatric wards at Rahima Moosa Mother and Child Hospital in Johannesburg, South Africa (SA). Children 6 months – 14 years old were screened for malnutrition using anthropometry and correlating WHO z-scores, and retrospectively assessed for nutritional risk using a modified STAMP (mSTAMP).

Results: The mSTAMP identified additional patients at nutritional risk. The majority (87%) of children with normal anthropometry scored as medium and high risk using the mSTAMP. Weight loss and length of hospital stay were higher in medium and high risk groups: One (10%) low risk child lost weight, compared to eight (47%) medium and 12 (26%) high risk children (p= 0.028). Low risk children had a median length of stay of two days (IQR : 1.5 – 5.5) compared to medium and high risk groups with medians of three (IQR: 2 – 6) and six (IQR: 4 – 10) days respectively (p= 0.04).

Conclusion: The mSTAMP identified more children at risk of malnutrition. These children may not have been considered for nutritional therapy during the hospital stay using anthropometry screening alone. There is a place for nutritional risk screening in developing world settings, but tools may need to be modified locally. Further studies and validation of these tools in Sub-Saharan Africa seem prudent and may result in improved nutrition and outcomes of hospitalised children.

INTRODUCTION

Childhood malnutrition impacts negatively on a child's immunity and growth and development, making it the most important risk factor for the global burden of disease.[1] The World Health Organisation (WHO) recommends identifying acute malnutrition in children 6 – 59 months old by measuring weight-for-length/height, mid upper-arm circumference (MUAC), and assessing the presence of nutritional oedema.[2] Length/height-for-age is used to identify stunting, the most common form of malnutrition in South Africa (SA).[3] Measurements are plotted on WHO growth standards charts, where *z*-scores correlate to a standard deviation of the international reference population.

While identifying children with established malnutrition is important, children at risk of developing malnutrition owing to their admission illness should also be identified as both predispose to poor outcomes and prolonged hospital admissions.[4] Screening for children who are at risk of developing malnutrition in hospital is recommended by the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN),[5] the European Society for Clinical Nutrition and Metabolism (ESPEN),[6] and the American Society for Parenteral and Enteral Nutrition (ASPEN).[7] Four major nutritional risk screening tools include the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP), the Paediatric Yorkhill Malnutrition Score (PYMS), the Screening Tool for Risk on Nutritional Status and Growth (STRONG(kids)), and the Subjective Global Nutritional Assessment (SGNA) for children. There is inconsistent and inconclusive data on which screening tool is superior to others, particularly in paediatrics.[8,9]

The purpose of nutritional screening is to identify children at risk of developing illness related- or hospital acquired malnutrition, and to initiate nutritional therapy early – when it can be more effective and less expensive.[8] European studies have found that screening tools identified children with acute malnutrition – Huysentruyt et al demonstrated a significant negative correlation between WHZ and the STRONGkids risk score (ρ= -0.23, p< 0.01)[8]– but also identified children who were at high nutritional risk who may have been missed based on their normal anthropometrics.[8,9] These tools have scarcely been studied or validated in a developing world setting.

At Rahima Moosa Mother and Child Hospital (RMMCH), a secondary level hospital in Johannesburg, SA, Paediatric departmental protocols comply with WHO recommendations in screening all children for acute malnutrition using anthropometry.[2] Admitted children are routinely weighed, measured, and screened for acute malnutrition based on these parameters (Table 1). Children with acute malnutrition should be referred to dietetics for nutritional rehabilitation, and those with severe acute malnutrition (SAM) with oedema should receive in-patient management as per the WHO "10 Steps".[2] Thus, in practice, only children with established malnutrition based on anthropometry are referred to dietetics, while others will rely on the physicians' opinion for the need for nutritional support. Furthermore, anthropometry is hampered by inconsistencies in the precise measurement of length/height,[3] and, due to genetic variations, the MUAC may not accurately depict the nutritional status of the child.[10]

The STAMP tool, developed and validated in the United Kingdom, scores nutritional risk based on parameters already assessed in our setting – anthropometry, nutritional intake, and diagnosis. Each parameter is scored out of three. Firstly, it scores the nutritional implications of the admission diagnosis, where 0 is no implications and 3 is definite implications. Then it assesses the nutritional intake of the child and scores this parameter, where no change in nutritional intake is given a score of 0 and a child with no intake a score of 3. Lastly, it scores the child's anthropometry and corresponding centiles, where 0 is given to children with normal anthropometry and 3 to children with severe wasting/SAM[11] (Appendix A). A total score more than 4 suggests high nutritional risk, requiring dietetics referral for nutritional rehabilitation. A score between 2 and 3 suggests a medium risk, warranting close dietary observation and repeat assessment after 3 days. A score of 0 to 1 suggests a low risk for malnutrition, and these children require repeat scoring weekly during their admission.[11] This quick screening tool should be easily and quickly implementable in many settings.

The tool may need to be modified to be more applicable locally however, as in its current form it does not list illnesses such as human immune deficiency virus (HIV), tuberculosis (TB), pneumonia, and gastroenteritis in its diagnosis table – illnesses among the leading causes of under-five mortality in SA.[12]

This study aimed to assess if a nutritional risk screening tool such as an appropriately modified STAMP may assist in identifying children at risk of developing malnutrition while in hospital, in addition to identifying children who are already malnourished using anthropometry alone. This would result in more children being referred for nutritional support during their hospital stay. Our study is the first in the region looking at such screening tools in hospitalised children.

METHODS

Study design and population

A retrospective study design was used, and data collected from hospital records of children admitted to the general paediatric wards at RMMCH. Included in the study were children 6 months – 14 years old admitted in February and March 2018. These age limits were determined by the hospital admission policy to the paediatric wards. The STAMP tool was modified as follows:

1. Inclusion of children from six months old,
2. Inclusion of HIV and TB as "*Definite nutritional implications*" and diarrhoeal disease, pneumonia, and meningitis as "*Possible nutritional implications*".

Anthropometry was classified using WHO growth standards charts and correlating *z*-scores. Children with primary surgical diagnoses were excluded as they were not managed by paediatric doctors. Children admitted for overnight observation were excluded.

Data collection

Details of the children in our study population were identified using the hospital database and the files obtained from the records department. The following information was taken from each patient's admission booklet: age, length of hospital stay in days (LOS), admission diagnoses, nutritional intake, admission weight (kg), length/height (cm), and MUAC (cm), clinician observed nutritional oedema, discharge weight, and outcome. Data was captured using REDCap electronic data capture tools hosted at the University of Witwatersrand. Captured data was anonymous, and ethical clearance was obtained from the Human Research Ethics Committee of the University of the Witwatersrand (Clearance number M180311).

