Publishing research in a second language: The case of Sudanese contributors to international medical journals

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Abstract

This paper compares published writing produced by British and Sudanese medical researchers. Twenty research articles were examined, 10 by British and 10 by Sudanese writers. All had been published in highly regarded international journals. As expected, all 20 articles conformed to editorial requirements and followed the conventional IMRD structure to a large extent. Differences were noted in the realisation of these components, however, and particularly in the discussion section where the reported findings were interpreted in terms of their significance and relevance. The British and Sudanese writers differed in their use of hedging, and the British writing made far greater use of nominalisation, both to express authorial disinterestedness and to realise processes and attributes in a more succinct way. Such variations are subtle and may not be immediately obvious to the reader, but could usefully inform the content of academic writing courses in Sudanese medical schools.

Keywords: Medicine; Research Article; Genre; Move Structure; Hedging; Nominalisation; EAP

1. Introduction

Sudan has been at the forefront of research in Tropical and Preventive Medicine since the Welcome Tropical Research Laboratories were first established in Khartoum in 1903. Nowadays there are over 62 Sudanese medical schools and research institutions, conducting most of their research in collaboration with international medical organisations (NERH report 2000). When Sudanese tertiary education was Arabicised in 1990, however, universities had to deal with both the lack of adequate Arabic-medium research resources and the loss of opportunities to use English as an international language of science (El-Hassan, 2004); Sudanese university research output decreased by about 22% during the 1990s compared to its level in the 1980s (El Tom, 2003), and junior researchers are now in urgent need of the language skills required to disseminate their work in English-medium international journals.

The basic global structure of the medical research article is well documented; the traditional sections of introduction, methods, results and discussion (IMRD) are required by many medical journals as a matter of editorial policy, and are referred to in the style recommendations produced

by the International Committee of Medical Journal Editors (1991), and in the CONSORT statement on the structure of reports of randomised controlled trials (Moher, Schulz & Altman, 2001). In an editorial for the *British Medical Journal*, Docherty and Smith (1999: 1224) claim that readers of scientific papers in medical journals know the function of each section of the IMRD structure, either consciously or unconsciously.

Thus Sudanese medical researchers are likely to be familiar with the model even if they have received no training in writing for publication. Simple conformity will not, however, guarantee that their own research articles will have the impact they deserve. As Skelton (1994: 455) points out, the advice provided by the medical research community 'tells prospective writers what to do rather than how to achieve it', and moreover it seems largely concerned with the inclusion of factual content, so that referees can assess the strengths and limitations of the research. In their advice to writers regarding the structure of discussion sections, for example, Docherty and Smith (1999: 1225) discourage non-evidential claims:

> most editors and readers will appreciate you being cautious,
> not moving beyond what is often limited evidence. Leave
> readers to make up their own minds on meaning.

In practice, though, experienced writers often include non-verifiable interpretations and speculations about the relevance of their research findings, especially in the final discussion section.

In short, documents such as the International Committee of Medical Journal Editors (1991), Docherty and Smith's *British Medical Journal* editorial (1999) and the CONSORT statement (2001) provide useful global structuring and content advice, but insufficient detail concerning the communicative functions and linguistic realisations actually occurring in published research articles. We hypothesised that, although Sudanese researchers publishing their work in international journals were likely to conform to the preferred structural template, their contributions might differ from those of native speaker authors. It was also possible that their contributions might convey the relevance of their research less effectively,

because the making of non-verifiable claims poses particular linguistic and cultural challenges for authors whose first language is not English.

In English for Academic Purposes move analysis is often used to explore the communicative functions and linguistic features of a given genre. The concept of the rhetorical move is discussed extensively in the works of Swales (1981, 1990) and by researchers such as Dudley-Evans (1989, 1994), Bhatia (1993) and Williams (1999, 2006). Moves are used to describe the schematic structure through which a particular persuasive communicative purpose is realised, where the structure is the result of the conventions which have developed in a specific discourse community. In any particular schematic structure some moves are optional, others are obligatory.

The overall move structure of the medical research article has been examined by Skelton (1994), with reference to 50 articles published in the *British Journal of General Practice*, and Nwogu (1997), who conducted a more detailed linguistic analysis of 15 research articles published in the *British Medical Journal, The Lancet, The Journal of the American Medical Association, The Journal of Clinical Investigation* and *The New England Journal of Medicine.* Neither author distinguished between the work of native and non-native speakers of English, but the majority of the articles in their corpora seem to have been written by native speakers.

