A NATIONAL PHYSICIAN SURVEY OF DIAGNOSTIC ERROR IN PAEDIATRICS

Perrem LM[1], Fanshawe TR[2], Sharif F[3], Plüddemann A[2], O'Neill MB[4]

Corresponding Author:

1. Lucy M Perrem; Department of Respiratory Medicine, Children's University Hospital, Temple Street, Dublin 1, Ireland. Email: lucyperrem@gmail.com

2. Thomas R Fanshawe, Annette Plüddemann: Nuffield Department of Primary Care Health Sciences, Oxford University, Oxford, United Kingdom. Email: thomas.fanshawe@phc.ox.ac.uk; annette.pluddemann@phc.ox.ac.uk

3. Farhana Sharif; Department of Paediatrics, Midlands Regional Hospital Mullingar, Mullingar, County Westmeath, Ireland. Email: Farhana.sharif@hse.ie

4. Michael B O'Neill; Department of Paediatrics, Mayo General Hospital, Castlebar, Co. Mayo, Ireland. Email: drmichaeloneill@gmail.com

Paediatric Clinical Decision-Making and Diagnostic Error

Key words: Diagnostic errors, misdiagnosis, physicians practice patterns, attitude of health personnel, clinical competence

A National Physician Survey of Diagnostic Error in Paediatrics

What is known

- Diagnostic errors are an important source of preventable patient harm and have an estimated incidence of 10-15%.
- They are multifactorial in origin and include cognitive, system-related and situational factors.

What is new

- We identified a low rate of self-perceived diagnostic error in contrast to the existing literature.
- Incomplete history and examination, inadequate staffing levels and excessive workload are cited as the principal contributing factors to diagnostic error in this study.

ABSTRACT

This cross-sectional survey explored paediatric physician perspectives regarding diagnostic errors. All paediatric consultants and specialist registrars in Ireland were invited to participate in this anonymous online survey. The response rate for the study was 54% (n=127). Respondents had a median of nine years clinical experience (IQR 4-20 years). A diagnostic error was reported at least monthly by 19 (15.0%) respondents. Consultants reported significantly less diagnostic errors compared to trainees (p value = 0.01). Cognitive error was the top ranked contributing factor to diagnostic error, with incomplete history and examination considered to be the principal cognitive error. Seeking a second opinion and close follow-up of patients to ensure that the diagnosis is correct were the highest ranked clinician-based solutions

to diagnostic error. Inadequate staffing levels and excessive workload were the most highly ranked system-related and situational factors. Increased access to and availability of consultants and experts was the most highly ranked system-based solution to diagnostic error.

Conclusions:

We found a low level of self-perceived diagnostic error in an experienced group of paediatricians, at variance with the literature and warranting further clarification. The results identify perceptions on the major cognitive, system-related and situational factors contributing to diagnostic error and also key preventative strategies.

Abbreviations

EHR - Electronic Health Record

HSE - Health Service Executive

IQR - interquartile range

ICU - Intensive Care Unit

RCPI - Royal College of Physicians of Ireland

Word count 1793

INTRODUCTION

Diagnostic error, defined as a diagnosis that is unintentionally delayed, missed or wrong, is an important source of preventable patient harm (1)**.** The true incidence of diagnostic error is difficult to measure but it is estimated that the diagnosis is 'wrong' 10-15% of the time (2). Diagnostic error is the most prevalent source, accounting for 32% to 47%, of paediatric malpractice claims (3-5) In the United States (US) meningitis, appendicitis, specific nonteratogenic congenital anomalies and pneumonia are the most prevalent conditions in paediatric malpractice claims caused by

misdiagnosis (6). Diagnostic errors are multifactorial in origin and include system-related and cognitive factors (1).

The aim of this survey study was to explore paediatric physician perspectives on diagnostic errors, including self-reported diagnostic error frequency, contributory factors and potential preventative strategies.

METHODS

Setting and Participants

Two hundred and thirty five hospital-based paediatric consultants and registrars across the Republic of Ireland were invited to participate in this study. All paediatric consultants and specialist registrars in Ireland were identified and contacted utilising the Royal College of Physicians of Ireland (RCPI) Faculty of Paediatrics database. The Dean of the Faculty of Paediatrics (RCPI) endorsed the study.