Data analysis and statistics

Stata Intercooled version 11 (StataCorp, USA) was used for statistical analysis. Patients were retrospectively scored using the modified STAMP (mSTAMP), with scores 0 – 3 given for each of admission diagnosis (the highest score was given if patients had multiple diagnoses), nutritional intake, and anthropometry (Appendix A). mSTAMP scores were analysed as categorical data with scores 0 – 1 as low, 2 – 3 as medium, and ≥ 4 as high risk. Overweight children were allocated the lowest score for anthropometry (0) as the tool was used specifically for undernutrition. Children with acute malnutrition scored 1 or 3 for wasting/moderate acute malnutrition (MAM) and severe wasting/SAM respectively (Table 1).

Anthropometric *z*-scores were calculated using the WHO Anthro and AnthroPlus software programs (WHO, Geneva). The median and 25 – 75% interquartile ranges (IQR) were calculated for continuous variables. Categorical variables were compared using Chi-square tests with Fisher exact statistics where appropriate. LOS and change in weight were analysed using the Kruskal Wallis test, and excluded children who died or were transferred to other facilities.

RESULTS

Baseline characteristics

A total of 262 children 6 months to 14 years were admitted during the study period. The 124 patients admitted for overnight observation and nine with surgical diagnoses were excluded from the study. Of the 129 eligible patients, 16 files were not found at the records department after multiple attempts. Therefore, 113 patient records were analysed. The median age of admitted children was 19 months (IQR: 9 – 41), with 81% of children under five years (*n*= 91).

Diagnoses

All children had at least one admission diagnosis. Respiratory illnesses made up most of the admission diagnoses (35%, *n*= 40/113), followed by diarrhoeal diseases (32%, *n*= 36/113), infections including HIV and TB (32%, *n*= 36/113), and nutritional illnesses (21%, *n*= 24). Almost 17% of admitted patients were HIV infected (*n*= 19/113). Notably, 20% *(n*= 23/113*)* of children had an admission diagnosis of acute malnutrition, the

majority of whom had SAM. Gastroenteritis, pneumonia, meningitis, HIV, and TB – diagnoses added to the STAMP tool – accounted for almost half of the admission diagnoses (47%, *n*= 89/186). The majority of patients had diagnoses with "*Possible nutritional implications*" (56%, *n*= 63/113), and 19% (*n*= 21/113) had diagnoses with "*Definite nutritional implications*"

Anthropometry

Not all patients had documented anthropometric data. Of the 113 analysed files 111 (98%) had an admission weight, 104 (92%) had both weight and length/height, and of the 91 patients ≤ 59 months, 42 (46%) had a documented MUAC. The majority (68%) of children had a normal weight-for-age (*n*= 75/111*)*. Wasting was the most common form of malnutrition. Moderate wasting was seen in 24% of children under five years (*n*= 20/85) and 14% (*n*= 12/85) had severe wasting. Nineteen percent *(n*= 20/104*)* of children were stunted, half of them severely stunted. Of the children under five years with MUAC measurements, 14% (*n*= 5/42) were < 11.5cm, classifying them as having SAM. Five patients (4%) had nutritional oedema (kwashiorkor). There were three (3%) overweight (WHZ > 2) and no obese (WHZ > 3) children.

Nutritional intake

Thirty-three children did not have documented intake data (29%) (Figure 1). Of those with intake data, half had poor or reduced intake (*n*= 40/80). Nearly 20% of children with intake data had no intake in the 24 – 48 hours prior to admission (*n*= 15/80).

Risk scores

Of the 113 patients, 8% (*n*= 9/113) had missing anthropometric data and 29% (*n*= 33/113) had missing intake data. Thus, 39 patients were excluded from the final analysis (three children had both missing intake and missing anthropometric data). The majority of children were classified as high risk using the mSTAMP (64%, *n*= 47/74) (Table 2). An analysis comparing the anthropometric assessment to the mSTAMP score showed that all children with SAM had a high risk mSTAMP score (Table 2). More than half of the high risk children had normal anthropometry (*n*= 24/47). Based on anthropometry alone 29 (39%) children had moderate or severe wasting/acute malnutrition, while using the mSTAMP 64 (86%) children were assessed as having

either medium or high nutritional risk. Of the 45 children with normal anthropometry 13% (*n*= 6/45) scored as low risk, 33% (*n*= 15/45) as medium risk, and 53% (*n*= 24/45) as high risk using the mSTAMP.

Outcomes

Half of the children were seen by a dietician (*n*= 37/74*)* (Table 3). Less than half of the high risk children (as identified by the mSTAMP tool) were seen by dietetics. Of the 38 children with acute malnutrition, 79% (*n*= 30/38*)* were seen by a dietician, while two children with SAM were neither referred to- nor screened by dietetics (Table 4). All but four children who saw a dietician received nutritional supplementation. There was a statistically significant correlation between increasing LOS and a higher mSTAMP score– Low risk had a median LOS of 2 days (IQR : 1.5 – 5.5) compared to medium and high risk groups with medians of 3 (IQR: 2 – 6) and 6 (IQR: 4 – 10) days respectively (Kruskal-Wallis: *p*= 0.04). Discharge weight, and hence weight lost/gained was available for 81 children. More children lost weight in the medium and high risk groups – one (10%) low risk child lost weight, compared to 8 (47%) medium and 12 (26%) high risk children (*p*= 0.028). High risk children had the most median weight gain per day compared to the other groups, with children who were medium risk having a median of 25g weight loss per day (IQR: -75 – 27). There were three deaths reported, none of whom were scored as low risk (Table 4). Five children were transferred to other facilities.

Comparing the original STAMP tool versus the mSTAMP, the original STAMP would have identified more low risk (13 vs 10 for STAMP and mSTAMP respectively) and more medium risk (42 vs 17 for STAMP and mSTAMP respectively), but fewer high risk patients (19 vs 47 for STAMP vs mSTAMP) (Table 5). The original STAMP tool did not predict LOS in our sample (*p*= 0.04 vs *p*= 0.55 for mSTAMP and STAMP respectively). Lastly, the original tool classified four of the 11 children with SAM as medium risk compared with all 11 children with SAM classified as high risk using the mSTAMP.

DISCUSSION

The current practice at Rahima Moosa Mother and Child Hospital, and South African health care centres at large, is to refer all children with acute malnutrition (MAM and SAM) to dietetics for nutritional assessment and rehabilitation. This is done using anthropometry and the WHO definition of acute malnutrition.[2] Thus, unless otherwise indicated, children with normal anthropometry are generally not referred for nutritional support. Anthropometrics alone do not consider illness and any further deterioration in the nutritional status of a child during illness and/or hospitalisation. The negative effects of poor or deteriorating nutrition in these children have been well described, with poorly nourished children at higher risk of nosocomial and wound sepsis, as well as increased LOS.[4,13] It has also been demonstrated that children at higher nutritional risk using a nutritional risk scoring tool have longer hospital admissions.[8] Our results support this, showing a statistically significant association between mSTAMP risk score and LOS (p= 0.04).