In our study, Nwogu's schema of 11 moves and 26 steps was used as a template against which to compare medical research articles produced by British and Sudanese writers. Bearing our hypotheses in mind, we did not expect to see large variations at the global level, but we thought there might be some subtle variations which it would be useful to identify and discuss for the benefit of novice medical researchers studying English for Academic Purposes in Sudan.

2. Method
Our corpus consisted of 20 research articles published in highly-regarded medical journals; 10 written by British researchers (26955 words) and 10

written by Sudanese researchers (22261 words) (see Appendix). Readability statistics were automatically calculated for the two subcorpora.

Move analysis was conducted following the model proposed by Nwogu (1997), and move and step distribution in the two subcorpora were compared. Variations in the move structure of the discussion section then led us to examine in more detail some of the lexico-grammatical features employed to realize key functions in the medical research article. Like passivisation, nominalisation can function to make claims appear more value-neutral. We therefore calculated the distribution of noun phrases in the corpus, following the method described by Marco (2000). As in Marco's study, a concordancing program identified and counted the collocational frameworks '*the...of*', '*a...of*', '*an...of*' and '*is...to*'. Of course not all nominalised forms occur within these collocational frameworks, but this was a handy means of comparing the extent of nominalisation in the two subcorpora. The corpus was also manually examined to establish the distribution of hedging devices, as identified by Salager-Meyer (1994).

3. Findings

3.1. Readability

As can be seen from Table Two, both subcorpora had low Flesch Reading Ease test scores, although the Sudanese texts were rated slightly easier to understand, the higher score reflecting the fact that the Sudanese sentences tended to be shorter. The Flesch-Kincaid Grade Level indicates that readers would need at least 12 years of education to understand the texts in both subcorpora. The Sudanese writers made greater use of passive structures.

Table Two: Readability scores for the Sudanese and British RAs				
RAs	Average sentence length (in words)	Percentage of passive sentences	Flesch Kincaid Grade Level	Flesch Reading Ease test score
Sudanese	21.25	35.2%	12.0	22.61
British	24.35	26.8%	12.0	17.86

3.2. Move structure

Move analysis following the model proposed by Nwogu (1997) indicated that the two subcorpora were almost identical in terms of global structure, as can be seen from Table Three, although Move 1 was obligatory in the British and Sudanese RAs, but not in Nwogu's corpus, and Move 11 occurred in all the British RAs (and almost all of Nwogu's), but only in seven of the Sudanese RAs.

Table Three: RA moves				
	Discourse functions	Nwogu	British	Sudanese
Introduction				
Move1	Presenting background information	47%	100%	100%
Move 2	Reviewing Related Research	100%	90%	90%
Move 3	Presenting New Research	100%	100%	100%
Methods				
Move4	Describing data collection	100%	100%	100%
Move 5	Describing Experimental procedure	100%	100%	90%
Move 6	Describing data-analysis procedures	60%	70%	50%
Results				
Move 7	Indicating consistent observations	100%	100%	100%
Move 8	Indicating non-consistent observation	40%	50%	60%
Discussion				
Move 9	Highlighting overall research outcome	100%	100%	100%
Move10	Explaining specific outcome	100%	100%	100%
Move 11	Stating research conclusion	93%	100%	70%

3.3. Variation within Moves

Other structural differences became apparent below the level of the Move, as can be seen in Table Four.

Table Four: RA moves and steps			
	Discourse functions	British	Sudanese
Introduction			
Move1	a- Reference to established knowledge in the field	100%	100%
	b- Reference to the main research problems	80%	60%
Move 2	a-Reference to previous research	80%	80%
	b-Reference to limitation of previous	60%	80%

