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Junior doctor skill in the art of physical examination: A retrospective study of the medical admission note over four decades

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Abstract.

Objectives To investigate the hypothesis that junior doctors' examination skills are deteriorating by assessing the medical admission note examination record.

Design Retrospective study of the admission record.

Setting Tertiary care hospital.

Methods: The admission records of 266 patients admitted to Wellington hospital between 1975 and 2011 were analysed, according to the total number of physical examination observations (PEOtot), examination of the relevant system pertaining to the presenting complaint (RelSystem), and the number of body systems examined (Nsystems). Subgroup analysis proceeded according to admission year, level of experience of the admitting doctor (registrar, house surgeon (HS) and trainee intern (TI)) and medical versus surgical admission notes. Further analysis investigated the trend over time in documentation with respect to cardiac murmurs, palpable liver, palpable spleen, carotid bruit, heart rate, fundoscopy, and apex beat location and character.

Results: PEOtot declined by 34% from 1975 to 2011. Surgical admission notes had 21% fewer observations than medical notes.

RelSystem occurred in 94% of admissions, with no decline over time. Medical notes documented this more frequently than surgical notes (98% and 86% respectively). There were no differences between registrars and HS, except for the 2010s subgroup (97% and 65% respectively).

Nsystems declined over the study period. Medical admission notes documented more body systems than surgical notes. There were no differences between registrars, house surgeons and trainee interns.

Less examinations were performed for palpable liver, palpable spleen, cardiac murmur and apex beat location and character over the study period, however more murmurs were detected. There was no temporal change in the positive findings of the other observations or heart rates divisible by 5.

Conclusions: There has been a decline in the admission record at Wellington hospital between 1975 and 2011, implying a deterioration in local doctors' physical examination skills. Measures to counter this trend are discussed.

Article Summary

Article focus

- There is well-documented international evidence supporting a declining standard in junior doctor physical examination skills in recent years.
- This study was conducted to address the research question that this deterioration has occurred locally in Wellington, New Zealand.

Key messages

- There has been a decline in the quantity and quality of the medical admission note examination records in this tertiary care centre between 1975 and 2011, which implies a decline in the examination skills of local junior doctors.
- Measures to address this decay in clinical ability include improved undergraduate curriculum, greater supervision of junior doctors, greater involvement of junior doctors in the admission process and increased staffing levels.

Strengths and limitations of this study

- This is a significant study involving large numbers of patient admission records over a substantial period of time (358 patient records over four decades) with a multitude of statistically robust outcome measures analysed.
- Our study is limited due to its retrospective nature, the use of the "surrogate" marker of the written medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them.

Introduction.

Thoughtful history taking and physical examination are recognised as fundamental to the practice of medicine. [1] Moreover, physicians rate physical examination as their most valuable skill. [2] It has also been shown that despite the current technology, physical examination remains important due to its diagnostic contribution,[3] positive effect on patient care [4] and cost reduction. [5]

There has been a well recognised international decline in the physical examination skills of doctors. Potential reasons for this deterioration include busy clinical workloads and lack of clinical teaching. [6, 7] However it is generally recognised that the most important influence has been the increased availability of specialised diagnostic equipment. [8, 9] Imaging technology such as ultrasound, CT and MRI have overshadowed the use of physical examination for diagnostic information. [8, 9] Although adding enormously to the cost of health care, these investigations are seen to be more accurate and less liable to litigation, than the more subjective art of physical examination. [8, 9] It has been argued that the overuse of this technology has also helped to erode the teaching and skill in physical diagnosis [8, 10] and that it may be undermining the value of these skills. [4] This is further impacted by the shift away from bedside teaching and supervision of physical examination skills during undergraduate years and early years of practice. [6, 10, 11] In the United States bedside teaching has fallen from 75% of clinical teaching in the 1960s [10] to 8-19% of clinical teaching in 2008. [12] Thus there are significant changes required from both the medical school and

hospital culture regarding physical examination skill acquisition, improvement and retention.

The medical record is a tool for communication between multiple health professionals, facilitating continuity of care and good patient management. [13] There have been a number of studies referencing the importance of the quality of the medical record. [14-19] The medical record is also a legal document and as such deserves the appropriate time and attention to ensure it is "comprehensive and accurate". [13] Some studies have looked into ways to improve documentation such as introducing a clinical note header section, [20] education and instruction [21, 22] and structured encounter forms [23] with positive results. There are currently no evidence based standards for best practice concerning adequacy of documentation of physical examination findings for Wellington Hospital, neither are there any clinical guidelines derived from expert opinion. Thus it is difficult to ascertain the expected minimum level of documentation. In order to retrospectively investigate examination practice over time we are reliant on this medical record for our information. The current study is inevitably an investigation into both the skills of doctors and their documentation practices, although our primary interest is the assessment of physical examination skills.