The top four disease groups in the study mirror the national trends, each being among the leading causes of under-five mortality in SA.[12,14] Illnesses added to the STAMP tool accounted for almost half of the total admissions, highlighting the differing disease profile seen in this setting. The use of the WHO *z*-scores may prevent confusion as local guidelines recommend the use of *z*-scores, which may improve the compliance of clinicians in completing the risk assessment. It will also allow clinicians to identify children with MAM and SAM.

Many of the patients had missing data, the majority of whom had missing intake data. This may be because the initial history is typically taken by the most junior doctor (such as the intern doctor). These doctors may, perhaps, not appreciate the importance of a dietary history in all children, specifically a 24 hour intake recall in an ill child – this despite poor intake being among the WHO Integrated Management of Childhood Illness (IMCI) “Danger Signs”.[15] Even more disappointing is the number of children with missing anthropometry, with MUAC most poorly performed in the current study, followed by length/height, and then weight. Given that anthropometrics (and correlating WHO *z*-scores) are the mainstay for malnutrition surveillance in SA, and that dosing in paediatric patients is largely weight-dependant, one would expect 100% compliance for weight.

Despite the reliance on anthropometry for nutritional screening, it remains very poorly performed among clinicians.[3] Appropriate equipment is frequently not calibrated or is unavailable in many hospitals, and there are inconsistencies in the plotting and interpretation of growth parameters, with some clinicians using WHO growth standards charts and others using one of many available mobile applications to calculate *z*-scores. All these issues potentially result in over- or underestimation of malnutrition. In addition to poorly performed anthropometry, not all children with MAM or SAM were referred to dietetics as recommended by the WHO – six children with an admission diagnosis of MAM and two with SAM did not see a dietician during their admission.

The results of this study showed that the mSTAMP identified more children at nutritional risk than anthropometry alone. The vast majority of children with normal anthropometry scored as medium to high risk using the mSTAMP, and more than half of the high risk children had normal anthropometry (Table 2). This suggests that the screening tool may useful in identifying at-risk children who, by virtue of having normal anthropometry, would otherwise not receive nutritional support. A third of children with normal anthropometry had weight loss on discharge, compared with 17% and 13% of children with MAM and SAM respectively (table 4). This may likely be explained by the mandatory nutritional rehabilitation offered to the latter two groups.

Notwithstanding our sample size being too small to validate the two scores in our setting, this preliminary data shows that the unmodified tool may not be appropriate in our setting. The original tool performed worse at predicting LOS and failed to classify four SAM patients as high-risk. This may be attributed to the addition of common admission diagnoses with likely nutritional or food intake implications to the modified score.

A final consideration is which member of the healthcare staff will implement the screening. The STAMP tool was designed for use by non-dietetic healthcare professionals, and hence screening may be performed by nursing staff, dieticians or physicians, depending on the local situation and staff availability. However, while the screening may be performed by non-dietetic staff, nutritional rehabilitation is facilitated by clinical dieticians. Thus, as more children are identified for nutritional risk using

screening tools such as the mSTAMP, more dieticians and dietetic services are required. This will have financial implications on the health system as it would mean more (and improved) anthropometric equipment, appropriate nutritional supplementations, as well as adequate human capacity. Nevertheless, early and preventative interventions for at-risk children may prove more cost effective and may be required for a shorter period than treating established malnutrition. In addition, improving the nutritional outcomes may result in shorter hospital stays with fewer complications. These assertions should be tested in prospective trials.

STUDY LIMITATIONS

Files not found at the records department affected the sample size. Intake, anthropometric, and discharge weight data were poorly captured. As this was a retrospective analysis, anthropometric measurement techniques and equipment were not witnessed and cannot be verified. Furthermore, no specialised growth charts or corrections were used for children with physical disabilities (e.g. cerebral palsy), ex-premature infants, and syndromic children (e.g. Down syndrome). Children admitted to surgical disciplines were excluded, although these children would likely benefit from nutritional screening as they are infrequently screened for malnutrition.

Lastly our modifications to the STAMP tool are yet to be validated, and further prospective studies are needed in this regard. Similarly, the cost benefit ratio of nutrition risk screening tools remains to be proven.

CONCLUSIONS

Nutritional risk screening tools are recommended globally and enable early detection of nutritional deterioration and treatment. They are yet to be explored as an adjunct to anthropometry in South Africa and Sub-Saharan Africa at large. This study shows that we are currently not referring all children at medium and high nutritional risk (as per mSTAMP) for dietetic assessment and/or intervention. Pitfalls in both measurement and interpretation of anthropometry may result in some children not receiving necessary nutritional rehabilitation. It is the authors' opinion that nutritional risk screening tools, with local modification, may have an important role to play in nutritional care of hospitalised children in the developing world setting. Further prospective

studies and validation of these tools in SA and Sub-Saharan Africa can assist in this respect. Implementing these tools may improve the nutritional status, decrease the length of stay and nosocomial infections, and improve the clinical outcomes of hospitalised children.

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Table 1: Anthropometric Definitions and Respective STAMP score

CLASSIFICATION	ANTHROPOMETRIC DEFINITION	STAMP SCORE
Normal	WHZ or BMIZ z-score > -2 SD of the WHO Child Growth Standards median	0
Moderate acute malnutrition	WHZ < -2 OR MUAC <12.5cm but > 11.5cm	1
Severe acute malnutrition	WHZ < -3 OR MUAC < 11.5cm OR bilateral pitting pedal oedema	3

Notes: STAMP = screening tool for the assessment of malnutrition in paediatrics, WHZ = weight-for-length/height *z*- score, BMIZ = Body mass index-for-age *z* -score, BMI = Body mass index, MUAC = mid-upper arm circumference **Weight-for-length/height measurements in children ≤ 59 months, **BMI-for-age in children ≥60 months.



Figure 1: Individual components of Modified STAMP Scores of Patients Admitted to Rahima Moosa Mother and Child Hospital

Table 2: Anthropometric Classification and Modified STAMP Scores

PARAMETER	LOW RISK	MEDIUM RISK	HIGH RISK
Final Score N= *74 (%)*	10 (13)	17 (23)	47 (64)
Anthropometry*			
No wasting n (%) N= 45	6 (13)	15 (33)	24 (53)
Wasting/MAM n (%) N= 18	4 (22)	2 (11)	12 (67)
Severe wasting/SAM n (%) N= 11	0 (0)	0 (0)	11 (100)

Notes: STAMP = The Screening Tool for the Assessment of Malnutrition in Paediatrics, MAM = Moderate acute malnutrition, SAM = Severe acute malnutrition, *WHO definition using Weight-for-length and/or mid upper-arm circumference and/or nutritional oedema, BMI-for-age (thinness) in children ≥ 60 months

