Letters to the Editor
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Incomplete requisition forms: Potential for error in the microbiology laboratory

Corresponding Author:

Name: Asima Banu
Email: asima.banu@gmail.com

Dear Editor,

Quality and accountability are the focus of current concern in laboratory medicine.[1] A microbiology laboratory service must be used appropriately if it is to be efficient and avoid redundancy.[2] Users of the service who provide insufficient information about the patient and themselves will lead to unreliable and irreproducible reporting.

Laboratory quality has been historically determined by the accuracy of the analytical phase. Following the development of high-quality analytical techniques, analytical error is no longer the main reason for error in the laboratory testing process. Up to 68.2% of laboratory errors occur in the pre-analytical phase.[3]

There is a perception among microbiologists that clinicians do not understand the working of a clinical laboratory, based in part upon the poor quality of requests received for microbiological investigations. In view of the paucity of studies examining pre-analytical errors in microbiology laboratories, we evaluated our laboratory request forms for the frequency of complete data.

We retrospectively examined sequential request forms received by the department of microbiology of a tertiary care hospital attached to a premier medical college and research institute over a period of one year from January 2010 to December 2010. This was an internal audit done by the department of microbiology and not by any external agency. The requesting clinicians were unaware that the data would be recorded. Each request was assessed for the presence and completeness of the information prompted by the request form. Data should be present on 100% of requests if completed correctly. The results were compiled and statistically analysed.

A total of 4055 requisition forms were analysed. Table 1 shows the various parameters assessed as well as the degree of response for each with the corresponding percentages.

Table 1: Completion rates of information required on laboratory request forms

Parameter	Complete response (of 4055)	Percentage completion rate (%)
Name	4051	99.9
Age	4027	99.3
Sex	4017	99.1
Date	3992	98.4
Time	0	0
Hospital number	3926	96.8
Investigation requested	3986	98.3
Sample	3950	97.4
Clinical history	3623	89.3
Differential diagnosis	1417	34.9
Previous investigations	1075	26.5
Antibiotics given	1063	26.2
Signature of requesting clinician	1708	42.1
Name of requesting clinician	814	20.1
Ward Name	926	22.8

The healthcare system is increasingly dependent on demographic details to identify the patient and allow correlation with previous investigations. Overall, the demographic details on requests received from hospital-based clinicians are adequately completed, although there is room for improvement. A written statement of the nature of the specimen helps to avoid identification errors. Knowledge of the test required directs the sample to the appropriate laboratory section. In our study the information regarding the type of sample was provided in 97.4% of cases and investigations required were specified in 98.3% of cases.

The time of specimen collection and its transport to the laboratory is very crucial in microbiological diagnosis since the isolation of the microbes and interpretation of results and antibiograms varies with time. Though the date of specimen collection was frequently reported (98.4%) the time of sampling was absent in all forms (0%). Hence the accuracy of reporting and interpretation of results becomes ambiguous.

Adequate clinical information permits inappropriate investigations to be discarded, informs the use of special staining techniques, and permits the microbiologist to tailor the report to the clinical need. Ideally, all specimens should be accompanied by adequate clinical details but these were provided only in 89.3% of requests. A differential diagnosis was given only in 34.9% of requests. An adequate clinical background of the clinical case rather than a list of differential diagnoses with precise queries regarding suspected diagnoses would avoid this problem.

Details of the requesting clinician are invaluable and allow additional information to be obtained and urgent results to be conveyed rapidly. Failure to provide such information may impede the diagnostic process and lead to delays in reporting. In our study the signature of the requesting clinician was present in 42.1% of the request forms of which less than half provided their names.

All microbiology specimens should be accompanied by a completed request form as in many cases this is the only contact between the clinician and the microbiologist. Failure to provide the requested information prevents the microbiologist from assessing the appropriateness of the investigation and places increased demands upon laboratory, secretarial, and microbiologist's time. Clinicians of all grades and specialties especially junior doctors must be educated to request the service appropriately.[2] In view of this audit, data was shared with the clinicians of our hospital in the monthly clinical meets. This was done over a period of three meetings. Subsequently, we found that the senior consultants showed significant improvement in providing the required information but there was no improvement among the junior doctors which included residents and interns. Whether this resulted in any improvement in patient management, needs to be analysed in future.