Methods

We looked at admission records from patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975 and 2010. The records were randomly selected by National Health Index (NHI) number if the patient

had been admitted during this time with certain medical diagnoses, as reflected by the "coding diagnosis" which enables clerical staff to enter the correct computer information about each admission. In this way we obtained 300 sets of patient admission records, 100 from 1998, 100 from 2000 and 100 from 2010, from the medical records department at Wellington Hospital. Out of each set of 100 records there were 50 general medical and 50 surgical admissions. The medical coding diagnoses were pneumonia, congestive heart failure, shortness of breath or chest pain. The surgical coding diagnoses were inguinal hernia, appendicitis, abdominal pain, fractured neck of femur or bowel obstruction. Many of these files included records from previous admissions to hospital. We included these older records if they had been coded with the aforementioned diagnoses, and if there was at least 10 years temporal separation from the randomly selected admission. Strict patient and staff confidentiality was maintained at all times.

The admission note from each record was examined and the relevant data was extracted. If there was no admission note, we examined the last documented examination in the emergency department before ward admission. This was generally performed by the registrar of the admitting ward.

We recorded the total number of physical examination observations (PEOtot) that were documented per admission. We also documented the number of major body systems that had been examined (NSystems). These included cardiovascular, gastrointestinal, respiratory, central nervous and musculoskeletal systems. We then noted whether the

relevant system pertaining to the presenting complaint had been examined (RelSystem). We then analysed the data in terms of year groups, in order to look for temporal change.

We subsequently analysed the data according to whether it was a medical or surgical admission note, and the level of experience of the admitting doctor (registrars, house surgeons (HS) or trainee interns (TI)) with respect to PEOtot, Nsystems and RelSystem. We also performed year group analysis on these subgroups.

We also investigated whether there was documentation of particular examination observations, positive or negative. These were palpable liver, palpable spleen, carotid bruit, cardiac murmur, apex beat location and character and fundoscopy. We analysed whether the frequency of these documented observations changed over time. Of the admission notes documenting the performance of these examinations, we then examined the frequency of positive findings and any change over time.

Finally we investigated the documentation of heart rate. Of those admission notes with a heart rate value, we analysed the frequency of the heart rates divisible by 5 and any change over time.

Results.

We looked at 358 patient admission records, from 266 patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975 and

2010. For administrative reasons we were unable to obtain 34 of the ordered sets of notes. There was no statistically significant difference in the patients' age between the year groups, after Kruskal-Wallis analysis.

As evidenced by the documentation in the hospital record admission notes, there has been a statistically significant decrease (34%) in the total number of physical examination observations per admission (PEOtot) from 1975 to 2011 ($p<0.001$).). (Figure 1).

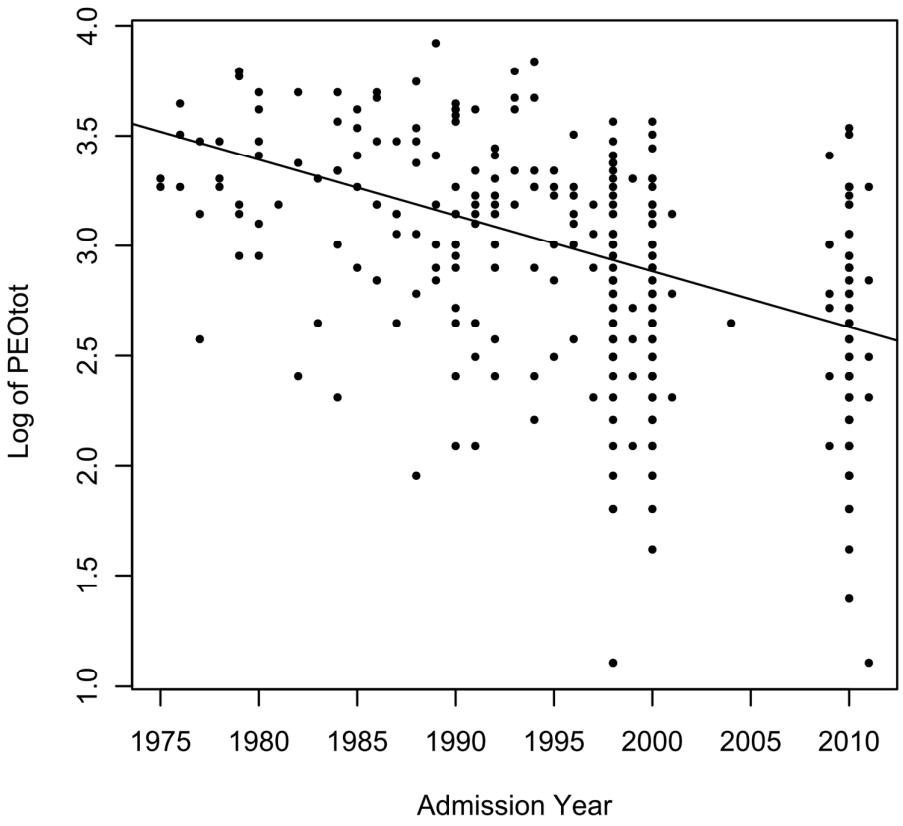

Figure 1: Total number of physical examination observations per admission (PEOtot) versus time.