Table 3: Modified STAMP (mSTAMP) Scores and Outcomes

PARAMETER	OVERALL	LOW RISK	MEDIUM RISK	HIGH RISK
mSTAMP Score n *(%)**	74 (100)	10 (13)	17 (23)	47 (63)
Seen by Dietician n *(%)*	37 (100)	2 (5)	5 (13)	30 (81)
Nutritional Supplementation n (%)	33 (100)	2 (6)	3 (9)	28 (85)
LOS Median Days (IQR) N= 71 †	4 (3 - 8)	2.5 (1 - 8)	3 (3 - 8)	6 (4 - 9)
Weight Gain/Day Median g (IQR) N= 71 †	20 (-19 - 68)	3 (0 - 40)	-25 (-75 - 27)	42 (-15 - 89)
Patients with Weight Loss g N= 71 (%) †	21 (100)	1 (5)	8 (38)	12 (57)
Deaths *n (%)*	1 (100)	0 (0)	0 (0)	1 (100)

Notes: STAMP = The Screening Tool for the Assessment of Malnutrition in Paediatrics, LOS = Length of stay. *Number of children with complete data, **Patients referred to or screened by dieticians, † excluding deaths and patients transferred out. Kruskall Wallis LOS per risk group $p = 0.04$

Table 4: WHO Anthropometric Classification and Outcomes

PARAMETER	OVERALL	NORMAL	MAM	SAM
WHO Classification n *(%)**	104 (100)	66 (63)	23 (22)	15 (14)
Seen by Dietician n *(%)* **	46 (44)	16 (35)	17 (37)	13 (28)
Nutritional Supplementation n (%)	42 (40)	14 (33)	15 (36)	13 (31)
LOS Median Days (IQR) N= 99 †	2 (4 - 8)	3 (2 - 5)	6 (4 - 10)	10 (6 - 15)
Weight Gain/Day Median g (IQR) N= 99 †	20 (-16 - 66)	0 (-40 - 60)	33 (0 - 70)	8 (-16 - 25)
Patients with Weight Loss g N= 99 (%) †	26 (25)	20 (77)	4 (15)	2 (8)
Deaths *n (%)*	2 (2)	2 (100)	0 (0)	0 (0)

Notes: MAM = Moderate acute malnutrition, SAM = Severe acute malnutrition, LOS = Length of stay.*WHO definition using Weight-for-length and/or mid upper-arm circumference and/or nutritional oedema, BMI-for-age (thinness) in children ≥ 60 months, **Patients referred to or screened by dieticians, † excluding deaths and patients transferred out. Kruskall Wallis LOS per WHO classification $p < 0.001$

Table 5: Comparing STAMP Against the Modified STAMP

	MODIFIED STAMP		
ORIGINAL STAMP	**Low Risk**	**Medium Risk**	**High Risk**
Low Risk n (%) N=13	9 (69)	4 (31)	0 (0)
Medium Risk n (%) N= 42	1 (2)	13 (31)	28 (67)
High Risk n (%) N= 19	0 (0)	0 (0)	19 (100)
Total n (%) N= 74	10 (14)	17 (23)	47 (64)

Notes: STAMP = The Screening Tool for the Assessment of Malnutrition in Paediatrics

WHAT IS ALREADY KNOWN ON THIS TOPIC?

Hospitalised children are at risk of developing malnutrition, which may increase their risk of complications and result in prolonged admissions.

Nutritional screening is recommended by several European and American paediatric expert nutritional societies to identify nutritionally at-risk hospitalised children due to their illness and/or hospitalisation.

Childhood malnutrition is a major public health issue, and Sub-Saharan Africa remains heavily burdened, but screening tools are yet to be evaluated in these settings.

WHAT THIS STUDY ADDS

Hospitalised children with normal anthropometry may still be at medium or high nutritional risk when using a nutritional screening tool.

Children with acute malnutrition, or those with medium to high nutrition risk using the mSTAMP screening tool, are frequently not being referred for dietetic intervention in the current setting.

Nutrition risk screening tools should be adapted to include the local disease profile, and to cater for other practical implications.

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Appendix A

Screening Tool for the Assessment of Malnutrition in Paediatrics

STAMP

Screening form and diagnosis table

To be used with the centile quick reference tables or growth charts, and the weighing and measuring instructions

For more information, and to download other materials, please visit www.stampscreeningtool.org

Supported by an educational grant from

Central Manchester University Hospitals NHS
NH Fc un Jatic n Trust

Abbott Nutrition

Date of preparation: April 2010 RXNPD100216

STAMP screening form

4HIS FORM CAN BE USED TO SCREEN A CHILD UP TO THREE TIMES n PLEASE DATESIGN AND INITIAL the space at the bottom of this sheet every time you do so.

Screening Tool for the Assessment of Malnutrition in Paediatrics

STAMP

Step 1 – Diagnosis				
Does the child have a diagnosis that has any nutritional implications?	Score	1st screening	2nd screening	3rd screening
Definite nutritional implications	3			
Possible nutritional implications	2			
No nutritional implications	0			
Step 2 – Nutritional intake				
What is the child's nutritional intake?	Score	1st screening	2nd screening	3rd screening
No nutritional intake	3			
Recently decreased or poor nutritional intake	2			
No change in eating patterns and good nutritional intake	0			
Step 3 – Weight and height				
Use a growth chart or the centile quick reference tables to determine the child's measurements	Score	1st screening wt: ht:	2nd screening wt: ht:	3rd screening wt: ht:
> 3 centile spaces/≥ 3 columns apart (or weight < 2nd centile)	3			
> 2 centile spaces/= 2 columns apart				
0 to 1 centile spaces/columns apart	1			
	0			
Step 4 – Overall risk of malnutrition				
Add up the scores from the boxes in steps 1–3 to calculate the overall risk of malnutrition	Score	1st screening	2nd screening	3rd screening
High risk				
Medium risk	≥4			
	2–3			
Low risk	0–1			
Step 5 – Care plan				
What is the child's overall risk of malnutrition, as calculated in step 4?	Use management guidelines and/or local nutrition policies to develop a care plan for the child			

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High risk	s 4AKE ACTION s 2EFER THE CHILD TO A $IETITIANNUTRITIONAL SUPPORT TEAMOR CONSULTANT s -ONITOR AS PER CARE PLAN
Medium risk	s -ONITOR THE CHILDS NUTRITIONAL INTAKE FOR DAYS s 2EPEAT THE 34!-0 SCREENING AFTER DAYS s !MEND CARE PLAN AS REQUIRED
Low risk	s #ONTINUE ROUTINE CLINICAL CARE s 2EPEAT THE 34!-0 SCREENING WEEKLY WHILE THE CHILD IS AN IN PATIENT s !MEND CARE PLAN AS REQUIRED

Please complete after each screening	Date	Signature	Initials
1st screening			
2nd screening			
3rd screening			