As a last resort patients' samples accompanied by incompletely filled request forms should be rejected since it may lead to inappropriate diagnosis which not only affects the patient but also compromises the credibility and reliability of the reporting doctor and laboratory. However, this conventional process in recent times would be subject to debate as we have an ethical and legal obligation towards a patient who has supplied the specimen in question. At times the specimen could be precious and it would be unwise to reject or not process the specimen. An alternative would be to process but withhold the results with the information transferred to the hospital administration for appropriate corrective action. A limitation of this study was our inability to assess the effect, if any, that this poor rate of completion had on patients' management. This is a possible area for future research.

Sincerely,

Asima Banu Associate Professor
Mridu Anand, PG resident
Jyoti S Kabbin, Associate Professor
Srinivas S, Laboratory Technologist
R Shetty, MBBS student

Bangalore Medical College and Research Institute, Bangalore, India.

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Prevalence of thyroid disorders among the ante-natal population

Corresponding Author:

Bhakti Deshmukh
Email: dr.bhaktideshmukh@gmail.com

Dear Editor,

Background

Thyroid disorders are common in women of reproductive age. The reported incidence is 2–5%.[1] The prevalence of subclinical hypothyroidism and hyperthyroidism is 4–10%

and 2% respectively.[2] There is increasing awareness in recent years that both overt and sub-clinical thyroid dysfunction is associated with adverse maternal and foetal outcome.[2-3] However, testing for thyroid function is not routinely done in ante-natal clinics unless high-risk factors are identified.

Untreated overt as well as sub-clinical thyroid status has adverse effects on both the mother as well as the baby. Early identification and treatment can reduce the rate of complications.

Limited data available on the prevalence of thyroid disorders in pregnant women from India has prompted us to undertake this study in a community-based hospital in rural/semi-urban Andhra Pradesh, Southern India.
Pregnancy associated changes in maternal thyroid physiology often leads to misdiagnosis and confusion in interpretation of abnormalities.[2]

Increased circulating levels of Thyroid Binding Globulin (TBG) mediated by oestrogen leads to increases in total T_3 and T_4. However, unbound or free portion is unaffected. Hence, testing for Free T_3, T_4 is recommended in pregnancy.

In the first trimester, thyroid stimulation occurs (as a result of "spill over" effect) due to structural homology. This causes a fall in serum TSH and a modest increase in free thyroxine. Hence, there is a need for gestational age specific reference ranges.[7]

Method

Study setting: The study was undertaken at Mediciti Institute of Medical sciences, Ghanpur A.P, India.
Sample size: 200 pregnant women attending the ante-natal clinics were randomly selected to be screened.
Study design: Prospective hospital based observational study.
Study period: The study period was from 1 September 2008 to 31 October 2008.
Inclusion criteria: All pregnant women irrespective of the gestational age, parity and past obstetric history.

Methodology

Two hundred pregnant women attending the ante-natal clinics at Mediciti Institute of Medical Sciences were screened. After obtaining consent, a thorough clinical history was taken. A blood sample (2ml) was then drawn which was assessed for the levels of free T_3,T_4 and TSH.

Results and Discussion

In the present study, the prevalence of thyroid dysfunction was found to be 8% – higher than the quoted prevalence in other studies. When the women who were known to have thyroid disease were excluded, the observed prevalence was 5.5%. This may be explained by the relatively small sample size and inadvertent clustering, as high-risk ante-natal patients are seen on particular days of the week in the out-patient clinic.

We observed similar prevalence for both hypo and hyperthyroidism (4% each). The prevalence of overt hypo and hyperthyroidism was 2.5% and 1%. For sub-clinical disease it was 1.5% and 3%.