	research		
Move 3	a-Reference to research purpose	100%	80%
	b-Reference to main research procedure	20%	50%
Methods			
Move4	a-Indicating the source of data	100%	100%
	b-Indicating data size	90%	90%
	c-Indicating criteria for data collection	100%	100%
Additional step	**d-Notification of ethical clearance**	**40%**	**50%**
Move 5	a- Identification of main research apparatus	80%	70%
	b- Recounting experimental process	100%	90%
	c-Indicating criteria for success	40%	50%
Move 6	a-Defining terminologies	50%	50%
	b-Indicating process of classification	80%	50%
Results			
Move 7	a-Highlighting overall observation	100%	100%
	b-Indicating specific observation	100%	100%
	c-Accounting for observation made.	90%	90%
Move 8	Indicating non-consistent observation	50%	60%
Discussion			
Move 9	Highlighting overall research outcome	100%	100%
Move10	a-Stating specific outcome	100%	80%
	b-Interpreting outcome	100%	90%
	c-Indicating significance of outcome	100%	80%
	d-Contrasting recent and previous outcomes	100%	90%
	e-Indicating limitations in the outcome	70%	70%
Move 11	a-Indicating research implications	90%	60%
	b-Promoting further research	40%	10%

In our corpus almost half of the articles contained an additional step in Move 4, *Notification of ethical clearance*, typically realised with reference to consenting authorities, as in the example below:

Move 4d

> The research team first visited Marbata village in April 2001, after approval for the study was given by the federal and state health authorities and ethical clearance was obtained from the Institutional Review Board of the Faculty of Medicine at Khartoum University. Informed consent for the research was obtained from the village People's Committee and the local community leader (Sheikh), as well as from all individuals who participated in the study. (**S2**

Nwogu does not mention this step, and Alsaayed (2004) claims that many published randomised trial reports do not explicitly mention ethical

clearance issues.

On the whole the distribution of steps in the Methods and Results sections was fairly evenly balanced between the two subcorpora. More variations were found in the two more discursive sections, the introduction and discussion. All the introduction sections contained a Move 3, but this was realised slightly differently by the British and Sudanese writers. The British writers tended to be less specific about the main research procedure, and some used Move 3 as an opportunity to positively evaluate their research, whereas the Sudanese writers tended to express research purpose and procedure more succinctly and objectively, as can be seen in the examples below (the italicisation is ours):

> We investigated in a *large* open population with a long term follow-up period which *easily measurable* factors (*clinically relevant* risk factors) will *best* identify patients at high risk of progression of osteoarthritis of the hip. **B8**

> The present study was aimed primarily at investigating any possible interaction(s) between Khat and ampicillin and amoxycillin. **S8**

Particularly noticeable were the variations in realisations of Moves 10 and 11 in the discussion section. Move 10 (Explaining specific outcome) occurred in all the RAs, but the Sudanese writers did not always produce steps 10a, b, c and d, which appeared to be obligatory for the British writers. In the examples below both the British and the Sudanese writers make hedged non-evidential claims (B2, 10c; S1, 10b), but only the British article seeks to persuade the reader of the importance of the reported research ('establishment of the effectiveness of such treatment in these patients is *fundamental* to understanding the overall relative benefit …..', **B2, 10c**).

> **British example (B2): a four step Move 10**
> *10a: Stating a specific outcome.* Marked variation in the results for many outcomes was greater than could be accounted for by chance alone.

10b: Interpreting an outcome. When we investigated the effects of potential confounders on the results we found that the heterogeneity for monotherapy was largely explained by decreasing effectiveness over time, which is consistent with the development of drug resistance. For double and triple therapy, the heterogeneity was mainly accounted for by the drugs tested (possible greater effectiveness of protease inhibitors and weaker effect of zidovudine) and issues of quality (blinding and concealment of allocation) for particular trials but was not always consistent between different surrogate and clinical outcomes.

10d: Contrasting present and previous outcomes. We found no published trials on the effectiveness of true full dose quadruple therapy.

10c: Indicating significance of the outcome. HIV patients who have never received antiretroviral drugs comprise only a part of clinical practice, but establishment of the effectiveness of such treatment in these patients is fundamental to understanding the overall relative benefit of the drugs, and subsequent treatment decisions are contingent on the initial choice. Though choice of this study population reduced confounding, other potential causes of clinical heterogeneity were reflected in the results. Exploration of heterogeneity with regression techniques suggested that different drugs might explain some of the variation.

Sudanese example (S1): a two step Move 10
10b: Interpreting an outcome. In Sudan and Somalia the predominant type of female genital mutilation is infibulation. Women with infibulation usually know that they require defibulation for safe vaginal delivery and this may explain the higher percentage of women with genital mutilation who booked their hospital care.