#HILDS NAME _____

_____

DOB: _____

Hospital no.: _____

Abbott Nutrition

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Diagnosis table

To be used to assign a score for step 1 of STAMP

Screening Tool for the Assessment of Malnutrition in Paediatrics
STAMP

Definite nutritional implications	Possible nutritional implications	No nutritional implications
Bowel failure, intractable diarrhoea Burns and major trauma #ROHNS DISEASE #YSTIC FIBROSIS Dysphagia Liver disease Major surgery Multiple food allergies/intolerances Oncology on active treatment Renal disease/failure Inborn errors of metabolism	Behavioural eating problems #ARDIOLOGY #EREBRAL PALSY #LEFT LIP AND PALATE #OELIAC DISEASE Diabetes 'ASTRO OESOPHAGEAL REFLUX Minor surgery Neuromuscular conditions Psychiatric disorders R espiratory syncytial virus (RSV) Single food allergy/intolerance	Day case surgery Investigations

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- While every effort has been made to include diagnoses that have nutritional implications, this list is not exhaustive
- If you have any queries, please discuss them with a Dietitian

34!-0 SHOULD BE USED IN ASSOCIATION WITH 4RUST REFERRAL GUIDELINES AND POLICIES



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Appendix B: Modified Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP)

Step 1 − Diagnosis				
Does the child have a diagnosis that has any nutritional implications?	Score	1st screening	2nd screening	3rd screening
Definite nutritional implications	3			
Possible nutritional implications	2			
No nutritional implications	0			
Step 2 − Nutritional Intake				
What is the child's nutritional intake?	Score			
No nutritional intake	3			
Recently decreased or poor nutritional intake	2			
No change in eating patterns and good nutritional intake	0			
Step 3 − Weight and height				
Use WHO growth standards charts (*z*-scores)	Score			
Severe wasting/acute malnutrition	3			
Moderate wasting/acute malnutrition	1			
Normal anthropometry	0			
Overall risk of malnutrition				
Add up the scores from the boxes in step 1 − 3 to calculate the overall risk of malnutrition	Score			
High risk	≥ 4			
Medium risk	2 − 3			
Low risk	0 − 1			

Modified STAMP Diagnosis Table

Definite nutritional implications	Possible nutritional implications	No nutritional implications
▪ Bowel failure, intractable diarrhoea ▪ Crohn's disease ▪ Cystic fibrosis ▪ Dysphagia ▪ Liver disease ▪ Multiple food allergies/intolerances ▪ Oncology on active treatment ▪ Renal disease/failure ▪ Inborn errors of metabolism ▪ **Human Immune deficiency Virus (HIV)** ▪ **Tuberculosis (Pulmonary and extra-pulmonary)**	▪ Behavioural eating problems ▪ Cardiology ▪ Cerebral palsy ▪ Cleft lip and Palate ▪ Coeliac disease ▪ Diabetes ▪ Gastro-oesophageal reflux ▪ Neuromuscular conditions ▪ Psychiatric disorders ▪ Respiratory syncytial virus (RSV) ▪ Single food allergy/intolerance ▪ **Meningitis** ▪ **Acute gastroenteritis** ▪ **Pneumonia**	▪ Day case surgery ▪ Investigations

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Lesego Ndhlovu (Student number: _0703064P) am a student registered for the degree of __MMed (Paeds) in the academic year __2020_.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
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R 14/49 Dr Lesego Ndhlovu

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M180311

NAME: (Principal Investigator)	Dr Lesego Ndhlovu
DEPARTMENT:	Paediatrics and Child Health Rahima Moosa Mother and Child Hospital
PROJECT TITLE:	Comparing Anthropometry against a Modified Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP) in Hospitalised Children at Rahima Moosa Mother and Child Hospital to Identify Children at Risk of Malnutrition
DATE CONSIDERED:	06/04/2018 Approved unconditionally
DECISION: CONDITIONS:	
SUPERVISOR:	Dr Tim De Maayer

Professor CB Penny, Chairperson, HREC (Medical)

APPROVED BY:

DATE OF APPROVAL: 29/05/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and ONE COPY returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. I agree to submit a yearly progress report. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in March and will therefore be due in the month of March each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

_____ _____

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

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WITWATERSRAND,
JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

28 October 2019

Dr L Ndhlovu

Person No: 0703064P
TAA

Dear Dr Lesego Ndhlovu

Master of Medicine: Change of title of research

I am pleased to inform you that the following change in the title of your Research Report for the degree of **Master of Medicine** has been approved:

From: **Assessing the feasibility of introducing a nutrition risk scoring system in the using a Modified STAMP Nutritional Assessment Tool**

To: **Introducing a new nutrition risk screening tool in a South African Hospital**

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Department of Paediatrics & Child Health
School of Clinical Medicine, Faculty of Health Sciences
UNIVERSITY OF THE WITWATERSRAND

Private Bag X20, Newclare 2112, South Africa Telephone: +27 11 470-9100/470-9284· Fax: +27 11 470-9169

2 May 2020

Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Dear Mrs Benn,

Re : Approval for changes on final research report

Candidate: Lesego Ndhlovu
Student number : 0703064P
Supervisor: Dr Tim De Maayer
Degree: MMed (Paediatrics)
Department: Paediatrics and Child Health

Title: INTRODUCING A NUTRITIONAL RISK SCREENING TOOL IN A SOUTH AFRICAN HOSPITAL

As Head of Dept I approve and support this final submission with corrections.

Yours truly

Adjunct Professor Ashraf Hassen Coovadia

Academic Head of Paediatrics and Child Health, School of Clinical Medicine
Faculty of Health Sciences
University of the Witwatersrand
Rahima Moosa Mother and Child Hospital

2020/05/04

Rahima Moosa Mother and Child Hospital

Re: Dr Lesego Ndhlovu – student no. 0703064P

To whom it may concern,

As the supervisors of the above student I confirm I have reviewed the corrections and recommendations to the Master of Medicine Research Report entitled:

"INTRODUCING A NUTRITIONAL RISK SCREENING TOOL IN A SOUTH AFRICAN HOSPITAL"

The examiners agreed to award the degree, provided that substantial amendments were done to the satisfaction of the supervisor and to the approval of the Head of Department. I have reviewed all corrections and am satisfied that all recommendations made by both internal and external examiners have been addressed satisfactorily.