There were significantly fewer (21%) total observations in surgical admission notes, compared to medical admission notes ($p<0.001$). Registrars recorded 12% fewer total observations compared to house surgeons ($p<0.001$). Statistical significance with respect to admission year group, speciality and level of experience of the admitting doctor in terms of predicting PEOtot was achieved by using the Wald chi-square test. PEOtot was analysed as a negative binomial regression model (overdispersed data) by rendering the 'admission year' as a continuous variable and the 'admission ward' and 'doctor level of experience' as categorical variables.

With respect to the examination of the relevant system pertaining to the presenting complaint (RelSystem), we have found that this occurred in 94% of all admission notes (95%C.I.) and there was no statistically significant change over time ($p<0.1$). There was however a significant difference according to speciality, with surgical doctors less likely to have examined RelSystem compared to their medical counterparts (86% vs 98% respectively, $p<0.001$)). Further subanalysis of speciality and RelSystem with respect to year group showed no statistically significant differences except for the 2010s, in which 25% of surgical admissions did not record examination of the relevant system compared with 3% of medical admissions ($p<0.05$); (pre 1990s ($p>0.05$), 1990s ($p<0.1$) 2000s ($p<0.1$)).

There was no statistically significant difference overall between examination of the relevant system pertaining to their presenting complaint (RelSystem) with respect to level of experience of admitting doctor (registrar, house surgeon and trainee intern) ($p<0.01$). Further analysis by year groups shows a difference only for the 2010s, in

which registrars documented RelSystem in 97% of admissions compared to 65% of house surgeons ($p<0.005$).

The total number of body systems examined (Nsystems) significantly declined over the study period, with a change of 1.184 mean body systems ($p<0.001$). (Figure 2).

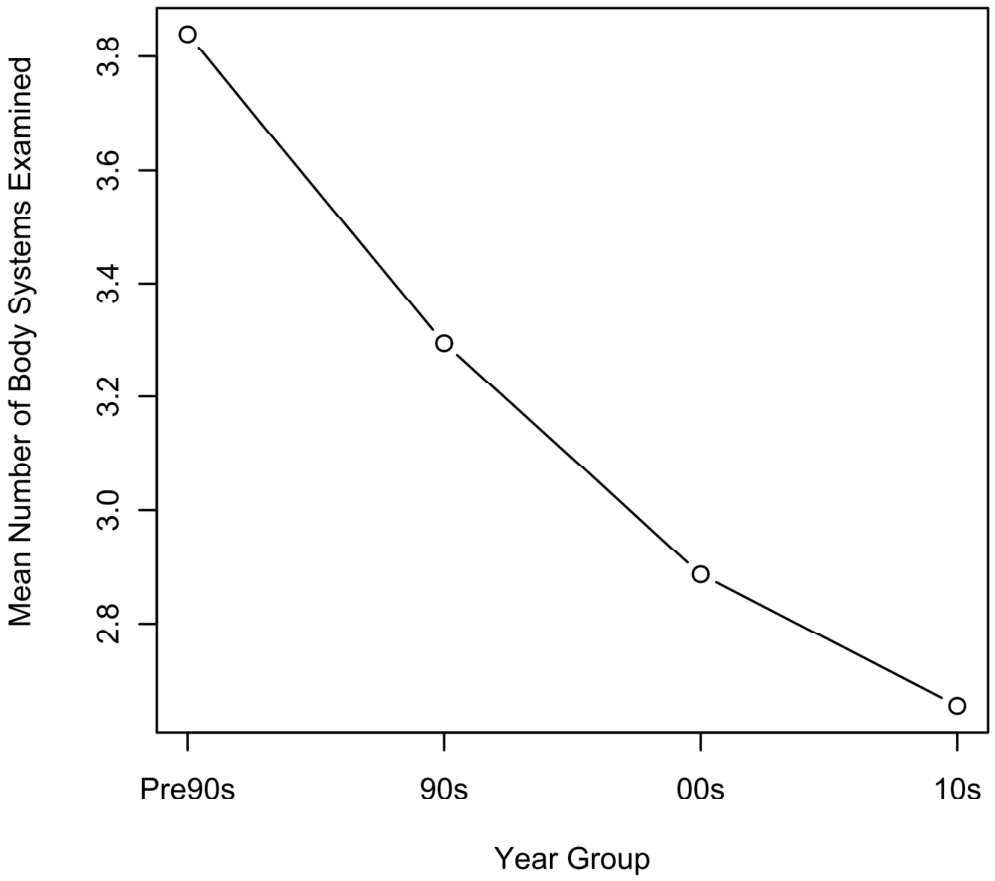

Figure 2: Mean number of body systems examined per year group.