Sub-clinical hyperthyroidism seemed to be more prevalent. However, all the women in this group were in the first trimester of pregnancy. The observed TSH alteration may be explained by the stimulatory effect of high levels of HCG. The observed mean TSH in the sub-clinical hyperthyroidism group was similar to the mean TSH of the entire hyperthyroid group.

The prevalence of thyroid dysfunction in women less than 20 years of age was 16.66%, 20–25 years was found to be 6.25% and 26–30 years was 10%. Thyroid dysfunction was detected to be more common in women under 20 years of age. This may highlight the need to screen for thyroid disease early in pregnancy in the unscreened population.

The prevalence in primigravidae and multigravidae was 9.09% and 6.93% (OR 1.34).

The prevalence in first, second and third trimester was 13.43%, 2.66%, 8.62% respectively. The majority of the cases were identified in the first trimester screening and sub-clinical hyperthyroidism was the most common abnormality detected. In the second and third trimesters the most common abnormality was hypothyroidism.

Consumption of un-iodised salt is highly prevalent in the community despite educational programs. About 23% of households were still consuming un-iodised salt. We observed that hypothyroidism was more common in this group of women (8.51% versus 2.61%)

The prevalence in women with one obstetric risk factor was 15.62% and 33.33% in those with more than one risk factor.

Sincerely,

Bhakti Deshmukh,

Mediciti Institute of Medical Sciences

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Doctoring in cross-racial contexts: Highlighting the role of colour vision

Corresponding Author:

Name: Rick van der Zwan
Email: rick.vanderzwan@scu.edu.au

Dear Editor,

International refugee resettlement programs necessitate that doctors, especially those practicing in relatively under-resourced regional areas, have occasion to treat patients from racial backgrounds different to their own. In such cases, treatment needs to be provided in the face of unique challenges: Obvious issues like the absence of a common language are accompanied by others that are more subtle but which can, nonetheless, have a significant impact on treatment outcomes. The aim of this letter is to raise awareness of one such. Specifically, it is to draw attention to the potential impact of cross-racial visual effects.

Visual neuroscience literature identifies an Other Race Effect (ORE) relating to a constellation of perceptual abilities that are negatively impacted when the race of 'viewers' differs from that of 'viewees'. Even basic, everyday judgements like discerning another person's sex and identity are effected.[1] Of particular relevance in the medico-clinical context, the ORE also negatively impacts *identification and differentiation between various skin tones and, importantly, changes to those tones*. It turns out that human beings typically detect colour variegation on the faces and bodies of individuals of their own race better than those of other races.

That deficiency in visual expertise has potentially serious implications when doctors find themselves, often suddenly and with little or no additional training, treating patients from racial backgrounds with which they may have limited experience. In such cases, the likelihood increases that important diagnostic cues will be missed: Sensitivity to the yellowing of the skin as a cue for jaundice, the reddening of skin as a cue for burn or rash, pallid skin as a cue for the on-set of shock or perhaps anaemia, blueness as a cue for cyanosis, amongst other examples, can be compromised. Most concerning of all, this can happen in the complete absence of awareness, and may permeate all aspects of the consultation process, including 'soft' skills like the ability to empathise.[1*]

There is a silver lining to this diagnostic cloud and fortunately it is one doctors can learn to see. Changizi[3] has shown that the reflectance pattern of skin of all colours is more or less identical: Whilst there are systematic differences in the *amount* of reflected light, the relative proportions of reflected wavelengths are constant. This has two consequences. The first is that viewer sensitivity to changes in patterns of reflected light is *potentially* no different across skin colours. Perceived colour is a product of ratios of reflected light and because the reflectance spectrum for all skin colours has the same baseline ratios, normal observers (trichromats) potentially have almost identical sensitivity to ratio changes across different skin colours. The second is that within that reflectance spectrum the critical feature is not the base colour itself, but sensitivity to deviations from it. A rash is "red" in comparison to the skin around it or in comparison to its normal pattern of reflectance (see Changizi, Figure 6, Chapter 1).[3] As such, the mostly unconscious feat of recognising changes in skin colour, and detecting the presence or absence of "diagnostic" colours, becomes a simple question of experience: cross-racial deficiencies in sensitivity can and do diminish over time.