Thank you



Dr Tim De Maayer

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INTRODUCING A NUTRITIONAL RISK SCREENING TOOL IN A SOUTH AFRICAN HOSPITAL Lesego Ndhlovu (Student number 0703064P) MBBCh(Wits), DCH(SA) Department of Paediatrics and Child Health, Rahima Moosa Mother and Child Hospital, University of the Witwatersrand Tim De Maayer:

MBBCh(Wits), FCPaeds(SA), MMED(Paed), Cert Gastroenterol (SA) Paed Department of Paediatrics and Child Health, Rahima Moosa Mother and Child Hospital, University of the WitwatersrandContact details for correspondence: Lesego Ndhlovu (mobile) + 27 79 390 8519 (email) lesego.ndhlovu1@wits.ac.za
ABSTRACT
..... . 2 INTRODUCTION ..... 3 METHODS .... 5 RESULTS..... ..... 6 DISCUSSION ..... 9 CONCLUSIONS ..... 11 TABLES AND FIGURES ..... 13 WHAT IS KNOWN ON THE TOPIC..... 16 REFERENCES..... 17 APPENDIX A ..... 19 APPENDIX B ..... 23 PLAGARISM DECLARATION..... 25 ETHICS APPROVAL.....26 TITLE CHANGE FACULTY CONFIRMATION LETTER ..... 27 LETTER FROM HEAD OF DEPARTMENT.....28 LETTER FROM SUPERVISOR..... 29 TURNITIN REPORT..... .30
ABSTRACT Background: Nutritional screening facilitates the early identification of hospitalised children at risk of malnutrition. Screening tools have scarcely been evaluated in the developing world where the burden of malnutrition is greatest. Methods: This was a retrospective study of 113 patients admitted to the general paediatric wards at Rahima Moosa Mother and Child Hospital in Johannesburg, South Africa (SA). Children 6 months – 14 years old were screened for malnutrition using anthropometry and correlating WHO z-scores, and retrospectively assessed for nutritional risk using a modified STAMP (mSTAMP). Results: The mSTAMP identified additional patients at nutritional risk. The majority (87%) of children with normal anthropometry scored as medium and high risk using the mSTAMP. Weight loss and length of hospital stay were higher in medium and high risk groups: One (10%) low risk child lost weight, compared to eight (47%) medium and 12 (26%) high risk children (p= 0.028). Low risk children had a median length of stay of two days(IQR : 1.5 – 5.5) compared to medium and high risk groups with medians of three (IQR: 2 – 6) and six (IQR: 4 – 10) days respectively (p= 0.04). Conclusion: The mSTAMP identified more children at risk of malnutrition. These children may not have been considered for nutritional therapy during the hospital stay using anthropometry screening alone. There is a place for nutritional risk screening in developing world settings, but tools may need to be modified locally. Further studies and validation of these tools in Sub-Saharan Africa seem prudent and may result in improved nutrition and outcomes of hospitalised children.
INTRODUCTION Childhood malnutrition impacts negatively on a child's immunity and growth and development, making it the most important risk factor for the global burden of disease.(1) The World Health Organisation (WHO) recommends identifying acute malnutrition in children 6 – 59 months old by measuring weight-for- length /height, mid upper-arm circumference (MUAC), and assessing the presence of nutritional oedema.(2) Length /height-for-age is used to identify stunting, the most common form of malnutrition

in South Africa (SA).(3) Measurements are plotted on WHO growth standards charts, where z-scores correlate to a standard deviation of the international reference population. While identifying children with established malnutrition is important, children at risk of developing malnutrition owing to their admission illness should also be identified as both predispose to poor outcomes and prolonged hospital admissions.(4) Screening for children who are at risk of developing malnutrition in hospital is recommended by the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN),(5) the European Society for Clinical Nutrition and Metabolism (ESPEN),(6) and the American Society for Parenteral and Enteral Nutrition (ASPEN).(7)Four major nutritional risk screening tools include the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP), the Paediatric Yorkhill Malnutrition Score (PYMS), the Screening Tool for Risk on Nutritional Status and Growth (STRONG(kids)), and the Subjective Global Nutritional Assessment (SGNA) for children.There is inconsistent and inconclusive data on which screening tool is superior to others, particularly in paediatrics.(8,9) The purpose of nutritional screening is to identify children at risk of developing illness related- or hospital acquired malnutrition, and to initiate nutritional therapy early – when it can be more effective and less expensive.(8) European studies have found that screening tools identified children with acute malnutrition – Huysentruyt et al demonstrated a significant negative correlation between WHZ and the STRONGkids risk score ($r= -0.23$, $p< 0.01$)(8)– but also identified children who were at high nutritional risk who may have been missed based on their normal anthropometrics.(8,9) These tools have scarcely been studied or validated in a developing world setting. At Rahima Moosa Mother and Child Hospital (RMMCH), a secondary level hospital in Johannesburg, SA, Paediatric departmental protocols comply with WHO recommendations in screening all children for acute malnutrition using anthropometry.(2) Admitted children are routinely weighed, measured, and screened for acute malnutrition based on these parameters (Table 1). Children with acute malnutrition should be referred to dietetics for nutritional rehabilitation, and those with severe acute malnutrition (SAM) with oedema should receive in- patient management as per the WHO "10 Steps".(2) Thus, in practice, only children with established malnutrition based on anthropometry are referred to dietetics, while others will rely on the physicians' opinion for the need for nutritional support. Furthermore, anthropometry is hampered by inconsistencies in the precise measurement of length/height,(3) and, due to genetic variations, the MUAC may not accurately depict the nutritional status of the child.(10) The STAMP tool, developed and validated in the United Kingdom, scores nutritional risk based on parameters already assessed in our setting – anthropometry, nutritional intake, and diagnosis. Each parameter is scored out of three. Firstly, it scores the nutritional implications of the admission diagnosis, where 0 is no implications and 3 is definite implications. Then it assesses the nutritional intake of the child and scores this parameter, where no change in nutritional intake is given a score of 0 and a child with no intake a score of 3. Lastly, it scores the child's anthropometry and corresponding centiles, where 0 is given to children with normal anthropometry and 3 to children with severe wasting/SAM(11) (Appendix A). A total score more than 4 suggests high nutritional risk, requiring dietetics referral for nutritional rehabilitation. A score between 2 and 3 suggests a medium risk, warranting close dietary observation and repeat assessment after 3 days. A score of 0 to 1 suggests a low risk for malnutrition, and these children require repeat scoring weekly during their admission.(11) This quick screening tool should be easily and quickly implementable in many settings. The tool may need to be modified to be more applicable locally however, as in its current form it does not list illnesses such as human immune deficiency virus (HIV), tuberculosis (TB), pneumonia, and gastroenteritis in its diagnosis table – illnesses among the leading causes of under-five mortality in SA.(12) This study