There was a significant difference according to speciality between medical and surgical admissions, with surgical doctors examining less Nsystems than physicians ($p<0.01$). There were no significant differences between speciality within each of the year groups

($p<0.1$). With respect to the level of experience of the admitting doctor, there were no significant differences in Nsystems ($p>0.5$) or within year groups ($p<0.1$).

There was a significant decline over the study period in the percentage of admission notes with recorded examinations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character ($p<0.001$; chi-square values of 51.3, 47.8, 32.0, 57.9 and 24.2 respectively, 1df). Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. There was no significant change in the frequency of recorded examinations for carotid bruits ($p>0.5$; chi-sqare = 0.4, 1 df)). There was no year goup analysis performed for fundoscopy, as this was only documented in the pre 90s year group.). (Figure 3a)

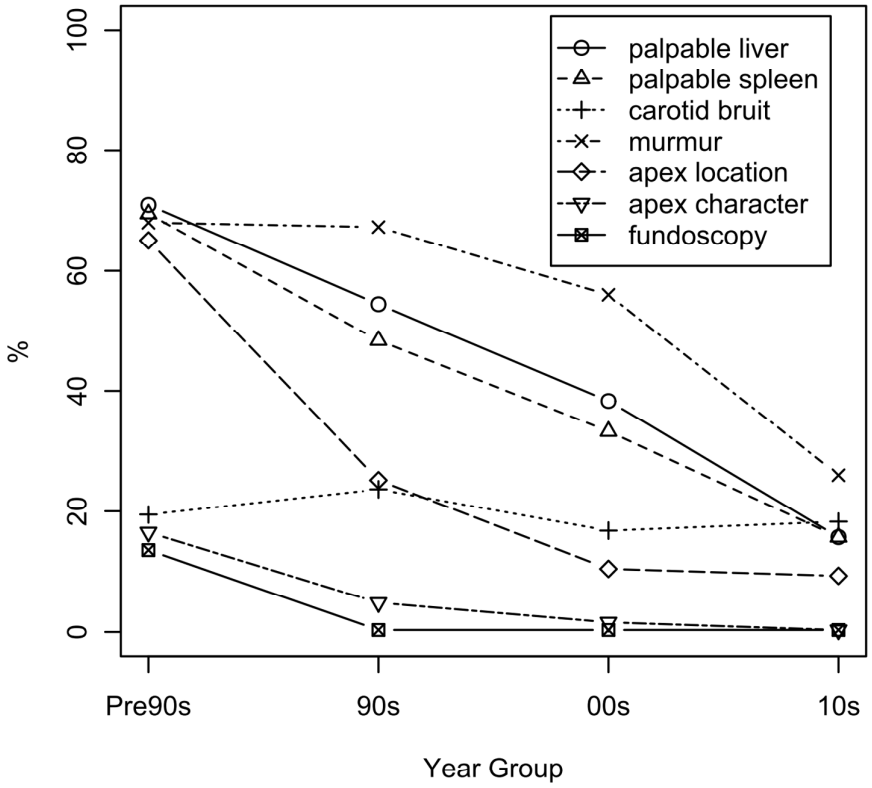

Figure 3a: Percentage of admission notes with recorded examinations for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

The percentage of admission notes documenting a positive cardiac murmur increased over the study period, out of the notes showing a relevant examination had been performed ($p<0.01$, chi-square 7.5, 1df). There were no changes over time in positive findings with respect to palpable liver, palpable spleen, carotid bruit and apex beat location and character ($p>0.1$, chi-square 1.5, 1.8, 1.7, 0.2, and 0.5 respectively, 1 df). This is probably due to the low frequency of positive findings within each of the year groups. Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. (Figure 3b).