All this generates two important take-home messages. The first is that in addition to more obvious cross-racial diagnostic challenges, doctors should be aware of the potential compromised status of their vision-based

[*] There are similarities between these effects and those experienced by physicians with colour vision deficiencies and that comparison highlights the problem. Colour discriminations are important in medicine. Indeed, so significant can those effects be, there are even social media sites dedicated to them (c.f. http://www.facebook.com/#!/pages/Colour-Blind-Doctors-and-Medical-Students/150090098396791). For a good bibliography of papers describing the effects of colour vision deficiencies on medical practice see www.colormed.com/papers.html.

diagnostic capabilities when treating patients from a racial background with which they have limited experience. Consequently, at least during the early stages of that process, they may benefit from adopting compensatory strategies like consciously placing greater weight on non-visual indicators. The second is that these colour-related visual deficits are experience-dependent: Repeated exposures will over time effectively improve the 'tuning' of the visual perceptual system such that any deficiencies are ameliorated. Our raising awareness of this issue is a "heads up". It is our express goal to be of service to those doctors providing health care to some of the international community's most vulnerable citizens.

Sincerely,

Rick van der Zwan
Anna Brooks

Southern Cross University, Australia.

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Representation of assertions in clinical free-text using SNOMED CT

Corresponding Author:
Name: Anthony Nguyen
Email: Anthony.Nguyen@csiro.au

Dear Editor,

Information retrieval (IR) by clinicians in the healthcare setting is critical for informing clinical decision-making. However, a large part of this information is in the form of free-text and inhibits clinical decision support and effective healthcare services. This makes meaningful use of clinical free-text in electronic health records (EHRs) for patient care a difficult task. Within the context of IR, given a repository of free-text clinical reports, one might want to retrieve and analyse data for patients who have a known clinical finding. Reports with patients that have the absence or family history of the clinical finding have a different clinical interpretation and therefore should not be returned to the user. As a result, there is a need to identify/extract and represent asserted findings to enhance clinical IR systems.

To address the issue with differing clinical interpretations of a medical concept, this study investigates the feasibility of representing medical concepts and their assertions as part of standard clinical terminologies. In particular, the Systematised Nomenclature of Medicine – Clinical Terms (SNOMED CT) has been investigated. SNOMED CT is an ontology of clinical terms that has been identified as the standard set of clinical terms to be used in systems within Australian healthcare.[1] By targeting SNOMED CT, the study helps move forward the national agenda for the adoption of SNOMED CT. To the best of our knowledge, there has been no analysis of the coverage of assertions within SNOMED CT.

The 2010 i2b2/VA Challenge for Natural Language Processing for Clinical Text defined an Assertion Annotation task.[2]

According to the challenge, assertions are an attribute of medical problem concepts and include the following six assertion categories: (1) present (*Present*), (2) absent (*Absent*), (3) possible (*Possible*) with the patient, (4) conditionally present with the patient under certain circumstances (*Conditional*), (5) hypothetically present with the patient at some future point (*Hypothetical*), and (6) mentioned in the patient report but associated with someone other than the patient (*Not associated with Patient*). All assertions except *Hypothetical* were considered time independent meaning that a problem experienced in the past and a problem the patient currently has can both be classified into the same assertion category.

Table 1 shows the corpus statistics for the different concept and assertion categories in the i2b2 data. Only concepts with the type *Problem* have assertions applied to them.