10d: Contrasting present and previous outcomes. The antenatal setting usually provides an opportunity to identify and discuss the obstetric issues arising from female genital mutilation including antenatal defibulation. In 1995 McCaffrey *et al*. suggested that antenatal defibulation under spinal anaesthesia is ideal for their Somali migrant women. This is thought to prevent acute problems at the time of delivery related to the risk of unfamiliarity of the staff on duty with defibulation. However, in our circumstances where the staff are very familiar with intrapartum defibulation and the results achieved reflect this, we continue to perform intrapartum defibulation.

Move 11 (Stating research conclusion) occurred in all ten of the British

articles but in only seven of the Sudanese articles. Again, the British writers sometimes used positive adjectives in Move 11 to evaluate their research (e.g. 'This *systematic* review provides *new* evidence', **B2 11a**).

> **British example (B2): Move 11**
>
> *11a: Indicating research implications.* This systematic review provides new evidence that the escalation of combinations of antiretroviral drugs up to triple therapy is an effective strategy. Our results for the relative effectiveness of monotherapy versus placebo and double therapy versus monotherapy are consistent with the results of smaller meta-analyses. Also, the overall findings are supported by the results of cohort studies.
>
> *11b: Promoting further research.* However, there is no fully published evidence on the effectiveness of quadruple or higher combinations.
> Exploratory analyses of the variation in results showed that differences resulted from the specific drugs used. Both effectiveness and cost considerations indicate that future work to clarify which triple combination is the most effective is as important as investigating the effectiveness of quadruple or higher combinations. As the number of drugs increases, quality of life and safety assume relatively greater importance but are currently inadequately reported.
> Better evidence is required. The exploratory analyses of heterogeneity indicate that the design of future trials must be more rigorous and less variable (for example, in trial duration, test drugs, comparators, and clinical stage at entry) and should not rely on surrogate outcomes alone. The research community must respond. There are still important questions to be answered about the effectiveness of existing agents. This may require publicly funded trials which should be carried out within a clear well supported collaborative framework.

The Sudanese writers, in contrast, were less likely to use persuasive tactics:

> **Sudanese example (S7): Move 11**
>
> We conclude that nutritional rickets might be a common problem in Jordan. Further studies at national level involving many health centres are needed to determine the prevalence in Jordan. Rachitic infants are commonly hospitalized because of lower respiratory tract infections, leading to a high index of suspicion of rickets among hospitalized infants with lower respiratory tract diseases.

3.4. Hedges

There were very few examples in the corpus of most of the types of hedging identified by Salager-Meyer (1994:155) ('approximators', 'authors'

comments', 'emotionally charged intensifiers' and 'compound hedges'). There were, however, 159 instances of 'shields' in the corpus, realised by modal verbs expressing possibility (e.g. '*might* have limited', **S5**), probability adverbs and their derivative adjectives (e.g. '*probably* involve', **S8**; 'a *possible* explanation', **B8**), and epistemic verbs (e.g. '*appears* to be limited', **B5**; '*seems* to facilitate', **S5**).

In Salager Meyer's study shields constituted 74% of all hedges, whereas in this study they constituted around 92%. About 18% more shields occurred in the British subcorpus (95 as opposed to 64).

3.5. Nominalisation

Finally, we found a significant difference in the number of the nominal triplets *the (noun) of* and *a (noun) of* occurring in the two subcorpora, as shown in Table Five.

Table Five: Nominal triplets in the RAs			
	British	**Sudanese**	**Log Likelihood**
the…of	259	61	96.89 $p < 0.0001$
a…of	39	7	18.83 $p < 0.0001$
an…of	8	-	-
is…to	13	6	-

4. Discussion

In confirmation of our hypotheses, both the British and Sudanese writers conformed to the conventional structural template for medical research articles, yet the subcorpora differed in the distribution and realisation of steps within moves, particularly in relation to the expression of 'non-evidential' truth (Skelton 1997).

Evidential claims concern what a study 'shows' or 'confirms' in relation to the research findings, and because such claims are supported by statistical evidence the writer does not have to express a personal judgement. 'It is the creation of evidential truth which removes responsibility from the writer,

and by extension facilitates the convention of depersonalisation' (Skelton 1997: 129).