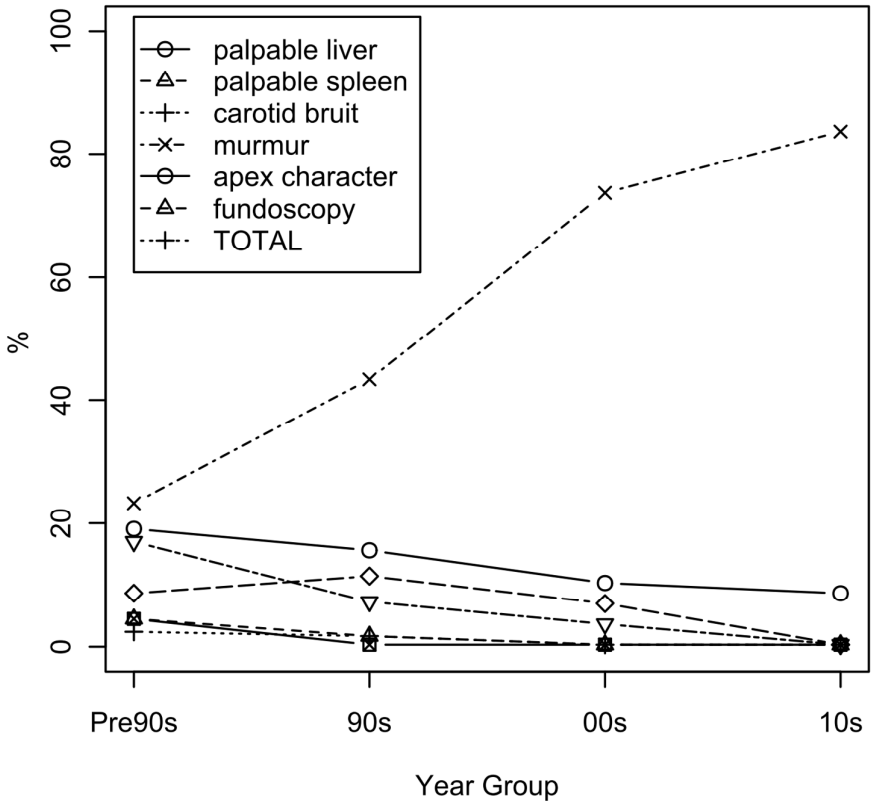

Figure 3b: Percentage of admission notes with positive findings for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

We found that the vast majority of admission notes documented heart rate, with approximately 50% in each year group documenting a heart rate divisible by five and no change over time with respect to the latter ($p>0.5$, chi-square 0.8, 1df). Statistical analysis was provided by Cochran-Armitage testing, and 95% confidence intervals were used. (Figure 4).

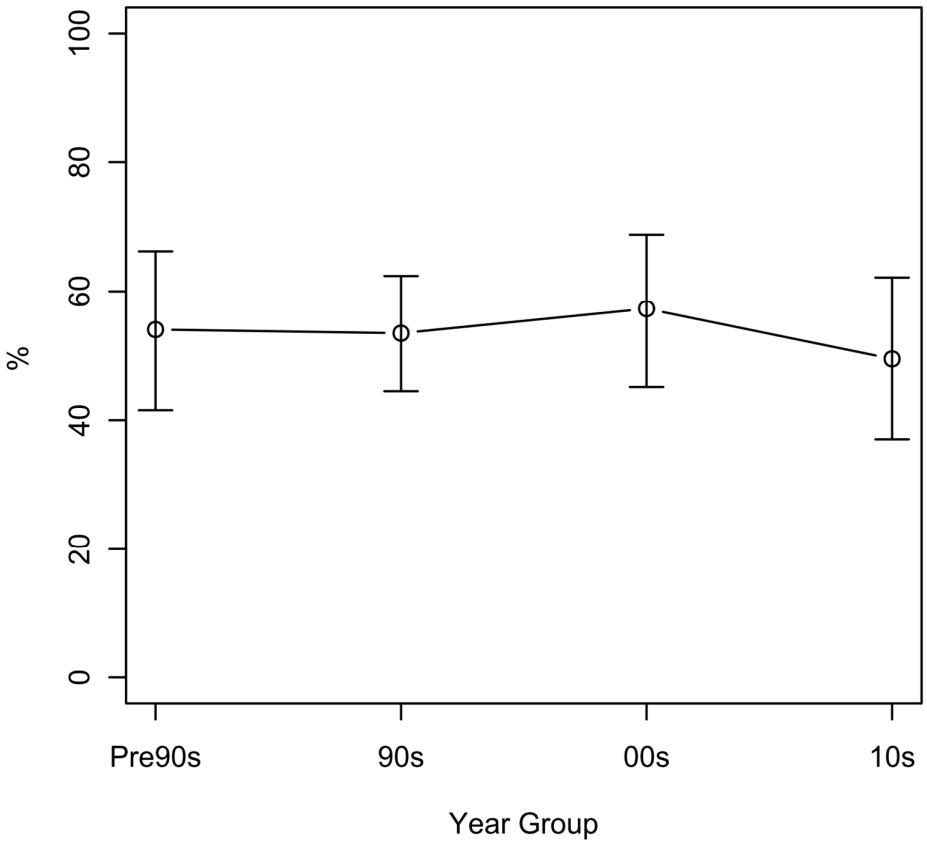

Figure 4: Percentage of heart rate observations divisible by five according to year group.