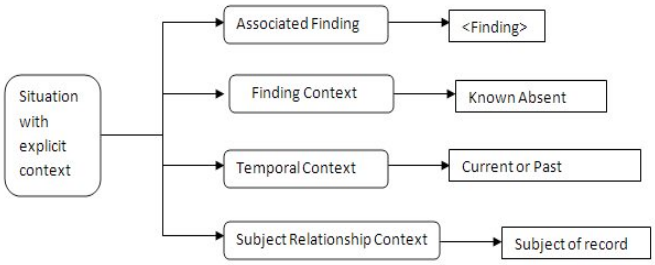
Table 1: Corpus statistics for the different concept and assertion categories

	Training	Test	Total
#documents	349	377	726
# annotations	27,837	45,009	72,846
Test	7,369	12,899	20,268
Treatment	8,500	13,560	22,060
Problem	11,968	18,550	30,518
Present	8,052	13,025	21,077
Absent	2,535	3,609	6,144
Possible	535	883	1,418
Hypothetical	651	717	1,368
Conditional	103	171	274
Unassociated	92	145	237

SNOMED CT[3] provides a standardised solution for representing information in electronic medical records. It is an international standard and enables users to analyse and retrieve data from many medical domains. It is the most extensive medical terminological resource available and contains more than 311,000 concepts, which are organised into acyclic taxonomic (*is-a*) hierarchies. Furthermore, the nature of its design allows users to perform queries and add concept extensions to the ontology. This study proposes to use SNOMED CT to represent concepts and assertions in free-text. The general goal is to build an automated representation process which is able to create consistent representations for clinical free-text data.

Generic SNOMED CT expression templates based on the *Situation with explicit context* model were used to automatically encode concepts and assertions. SNOMED CT can be used to represent *Situations with explicit context (243796009)*, which itself is a hierarchy for concepts requiring the specification of explicit context such as assertions. Figure 1 shows an example template for the *Absent* assertion. The templates are for illustrative purposes and will need to be represented as valid SNOMED CT expressions. Also, the default context values of *Known Present*, *Current or Past*, and *Subject of Record* for the *Finding Context*, *Temporal Context*, and *Subject Relationship Context* attribute, respectively, are used unless an assertion found in the free-text suggests otherwise. The templates can be used to populate the relevant assertion and <*Finding*> concept to alter the interpretation of the concept.

Figure 1: Expression template for the concept <*Finding*> and an *Absent* assertion



The coverage of assertions that could be directly processed and represented as SNOMED CT expressions on the 30,518 gold standard assertions from the 726 i2b2 documents was 94.62% (Table 2). A one to one mapping from the *Present*, *Absent* and *Possible* assertion types to a relevant SNOMED CT expression template can be made possible with no ambiguity through *the Finding* context attribute. *Not related to the patient* can be represented with the specification of a specific patient relationship, while *Hypothetical* and *Conditional* both currently cannot be modelled using SNOMED CT.

Table 2: Coverage statistics for the assertion representation

Assertion types	Number of Assertions	Coverage	Represented in SNOMED CT?
Present *Absent* *Possible*	21,077 6,144 1,418	93.84%	Yes
Not associated with patient	237	0.78%	Yes
Hypothetical	1,368	4.48%	No
Conditional	274	0.90%	No
Total	30,518	100%	

Future work will aim to improve the coverage of other assertions typically found in free-text (e.g. *Conditional* and *Hypothetical*). These assertions will require more sophisticated expression templates and/or additional information models to properly represent them. Although the assertions are not bounded by just those investigated in this study, further investigations are needed to determine the range of possible assertions found in clinical free-text and how to best represent them.

In conclusion, this study has focused on a small but important aspect of information representation from clinical free-text, namely assertions. The research ultimately has potential to provide a standardised

representation of free-text reports to facilitate information aggregation and analysis across disparate healthcare systems.

Sincerely,

Anthony Nguyen[1], Yue Kimi Sun [1,2], Laurianne Sitbon[2], Shlomo Geva[2]

1. The Australian e-Health Research Centre, CSIRO ICT Centre, Brisbane, Australia
2. Faculty of Science & Technology, Queensland University of Technology, Brisbane, Australia

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