The move analyses of Skelton (1994) and Nwogu (1997) suggest, however, that discussion sections typically contain a mixture of evidential and non-evidential claims. Skelton and Edwards (2000: 1269) argue that in medical research articles 'a central aim of discussions is to reinterpret the significant as relevant – and that requires subjective interpretation of the data'. Clearly, it requires greater linguistic skill for a writer to conform to the 'convention of depersonalisation' when interpreting findings in this way, and according to Docherty and Smith (1999: 1224) the discussion section 'is often the weakest part of the paper, where careful explanation gives way to polemic'. An awareness of this possible pitfall may explain why some of the Sudanese writers opted to avoid some of the steps in moves 10 and 11. Cultural differences may also have influenced this choice, as the steps require writers to take an independent view, only supported by the strength of their own argument, an approach well understood in individualist cultures which promote self expression and personal choice but arguably at odds with accepted behaviour in a collectivist society. (The notions of individualism and collectivism were first conceptualised by Hofstede, 1980, as a means of differentiating world cultures, and have since been widely used to explain cultural variation in attitudes, beliefs, values and behaviours, e.g. in the work of Triandis, 1995.) Additionally, personal experience suggests that Sudanese writers may be unwilling to promote future research (step 11b), for fear of encouraging rival research groups in an environment where there is intense competition for funding.

Hedging provides a means of modifying the strength of unverifiable claims, and thus reducing the appearance of polemic and the threat to the reader's and writer's face. Skelton (1997: 133-4) draws attention to the use of probability adverbs and modal verbs (i.e. shields) in discussion sections, to acknowledge methodological flaws, to imply future research opportunities and to speculate more widely.

The following examples illustrate the use of hedging in the RAs in our corpus. In **B2**:

10b: Interpreting an outcome.
> the heterogeneity for monotherapy was *largely* explained by decreasing effectiveness over time
>
> the heterogeneity was *mainly* accounted for by the drugs tested (*possible* greater effectiveness of protease inhibitors and weaker effect of zidovudine)

10c: Indicating significance of the outcome.
> Exploration of heterogeneity with regression techniques *suggested that* different drugs *might* explain some of the variation.

10e: Indicating limitations of outcomes.
> Despite a rigorous search for trials, the *possibility* of publication bias cannot be completely excluded.

11b: Promoting further research.
> However, there is no *fully* published evidence on the effectiveness of quadruple or higher combinations.
> Both effectiveness and cost considerations *indicate that* future work…..
> The exploratory analyses of heterogeneity *indicate that* the design of future trials must be more rigorous and less variable
> This *may* require publicly funded trials

And in **S1**:

10b: Interpreting an outcome.
> this *may* explain the higher percentage of women with genital mutilation who booked their hospital care.

Hedging devices occurred in both subcorpora, but somewhat more frequently the British articles. This accords with the findings of Skelton (1988) and Salager-Meyer (1994), who note that NNS writers tend to hedge less than NS writers, a phenomenon perhaps attributable to lack of language skill.

The readability statistics for the two subcorpora indicated that the Sudanese writers made greater use of the passive than the British writers. The British writers, on the other hand, were more likely to employ nominalisation as an alternative means of depersonalising their claims (as their significantly

greater use of the collocational frameworks *the (noun) of* and *a (noun) of* suggests). Both passivisation and nominalisation 'hide' the human researcher, 'conveying the impression that this type of discourse is a "value-neutral" objective description of facts' (Marco 2000: 66). Nominalisation, however, has the added advantage of enabling the writer to condense meaning, and thus pack more information into the very limited space permitted in most medical journals. A closer (manual) survey of the British subcorpus revealed that the structure *process* (nominal group) + *relation* (verbal group) + *process* (nominal group) was common. In the following examples (from the discussion section of B2) the italicised nominal groups are highly condensed expressions of process.

> *choice of this study population* reduced *confounding*
> data on individual patients would allow better *exploration of the*
> *effect of patient characteristics*
> *patient behaviour* may differ from *clinical practice*
> *full evaluation of adverse events* should include *postmarketing*
> *surveillance*
> *the escalation of combinations of antiretroviral drugs up to triple*
> *therapy* is an effective strategy
> *The exploratory analyses of heterogeneity* indicate that *the*
> *design of future trials* must be more rigorous

Examples of this type of structure are somewhat harder to find in the Sudanese subcorpus, and we hypothesise that some propositions realised through passive structures in the Sudanese corpus might have been expressed through nominalisation had they been reported by British writers. For example in one Sudanese paper we find:

> Many patients were followed for up to 2 years and no new PKDL
> cases were detected after the 6-month period. **S4**

whereas a British researcher might have written, equally impersonally but more succinctly:

> Follow-up studies for up to 2 years detected no new PKDL cases
> after the 6-month period.