aimed to assess if a nutritional risk screening tool such as an appropriately modified STAMP may assist in identifying children at risk of developing malnutrition while in hospital, in addition to identifying children who are already malnourished using anthropometry alone. This would result in more children being referred for nutritional support during their hospital stay. Our study is the first in the region looking at such screening tools in hospitalised children. METHODS Study design and population A retrospective study design was used, and data collected from hospital records of children admitted to the general paediatric wards at RMMCH. Included in the study were children 6 months – 14 years old admitted in February and March 2018. These age limits were determined by the hospital admission policy to the paediatric wards. The STAMP tool was modified as follows: 1. Inclusion of children from six months old, 2. Inclusion of HIV and TB as "Definite nutritional implications" and diarrhoeal disease, pneumonia, and meningitis as "Possible nutritional implications". Anthropometry was classified using WHO growth standards charts and correlating z- scores. Children with primary surgical diagnoses were excluded as they were not managed by paediatric doctors. Children admitted for overnight observation were excluded. Data collection Details of the children in our study population were identified using the hospital database and the files obtained from the records department. The following information was taken from each patient's admission booklet: age, length of hospital stay in days (LOS), admission diagnoses, nutritional intake, admission weight (kg), length/height (cm), and MUAC (cm), clinician observed nutritional oedema, discharge weight, and outcome. Data was captured using REDCap electronic data capture tools hosted at the University of Witwatersrand. Captured data was anonymous, and ethical clearance was obtained from the Human Research Ethics Committee of the University of the Witwatersrand (Clearance number M180311). Data analysis and statistics Stata Intercooled version 11 (StataCorp, USA) was used for statistical analysis. Patients were retrospectively scored using the modified STAMP (mSTAMP), with scores 0 – 3 given for each of admission diagnosis (the highest score was given if patients had multiple diagnoses), nutritional intake, and anthropometry (Appendix A). mSTAMP scores were analysed as categorical data with scores 0 – 1 as low, 2 – 3 as medium, and ≥ 4 as high risk. Overweight children were allocated the lowest score for anthropometry (0) as the tool was used specifically for undernutrition. Children with acute malnutrition scored 1 or 3 for wasting/moderate acute malnutrition (MAM) and severe wasting /SAM respectively (Table 1). Anthropometric z-scores were calculated using the WHO Anthro and AnthroPlus software programs (WHO, Geneva). The median and 25 – 75% interquartile ranges (IQR) were calculated for continuous variables. Categorical variables were compared using Chi-square tests with Fisher exact statistics where appropriate. LOS and change in weight were analysed using the Kruskal Wallis test, and excluded children who died or were transferred to other facilities. RESULTS Baseline characteristics A total of 262 children 6 months to 14 years were admitted during the study period. The 124 patients admitted for overnight observation and nine with surgical diagnoses were excluded from the study. Of the 129 eligible patients, 16 files were not found at the records department after multiple attempts. Therefore, 113 patient records were analysed. The median age of admitted children was 19 months (IQR: 9 – 41), with 81% of children under five years (n= 91). Diagnoses All children had at least one admission diagnosis. Respiratory illnesses made up most of the admission diagnoses (35%, n= 40/113), followed by diarrhoeal diseases (32%, n= 36/113), infections including HIV and TB (32%, n= 36/113), and nutritional illnesses (21%, n= 24). Almost 17% of admitted patients were HIV infected (n= 19/113). Notably, 20% (n= 23/113) of children had an admission diagnosis of acute malnutrition, the majority of whom had SAM. Gastroenteritis, pneumonia, meningitis, HIV, and TB – diagnoses added to the STAMP tool – accounted for almost half of the admission diagnoses

(47%, n= 89/186). The majority of patients had diagnoses with "Possible nutritional implications" (56%, n= 63/113), and 19% (n= 21/113) had diagnoses with "Definite nutritional implications" Anthropometry Not all patients had documented anthropometric data. Of the 113 analysed files 111 (98%) had an admission weight, 104 (92%) had both weight and length/height, and of the 91 patients ≤ 59 months, 42 (46%) had a documented MUAC. The majority (68%) of children had a normal weight-for-age (n= 75/111). Wasting was the most common form of malnutrition. Moderate wasting was seen in 24% of children under five years (n= 20/85) and 14% (n= 12/85) had severe wasting. Nineteen percent (n= 20/104) of children were stunted, half of them severely stunted. Of the children under five years with MUAC measurements, 14% (n= 5/42) were < 11.5cm, classifying them as having SAM. Five patients (4%) had nutritional oedema (kwashiorkor). There were three (3%) overweight (WHZ > 2) and no obese (WHZ > 3) children. Nutritional intake Thirty-three children did not have documented intake data (29%) (Figure 1). Of those with intake data, half had poor or reduced intake (n= 40/80). Nearly 20% of children with intake data had no intake in the 24 – 48 hours prior to admission (n= 15/80). Risk scores Of the 113 patients, 8% (n= 9/113) had missing anthropometric data and 29% (n= 33/113) had missing intake data. Thus, 39 patients were excluded from the final analysis (three children had both missing intake and missing anthropometric data). The majority of children were classified as high risk using the mSTAMP (64%, n= 47/74) (Table 2). An analysis comparing the anthropometric assessment to the mSTAMP score showed that all children with SAM had a high risk mSTAMP score (Table 2). More than half of the high risk children had normal anthropometry (n= 24/47). Based on anthropometry alone 29 (39%) children had moderate or severe wasting/acute malnutrition, while using the mSTAMP 64 (86%) children were assessed as having either medium or highnutritional risk. Of the 45 children with normal anthropometry 13% (n= 6/45) scored as low risk, 33% (n= 15/45) as medium risk, and 53% (n= 24/45) as high risk using the mSTAMP. Outcomes Half of the children were seen by a dietician (n= 37/74) (Table 3). Less than half of the high risk children (as identified by the mSTAMP tool) were seen by dietetics. Of the 38 children with acute malnutrition, 79% (n= 30/38) were seen by a dietician, while two children with SAM were neither referred to- nor screened by dietetics (Table 4). All but four children who saw a dietician received nutritional supplementation. There was a statistically significant correlation between increasing LOS and a higher mSTAMP score– Low risk had a median LOS of 2 days (IQR : 1.5 – 5 .5) compared to medium and high risk groups with medians of 3 (IQR: 2 – 6) and 6 (IQR: 4 – 10) days respectively (Kruskal-Wallis: p= 0.04). Discharge weight, and hence weight lost/gained was available for 81 children. More children lost weight in the medium and high risk groups – one (10%) low risk child lost weight, compared to 8 (47%) medium and 12 (26%) high risk children (p= 0.028). High risk children had the most median weight gain per day compared to the other groups, with children who were medium risk having a median of 25g weight loss per day (IQR: -75 – 27). There were three deaths reported, none of whom were scored as low risk (Table 4). Five children were transferred to other facilities. Comparing the original STAMP tool versus the mSTAMP, the original STAMP would have identified more low risk (13 vs 10 for STAMP and mSTAMP respectively) and more medium risk (42 vs 17 for STAMP and mSTAMP respectively), but fewer high risk patients (19 vs 47 for STAMP vs mSTAMP) (Table 5). The original STAMP tool did not predict LOS in our sample (p= 0.04 vs p= 0.55 for mSTAMP and STAMP respectively). Lastly, the original tool classified four of the 11 children with SAM as medium risk compared with all 11 children with SAM classified as high risk using the mSTAMP. DISCUSSION The current practice at Rahima Moosa Mother and Child Hospital, and South African health care centres at large, is to refer all children with acute malnutrition (MAM and SAM) to dietetics for nutritional assessment and