Survey Development and Administration

The survey was developed following a comprehensive literature review. It was pilot tested among a group of eight paediatric consultants and specialist registrars and survey questions were refined in an iterative process. The anonymous survey was administered using SurveyMonkey® (California, USA), an online survey tool. To maximise the response rate, hard copies of the survey were sent to consultants in addition to an emailed invitation. A second e-mail was sent to non-respondents two weeks after the initial invitation.

Statistical Analysis

Data were downloaded from SurveyMonkey® and analysed using SPSS 21.0 (SPSS Inc. Chicago, Illinois). Data from paper surveys were manually inputted into SPSS.

Medians and interquartile ranges (IQR) were used for all descriptive data. The Mann-Whitney U and Kruskal Wallis tests were used to assess for differences in reported frequencies of diagnostic error. To calculate rankings weighted averages were computed; 3 points were given to a respondents' first choice, 2 points for second choice and 1 point for third choice. All other choices were scored as zero. The average of all of these values for all respondents was calculated. Friedman's Test was used to assess for non-randomness of ranking and test for significant differences among choices.

RESULTS

Demographics

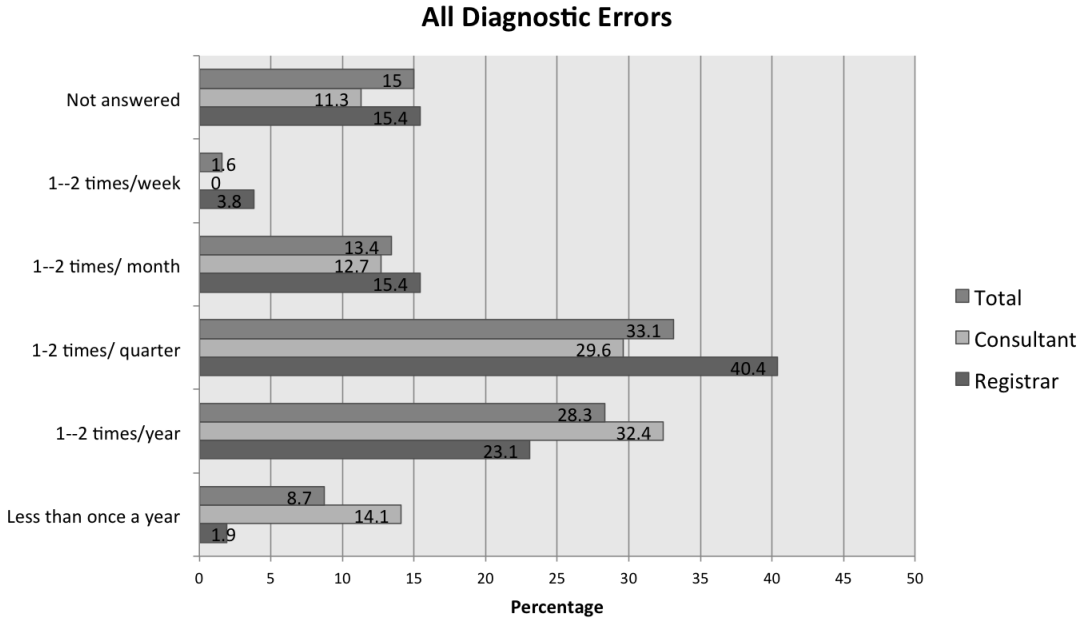
Two hundred and thirty five questionnaires were sent to 135 paediatric consultants and 100 paediatric registrars between 13th March and 30th May 2014. The overall response rate was 54% (n=127). Fifty-eight (51.2%) respondents were female. Respondents included 71 (55.9%) consultants and 52 (41%) registrars [23 (18.1%) registrars, 29 (22.8%) specialist registrars, 33 (26.0%) general paediatricians, 38 (29.9%) specialist paediatricians]. Four (3.1%) participants did not specify their clinical role. Overall, respondents had a median of nine years clinical experience (IQR 4-20 years) with consultants and registrars practicing for a median of 20 years (IQR 15-24) and six years (IQR 4-8 years) respectively. Sixty-three (49.6%) of respondents received some training (under- or post- graduate), whether formal or informal, on the significance of and factors that may lead to diagnostic errors. This training was formal in nature for 27 (21.3%) respondents, informal for 32 (25.2%) and both formal and informal for 4 (3.1%).