5. Conclusion

The sample of papers examined in this study was quite small, reflecting the fact that a relatively small number of Sudanese researchers have first authored papers in prestigious international medical journals in recent years.

Clearly, a larger dataset would yield more conclusive findings. Nevertheless our study indicates important differences between Sudanese and British medical writing which could be usefully explored in the context of an EAP programme. We would not wish to suggest that Sudanese writers should mindlessly copy the linguistic and rhetorical features found in British writing, but rather that such exploration might raise awareness of generic requirements and constraints, and promote communicatively effective self-expression.

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Appendix
Medical RAs by British writers (B) and Sudanese writers (S)

B1 Billings, J. *et al.* 2006. Case finding for patients at risk of readmission to hospital: development of algorithm to identify high risk patients. *BMJ*, **333**: 327-330

B2 Jordan, R. *et al.* 2002. Systematic review and meta-analysis of evidence for increasing numbers of drugs in antiretroviral combination therapy. *BMJ*, **324**: 757

B3 Gerrard, D. *et al.* 2002. Effect of chronic renal failure on mortality rate following arterial reconstruction. *International Journal of Paediatric Dentistry*, **11:** 886-890

B4 Collard, M. and Hunter, M. 2002. Oral and dental care in acute lymphoblastic leukaemia: a survey of United Kingdom Children's Cancer Study Group Centres. *British Journal of Surgery*, **89**: 86

B5 Branagan, G. *et al.* 2002. Detection of micrometatastases in lymph nodes from patients with breast cancer**.** *British Journal of Surgery*, **89:** 88

B6 Moyes, C. and Dunne, B. 2004. Predictive power of cytomorphological features in equivocal (C3 C4) breast FNAC. *Cytopathology*, **15:** 305-310

B7 Murray, B. *et al.* 2005. A comparative study of the efficacy of Aphtheal TM in the management of recurrent minor aphthuous ulceration. *Journal of Oral Pathology Medicine*, **34**: 413.

B8 Reijiman, M. *et al.* 2005. Role of radiography in predicting progression of osteoarthritis of the hip: prospective cohort study. *BMJ*, **330**: 1183)

B9 Owen, C. *et al.* 2001. A systematic review of antistreptococcal interventions for guttate and chronic plaque psoriasis *British Journal of Dermatology*, **145:**889

B10 Kasper, S. *et al.* 2006. Superior efficacy of St John's wort extract WS®5570 compared to placebo in patients with major depression: a randomized, double blind, placebo-controlled, multi-center trial *BMC Medicine*, **4**:14

S1. Rouzi, A. *et al.* 2001. The use of intrapartum defibulation in women with female genital mutilation. *British Journal of obstetrics and gynaecology* Vol.**108**:949-951.)

S2. Aljafari, A. *et al.* 2004. Diagnosis of tuberculous lymphadenitis by FNAC, microbiological methods and PCR: a comparative study. *Cytopathology*: 15:44-48

S3. El Safi, S. *et al* 2004. Infection rates with Leishmania donovani and Mycobacterium tuberculosis in a village in eastern Sudan. *Tropical Medicine and International Health*, **9/**12: 1305-1311

S4. Gasim, E. *et al.* 1998. High level of plasma IL-10 and expression of IL-10 by keratinocytes during visceral leishmaniasis predict subsequent development of post-kala-azar dermal leishmaniasis. *Clinical and Experimental Immunology*, **111**: 64-69

S5. ElBagir, M. *et al.* 1998. Classification of newly-onset IDDIM and NIDDIM in subjects aged 25-45 years in Sudan. *Journal of Internal Medicine*, **244**: 443-450

S6. Suleiman, A. *et al.* 2005. Prevalence of cleft lip palate in a hospital-based population in the Sudan. *International Journal of Paediatric Dentistry,* 15: 185-189

S7. Najada, A. *et al.* xxxx. The frequency of Nutritional Rickets among hospitalised infants and its relation to respiratory diseases. *Journal of Tropical Medicine,* **50**/6: 364-368

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