Discussion

Thus the results imply that there has been deterioration in the physical examination skills of junior doctors in Wellington Hospital from 1975 to 2010, after detailed analysis of the medical admission record notes. This is evident from the observed decline in the recorded total number of physical examination observations, total number of body systems examined and the number of recorded observations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character. In the author's opinion,

this temporal deterioration could be due to the increased use and availability of complex diagnostic technology [8, 9] as well as the concurrent loss of confidence in physical examination skills. Busy workloads [24] often necessitate substandard physical examinations and the resulting documentation. Low examination skill proficiency after initial training, and little opportunity to improve these skills [6, 7] and the resultant effect on student and teacher confidence further contribute to the demise of clinical examination.

Interestingly there has been no reduction in the examination of the relevant system pertaining to their presenting complaint (RelSystem). It could be argued that the latter constitutes the 'bare minimum', and hence has suffered less than the other parts of the medical admission record. In addition, there was a significant increase over time in the ratio of documented positive cardiac murmurs, out of the admission records indicating an examination had been performed. It is unclear why this particular physical observation has 'improved' over time. It could be due to particular clinical focus on cardiac auscultation in the undergraduate program, from students or clinicians or both. A more statistical explanation is supplied by the low frequencies of positive findings within each of the year groups for palpable liver, palpable spleen, apex beat location and character, affecting trend analysis.

We found that registrars recorded 12% fewer total observations than house surgeons. In the authors' opinion, this could be a reflection of the local admission process, for both medical and surgical patients. For many years, it has been the convention in Wellington that the registrar assesses and diagnoses the patient before instigating appropriate initial

therapy. Then the team house surgeon is called to finish the 'clarking' process – ie complete the history and examination of the admission, chart the patients medications and fluids etc. This may not reflect practice in all New Zealand or international hospitals.

It remains unclear why surgical admission notes contain less total observations and number of body systems than their medical counterparts. In the authors' opinion, physicians may arguably take a more holistic approach to their patients, and are hence more likely to examine more body systems and document a greater number of examination findings. The differential diagnoses of medical complaints may be broader than surgical complaints, warranting such a detailed assessment. Junior surgical staff are frequently time pressured as they are often on call for acute assessments, as well as being expected to be in the operating theatre. Surgical house officers are the only staff available to deal with the often complex medical issues in the surgical ward. If this time pressure is indeed a true factor in the declining standards of the surgical admission note, greater surgical staffing resources could ameliorate this situation. Other measures that may help reduce the workload include the involvement of senior medical staff early in the admission process in managing complex medical problems. This is already occurring in some wards, with Consultant Geriatricians seeing elderly orthopaedic patients with hip fractures soon after admission. Certainly there is consensus regarding the benefits resulting from the routine involvement of an elderly care physician in such circumstances. [25] Many studies have shown shorter hospital stays, reduced mortality, improved placement on discharge although there is conflicting evidence regarding cost-savings. [25] While this apporach may indeed benefit hospitals and orthogeriatric patients, it may result in further clinical deskilling of junior doctors.

Surgical admisssion notes contained less examination of the relevant system pertaining to the persenting complaint compared to medical admission notes. This was especially true in the 2010s year group. In the authors' opinion, this could be again due to the surgical admission process, whereby the surgical registrar assesses the patient (and presumably examines the relevant system) but doesn't actually complete a full admission note, which is then completed by the surgical house officer. Anecdotal experience shows that in recent years, junior staff completing the admission note often don't feel it is necessary to repeat the examination of the relevant system, especially as further examination of a tender abdomen or fractured limb can cause discomfort. This is borne out by the subgroup analysis finding showing that in the 2010s year group the registrars documented RelSystem in 97% of admissions, compared to 65% of house surgeons.

There were several limitations to our study. These include its retrospective nature, the use of the "surrogate" marker of the medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, database restrictions in the medical records department meant we were only able to request medical admission files from 1998 onwards. The study could have had greater impact if we were able to access large numbers of records from much earlier. We were able to obtain some earlier admission notes, when these were co-filed with more contemporary records, although these were not randomly selected. However these earlier notes were at least 10 years apart from

the other records, and statistical analysis showed no difference in patient age across the year groups.

This is the second study from Wellington Hospital that has identified the declining quality of the hospital admission note with regard to physical examination. A previous Wellington study concluded that there has been a decline in the quality of the surgical house surgeon admission note (SHSurgAdN) when comparing 2005 and 2009. [24] The authors found that the SHSurgAdN was comparatively deficient in the documentation of the relevant system examination and the cardio-respiratory examination, and that this deficiency had worsened over the intervening 4 years. [24] This study faced similar limitations as the current study, ie it was retrospective, the admission note was used as a surrogate for the assessment of the junior doctors physical examination skills, and the admission process is complicated. However it was well designed and had good power, with 100 admission notes audited in total. This study differed from the current study in that it incorporated a house surgeon questionnaire, with questions on history taking as well as clinical examination. The currrent study involves the investigation of an even greater number of admissions over a longer time period, with more extracted data.