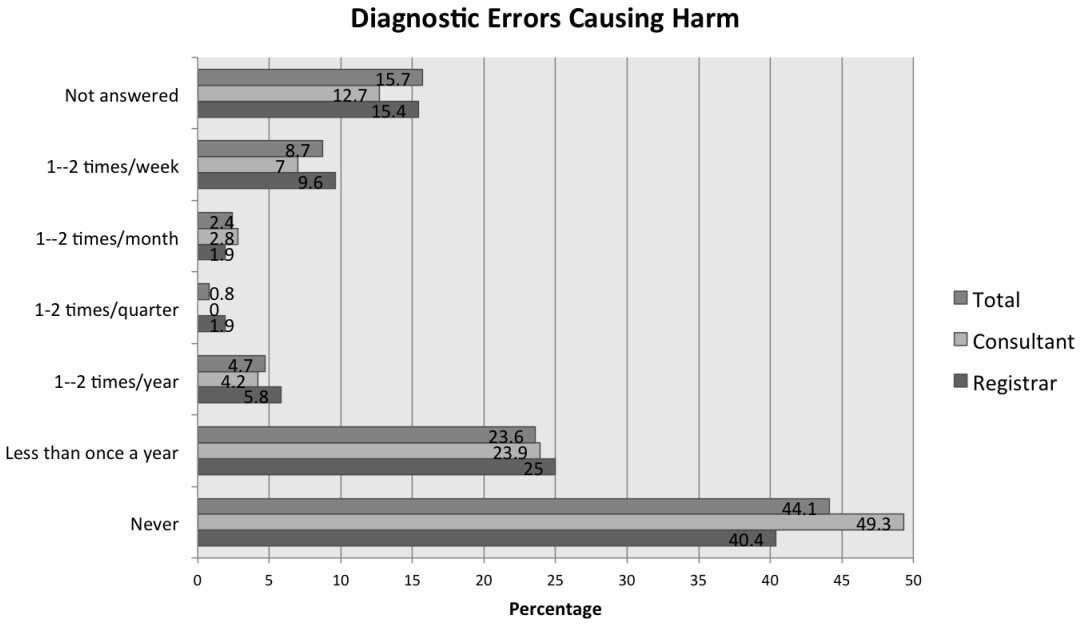
Diagnostic Error

The reported frequency of all diagnostic errors and diagnostic errors resulting in patient harm by group are demonstrated in Figure 1. Overall, 19 (15.0%) respondents reported making a diagnostic error at least monthly, and 14 (11.0%) respondents reported making a diagnostic error resulting in patient harm at least monthly. Consultants reported significantly less diagnostic errors compared to registrars (p value 0.01). However, with respect to diagnostic error specifically resulting in patient harm, there was no significant difference between groups (p value = 0.331). Eleven (35.4%) respondents with formal training in diagnostic errors reported making a diagnostic error at least monthly, compared to seven (9.2%) respondents with no such formal training (p value = 0.008). Years of clinical experience did not significantly affect the reported diagnostic error frequencies (P value= 0.126).

Table 1 displays the respondents' rankings of the most common overall factors, specific predisposing factors and possible solutions to diagnostic error. The rankings of the relative contribution of cognitive, systemic and situational factors to diagnostic error and possible solutions were statistically significant across all categories (Friedman test $p \leq 0.001$). When analysed separately, all groups similarly ranked items (data not shown).

Figure 1: Self-reported diagnostic error frequency


All Diagnostic Errors
Not answered
1--2 times/week
1--2 times/ month
1-2 times/ quarter
1--2 times/year
Less than once a year
15
11.3
15.4
1.6
0
3.8
13.4
12.7
15.4
33.1
29.6
40.4
28.3
32.4
23.1
8.7
14.1
1.9
0 5 10 15 20 25 30 35 40 45 50
Percentage
Total
Consultant
Registrar


Diagnostic Errors Causing Harm
Not answered
1--2 times/week
1--2 times/month
1-2 times/quarter
1--2 times/year
Less than once a year
Never
15.7
12.7
15.4
8.7
7
9.6
2.4
2.8
1.9
0.8
0
1.9
4.7
4.2
5.8
23.6
23.9
25
44.1
49.3
40.4
0 5 10 15 20 25 30 35 40 45 50
Percentage
Total
Consultant
Registrar