rehabilitation. This is done using anthropometry and the WHO definition of acute malnutrition.(2) Thus, unless otherwise indicated, children with normal anthropometry are generally not referred for nutritional support. Anthropometrics alone do not consider illness and any further deterioration in the nutritional status of a child during illness and/or hospitalisation. The negative effects of poor or deteriorating nutrition in these children have been well described, with poorly nourished children at higher risk of nosocomial and wound sepsis, as well as increased LOS.(4,13) It has also been demonstrated that children at higher nutritional risk using a nutritional risk scoring tool have longer hospital admissions.(8) Our results support this, showing a statistically significant association between mSTAMP risk score and LOS (p= 0. 04). The top four disease groups in the study mirror the national trends, each being among the leading causes of under-five mortality in SA.(12,14) Illnesses added to the STAMP tool accounted for almost half of the total admissions, highlighting the differing disease profile seen in this setting. The use of the WHO z-scores may prevent confusion as local guidelines recommend the use of z-scores, which may improve the compliance of clinicians in completing the risk assessment. It will also allow clinicians to identify children with MAM and SAM. Many of the patients had missing data, the majority of whom had missing intake data. This may be because the initial history is typically taken by the most junior doctor (such as the intern doctor). These doctors may, perhaps, not appreciate the importance of a dietary history in all children, specifically a 24 hour intake recall in an ill child – this despite poor intake being among the WHO Integrated Management of Childhood Illness (IMCI) "Danger Signs".(15) Even more disappointing is the number of children with missing anthropometry, with MUAC most poorly performed in the current study, 9 followed by length/height, and then weight. Given that anthropometrics (and correlating WHO z-scores) are the mainstay for malnutrition surveillance in SA, and that dosing in paediatric patients is largely weight-dependant, one would expect 100% compliance for weight. Despite the reliance on anthropometry for nutritional screening, it remains very poorly performed among clinicians.(3) Appropriate equipment is frequently not calibrated or is unavailable in many hospitals, and there are inconsistencies in the plotting and interpretation of growth parameters, with some clinicians using WHO growth standards charts and others using one of many available mobile applications to calculate z- scores. All these issues potentially result in over- or underestimation of malnutrition. In addition to poorly performed anthropometry, not all children with MAM or SAM were referred to dietetics as recommended by the WHO – six children with an admission diagnosis of MAM and two with SAM did not see a dietician during their admission. The results of this study showed that the mSTAMP identified more children at nutritional risk than anthropometry alone. The vast majority of children with normal anthropometry scored as medium to high risk using the mSTAMP, and more than half of the high risk children had normal anthropometry (Table 2). This suggests that the screening tool may useful in identifying at-risk children who, by virtue of having normal anthropometry, would otherwise not receive nutritional support. A third of children with normal anthropometry had weight loss on discharge, compared with 17% and 13% of children with MAM and SAM respectively (table 4). This may likely be explained by the mandatory nutritional rehabilitation offered to the latter two groups. Notwithstanding our sample size being too small to validate the two scores in our setting, this preliminary data shows that the unmodified tool may not be appropriate in our setting. The original tool performed worse at predicting LOS and failed to classify four SAM patients as high-risk. This may be attributed to the addition of common admission diagnoses with likely nutritional or food intake implications to the modified score. A final consideration is which member of the healthcare staff will implement the screening. The STAMP tool was designed for use by non-dietetic healthcare professionals, and hence screening

may be performed by nursing staff, dieticians or physicians, depending on the local situation and staff availability. However, while the screening may be performed by non-dietetic staff, nutritional rehabilitation is facilitated by clinical dieticians. Thus, as more children are identified for nutritional risk using screening tools such as the mSTAMP, more dieticians and dietetic services are required. This will have financial implications on the health system as it would mean more (and improved) anthropometric equipment, appropriate nutritional supplementations, as well as adequate human capacity. Nevertheless, early and preventative interventions for at-risk children may prove more cost effective and may be required for a shorter period than treating established malnutrition. In addition, improving the nutritional outcomes may result in shorter hospital stays with fewer complications. These assertions should be tested in prospective trials. STUDY LIMITATIONS Files not found at the records department affected the sample size. Intake, anthropometric, and discharge weight data were poorly captured. As this was a retrospective analysis, anthropometric measurement techniques and equipment were not witnessed and cannot be verified. Furthermore, no specialised growth charts or corrections were used for children with physical disabilities (e.g. cerebral palsy), ex- premature infants, and syndromic children (e.g. Down syndrome). Children admitted to surgical disciplines were excluded, although these children would likely benefit from nutritional screening as they are infrequently screened for malnutrition. Lastly our modifications to the STAMP tool are yet to be validated, and further prospective studies are needed in this regard. Similarly, the cost benefit ratio of nutrition risk screening tools remains to be proven. CONCLUSIONS Nutritional risk screening tools are recommended globally and enable early detection of nutritional deterioration and treatment. They are yet to be explored as an adjunct to anthropometry in South Africa and Sub-Saharan Africa at large. This study shows that we are currently not referring all children at medium and high nutritional risk (as per mSTAMP) for dietetic assessment and/or intervention. Pitfalls in both measurement and interpretation of anthropometry may result in some children not receiving necessary nutritional rehabilitation. It is the authors' opinion that nutritional risk screening tools, with local modification, may have an important role to play in nutritional care of hospitalised children in the developing world setting. Further prospective studies and validation of these tools in SA and Sub-Saharan Africa can assist in this respect. Implementing these tools may improve the nutritional status, decrease the length of stay and nosocomial infections, and improve the clinical outcomes of hospitalised children. There was no funding received. Neither author has any conflict of interest to declare. WHAT IS ALREADY KNOWN ON THIS TOPIC? Hospitalised children are at risk of developing malnutrition, which may increase their risk of complications and result in prolonged admissions. Nutritional screening is recommended by several European and American paediatric expert nutritional societies to identify nutritionally at-risk hospitalised children due to their illness and/or hospitalisation. Childhood malnutrition is a major public health issue, and Sub-Saharan Africa remains heavily burdened, but screening tools are yet to be evaluated in these settings. WHAT THIS STUDY ADDS Hospitalised children with normal anthropometry may still be at medium or high nutritional risk when using a nutritional screening tool. Children with acute malnutrition, or those with medium to high nutrition risk using the mSTAMP screening tool, are frequently not being referred for dietetic intervention in the current setting. Nutrition risk screening tools should be adapted to include the local disease profile, and to cater for other practical implications. REFERENCES 1. International Food Policy Research Institute. Global Nutrition Report 2016: From Promise to Impact: Ending Malnutrition by 2030. Washington, DC;2016 2. WHO Guideline: Updates on the Management of Severe Acute Malnutrition in Infants and Children. Geneva: World Health Organisation;2013 3. Brink J, Pettifor JM, Lala SG. The prevalence of malnutrition in children admitted to a

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