There are potential solutions to halt this decline in physical examination skills. Some local barriers to clinical competence have been identified and ways to improve this deficit have been suggested. [7, 24] These include increased senior supervision of the admitting process including formative feedback and reflection. [24] A local cultural change could be implented, enabling house surgeons to assess patients initially while more senior staff provide supervision and guidance. [24] This would require increased junior staffing or work-based changes to address workload issues, as well as

commitment from senior colleagues to ensure that there is no compromise to patient safety. Finally, international evidence suggests that improved undergraduate curriculum especially bedside teaching and enhanced supervision of new doctors could redirect the current downward trend in physical examination. [6, 8, 10, 11]

During the audit process in this study, there was also significant variation in the history component of the admission note. The history is a vital part of the admission process, and is crucial to diagnostic success. [26, 27] Further research is warranted regarding the adequacy of history taking as evidenced by the admission record, and this concern is supported by contemporary studies. [24]

Competing interest statement : All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available

on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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- **Authorship and Contributorship statement:** The authors listed have made significant contributions to this paper. First author Ms Oliver was involved in the extraction and processing of data, data analysis and interpretation, literature search, discussion points and initial draft formation. Second and corresponding author Dr Hunter is not only involved in an administrative and communication capacity but has contributed significantly with respect to study design, data extraction and analysis, interpretation and statistical analysis, literature search, and final paper revisions. Third author Dr Takayoshi is responsible for the statistical analysis and figures. Last author Associate Professor Galletly designed the study and was involved in the interpretation of the data and critical review of the publication.

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Abstract.

Objectives To investigate the hypothesis that junior doctors' examination skills are deteriorating by assessing the medical admission note examination record.

Design Retrospective study of the admission record.

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Methods: The admission records of 266 patients admitted to Wellington hospital between 1975 and 2011 were analysed, according to the total number of physical examination observations (PEOtot), examination of the relevant system pertaining to the presenting complaint (RelSystem), and the number of body systems examined (Nsystems). Subgroup analysis proceeded according to admission year, level of experience of the admitting doctor (registrar, house surgeon (HS) and trainee intern (TI)) and medical versus surgical admission notes. Further analysis investigated the trend over time in documentation with respect to cardiac murmurs, palpable liver, palpable spleen, carotid bruit, heart rate, fundoscopy, and apex beat location and character.

Results: PEOtot declined by 34% from 1975 to 2011. Surgical admission notes had 21% fewer observations than medical notes.

RelSystem occurred in 94% of admissions, with no decline over time. Medical notes documented this more frequently than surgical notes (98% and 86% respectively). There were no differences between registrars and HS, except for the 2010s subgroup (97% and 65% respectively).

Nsystems declined over the study period. Medical admission notes documented more body systems than surgical notes. There were no differences between registrars, house surgeons and trainee interns.

Fewer examinations were performed for palpable liver, palpable spleen, cardiac murmur and apex beat location and character over the study period. There was no temporal change in the positive findings of these observations or heart rate rounding.

Conclusions: There has been a decline in the admission record at Wellington hospital between 1975 and 2011, implying a deterioration in local doctors' physical examination skills. Measures to counter this trend are discussed.

Article Summary

Article focus

- There is well-documented international evidence supporting a declining standard in junior doctor physical examination skills in recent years.
- This study was conducted to address the research question that this deterioration has occurred locally in Wellington, New Zealand.

Key messages

- There has been a decline in the quantity and quality of the medical admission note examination records in this tertiary care centre between 1975 and 2011, which implies a decline in the examination skills of local junior doctors.
- Measures to address this decay in clinical ability include improved undergraduate curriculum, greater supervision of junior doctors, greater involvement of junior doctors in the admission process and increased staffing levels.

Strengths and limitations of this study

- This is a significant study involving large numbers of patient admission records over a substantial period of time (358 patient records over four decades) with a multitude of statistically robust outcome measures analysed.
- Our study is limited due to its retrospective nature, single-centre study, the use of the "surrogate" marker of the written medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, the data was extracted by only one researcher.

Introduction.