120

121

Most Common Reasons for Diagnostic Error	**Mean Ranking Range 0-3**
1) Cognitive errors such as failing to gather all relevant information	1.77
2) Interplay of cognitive and system-related factors	1.72
3) System-related errors such as equipment problems, hospital policy etc.	1.17
4)"No-fault" errors such as those involving rare diseases or unusual presentations	0.96
System Related Factors Leading to Diagnostic Error	
1) Inadequate staffing levels and/or experience of healthcare staff	2.1
2) Poor communication	1.57
3) Delays in accessing sub-specialist expertise when needed	0.80
4) Unavailability of resources due to financial reasons (e.g. MRI, endoscopy etc.)	0.77
5) Inadequate information systems (e.g. electronic patient records)	0.77
6) Technical problems (e.g. equipment not working correctly)	0.27
Cognitive Related Factors Leading to Diagnostic Error	
1) Incomplete history or examination	1.75
2) Failure to consider other possibilities once an initial diagnosis has been reached	1.42
4) Over or underestimating the meaningfulness of a clinical finding	0.76
5) Drawing an inappropriate conclusion from the available data	0.63
6) Missing a symptom or sign that should be noticeable	0.34
Situational Factors Leading to Diagnostic Error	
1) Excessive workload	2.18
2) Physician fatigue	1.20

3) Being misled by advice or anticipated advice from other physicians	0.75
4) Overconfidence about one's own diagnostic ability	0.60
5) Having an attitude towards the patient either of dislike or of fondness	0.08
Clinician-based Solutions to Diagnostic Error	
1) Asking for a second opinion	1.38
2) Close follow-up of patients to ensure that the diagnosis is correct	1.33
3) Increasing time spent in clinical encounters with patients	1.00
4) Improving teamwork and communication within healthcare team	0.98
5) More training in diagnostic reasoning skills	0.65
6) Increase awareness about diagnostic uncertainty among patients and families	0.59
System-based Solutions to Diagnostic Error	
1) Increased access to and availability of consultants and experts	1.58
2) Electronic patient records	1.32
3) Establishing a non-punitive feedback system to learn from errors	1.18
4) Improved feedback pathways to communicate changes in diagnosis	1.15
5) Improved access to electronic diagnostic decision support tools and reference texts	0.71

Table 1: Possible causes and solutions to diagnostic error

DISCUSSION

This study explored physician perspectives on diagnostic error. Self-reported diagnostic error rates were low in this study. We found that consultants reported significantly less diagnostic errors overall compared to trainees, but a similar frequency of errors causing patient harm. Physician surveys have consistently found that approximately half the respondents encounter diagnostic errors at least monthly.(2) Just 15% of respondents in our study reported making a diagnostic error at least monthly, regardless of harm, compared to 35%(7) and 51% in US paediatrician surveys.(8) In the study by Singh et al(8) 27% percent of paediatricians had greater than 10 years of clinical experience compared to 53% in our study. However, the actual diagnostic error rate of respondents is unknown, so this relatively low perceived frequency of diagnostic error may reflect the clinical experience of the sample, signify poor error recognition or overconfidence in one's diagnostic acumen.

Factors implicated in the under-reporting of diagnostic errors include recall bias, the time required to submit cases, a natural reluctance to call attention to one's own mistakes, lack of physician reflection on their clinical practice, the fear of provoking a malpractice suit and misunderstanding what is meant by diagnostic error. Additional organizational factors include: lack of safety culture in healthcare setting, poor risk assessment strategies or incident management and the likelihood of patients representing to different healthcare settings and providers.

In Ireland, as in other countries, the true incidence of diagnostic error is not well described. In a report by the Irish National State Claims Agency in 2012, diagnosis related adverse events accounted for just 1.8% of the 1,364 total reported adverse

events.(9) A systematic review of autopsy studies in paediatric ICUs found a major diagnostic error in 344 (20%) deaths.(10) However, a UK study in a community hospital setting found a much lower incidence of misdiagnosis in children presenting to the emergency department (ED) with acute illness (5.0%, n=19). This was attributed to relatively straightforward clinical cases and experienced treating physicians.(11)

Respondents ranked cognitive errors and the interplay of cognitive and system related factors as the most common reasons for diagnostic errors, in keeping with previous research.(1) Similarly to the findings by Singh et al,(8) faulty data gathering by way of incomplete history and examination, was the most highly ranked cognitive factor. "Premature closure", the tendency to favour the initial hypothesis and stop searching for additional possibilities, has been identified as the most common cognitive error in the literature(1) and was highly ranked among respondents in this study. Missing a symptom or sign that should be noticeable was the lowest ranked cognitive factor, which may reflect the clinical experience of the sample. Seeking a second opinion and close follow-up of patients to ensure that the diagnosis is correct were the highest ranked clinician based solutions to diagnostic error in this study.

A systematic review by Graber et al(12) summarizes the cognitive interventions aimed at reducing the harm caused by diagnostic errors. Interventions described in this review include improving knowledge and experience with simulation-based training, interventions to improve clinical reasoning and decision-making skills, such as reflective practice and interventions that provide cognitive 'help' including electronic health records (EHR) and integrated decision support and facilitating access to second opinions and specialists.(12) Thirty-four percent of respondents in our sample had received no training, whether formal or informal, on the significance

of, and factors that may lead to, diagnostic errors, compared to 27% in the study by Singh et al.(8) Those with formal training reported making significantly more diagnostic errors, suggesting improved awareness of diagnostic error in their clinical practice.

Inadequate staffing levels and excessive workload were strongly identified as the leading system-related and situational factors respectively contributing to diagnostic error. Increased access to, and availability of, consultants and experts was the highest ranked system-based solution. These results are not unexpected in the context of a resource deficient Irish health service post economic recession. There is a shortage of consultants across specialties, with one in eight (approximately 300) hospital consultant posts vacant or filled only in a locum capacity. This study identified errors of omission, failing to gather all the relevant information in a case, as the number one cognitive factor related to diagnostic error, this may be explained by time pressures created by inadequate staffing levels.

The Electronic Health Record (EHR) was a highly-ranked systems based solution to diagnostic error. However, in a recent US survey of paediatricians, 36% did not believe that EHR helped to reduce diagnostic errors.(7) Developing a national EHR has been identified by the Health Service Executive (HSE) as a key requirement for the future of delivery of healthcare. An EHR system is proposed for the National Children's Hospital, anticipated to be operational by 2020.

According to the Improving Diagnosis in Healthcare report,(13) diagnostic errors harm an unacceptable number of patients, with most people experiencing at least one diagnostic error in their lifetime. The committee outlined goals to improve diagnosis

and reduce diagnostic error including; facilitate more effective teamwork in the diagnostic process, enhance health care professional education and training, ensure adequate health information technology support, develop and deploy approaches to identify, learn from, and reduce diagnostic errors and near misses in clinical practice, establish a work system and culture that supports the diagnostic process, develop a reporting environment and medical liability system that facilities improved diagnosis through learning from diagnostic errors and near misses.(13)

This study has several limitations: 1) the under-reporting of diagnostic errors could not be objectively verified as a survey is not the ideal method of estimating diagnostic error rates 2) the information regarding participants clinical practice including the number of patients seen per physician and time spent in clinical encounters was not known 4) our results are in the context of a resource deficient Irish healthcare system and may not be generalizable to other countries 5) the response rate was 54% and not all questions were answered by all participants.6) the demographics of non-responders is not known.

CONCLUSIONS

We found a low level of self-perceived diagnostic error in an experienced group of paediatricians at variance with the literature. Tackling diagnostic errors in clinical practice is challenging and requires a multifaceted approach including improving error recognition, physician training in the significance of cognitive errors and addressing system-related factors such as inadequate staffing levels and access to specialist expertise when required.

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Author Contributions

Lucy Perrem designed the survey, collected and analysed the data and wrote the first draft of the manuscript. Thomas Fanshawe was involved in the statistical analysis and approved the manuscript. Farhana Sharif, Annette Plüddemann and Michael O'Neill were involved in the study design and manuscript writing.

Ethical Approval

The survey was anonymous and the content was approved and endorsed by the Dean of the Faculty of Paediatrics on behalf of the Royal College of Physicians of Ireland. RCPI members were informed of the content of the survey prior to their consenting to participation.

Competing Interests:

None

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