Thoughtful history taking and physical examination are recognised as fundamental to the practice of medicine. [1] Moreover, physicians rate physical examination as their most valuable skill. [2] It has also been shown that despite the current technology, physical examination remains important due to its diagnostic contribution,[3] positive effect on patient care [4] and cost reduction. [5]

There has been a well recognised international decline in the physical examination skills of doctors. Potential reasons for this deterioration include busy clinical workloads and lack of clinical teaching. [6, 7] However it is generally recognised that the most important influence has been the increased availability of specialised diagnostic equipment. [8, 9] Imaging technology such as ultrasound, CT and MRI have overshadowed the use of physical examination for diagnostic information. [8, 9] Although adding enormously to the cost of health care, these investigations are seen to be more accurate and less liable to litigation, than the more subjective art of physical examination. [8, 9] It has been argued that the overuse of this technology has also helped to erode the teaching and skill in physical diagnosis [8, 10] and that it may be undermining the value of these skills. [4] This is further impacted by the shift away from bedside teaching and supervision of physical examination skills during undergraduate years and early years of practice. [6, 10, 11] In the United States bedside teaching has fallen from 75% of clinical teaching in the 1960s [10] to 8-19% of clinical teaching in 2008. [12] Thus there are significant changes required from both the medical school and

hospital culture regarding physical examination skill acquisition, improvement and retention.

The medical record is a tool for communication between multiple health professionals, facilitating continuity of care and good patient management. [13] There have been a number of studies referencing the importance of the quality of the medical record. [14-19] The medical record is also a legal document and as such deserves the appropriate time and attention to ensure it is "comprehensive and accurate". [13] Some studies have looked into ways to improve documentation such as introducing a clinical note header section, [20] education and instruction [21, 22] and structured encounter forms [23] with positive results. There are currently no evidence based standards for best practice concerning adequacy of documentation of physical examination findings for Wellington Hospital, neither are there any clinical guidelines derived from expert opinion. Thus it is difficult to ascertain the expected minimum level of documentation. In order to retrospectively investigate examination practice over time we are reliant on this medical record for our information. The current study is inevitably an investigation into both the skills of doctors and their documentation practices, although our primary hypothesis is whether or not there has been a decline in the standards of junior doctors physical examination skills.

Methods

This retrospective study looked at admission records from patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975

and 2010. The records were randomly selected by National Health Index (NHI) number if the patient had been admitted during this time with certain medical diagnoses, as reflected by the "coding diagnosis" which enables clerical staff to enter the correct computer information about each admission. 1998 was the earliest year for which we could get a random NHI list generated. In this way we obtained 300 sets of patient admission records, 100 from 1998, 100 from 2000 and 100 from 2010, from the medical records department at Wellington Hospital. Out of each set of 100 records there were 50 general medical and 50 surgical admissions. The medical coding diagnoses were pneumonia, congestive heart failure, shortness of breath or chest pain. The surgical coding diagnoses were inguinal hernia, appendicitis, abdominal pain, fractured neck of femur or bowel obstruction. Many of these medical files included records from previous admissions to hospital. We included these older admission notes if they had been coded with the aforementioned diagnoses, and if there was at least 10 years temporal separation from the randomly selected admission and we used only one older admission per patient. Strict patient and staff confidentiality was maintained at all times.

The admission note from each record was examined and the relevant data was extracted by one researcher, the primary author, with verification and close supervision by two other researchers (the corresponding and final authors). This data was entered into a pre-developed spreadsheet. If there was no admission note, we examined the last documented examination in the emergency department before ward admission. This was generally performed by the registrar of the admitting ward. The data from this examination was then entered as stated previously.

We recorded the total number of physical examination observations (PEOtot) that were documented per admission. We also documented the number of major body systems that had been examined (NSystems). These were defined as the cardiovascular, gastrointestinal, respiratory and central nervous systems. We then noted whether the relevant system pertaining to the presenting complaint had been examined (RelSystem). We then analysed the data in terms of year groups, in order to look for temporal change.

We subsequently analysed the data according to whether it was a medical or surgical admission note, and the level of experience of the admitting doctor (registrars, house surgeons (HS) or trainee interns (TI)) with respect to PEOtot, Nsystems and RelSystem. We also performed year group analysis on these subgroups.

We also investigated whether there was documentation of particular examination observations, positive or negative. These were palpable liver, palpable spleen, carotid bruit, cardiac murmur, apex beat location and character and fundoscopy. We analysed whether the frequency of these documented observations changed over time. Of the admission notes documenting the performance of these examinations, we then examined the frequency of positive findings and any change over time.

Finally we investigated the documentation of heart rate. Of those admission notes with a heart rate value, we analysed the frequency with which the heart rate was given as a value perfectly divisible by five, suggesting a tendency of the admitting doctor toward

rounding the actual value and thus potential inaccuracy. We then examined for a change in this trend over time.

Results.

We examined 358 patient admission records, from 266 patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975 and 2010. For administrative reasons we were unable to obtain 34 of the ordered sets of notes. There was no statistically significant difference in the patients' age between the year groups, after Kruskal-Wallis analysis. A biostatistician performed all analyses.

As evidenced by the documentation in the hospital record admission notes, there has been a statistically significant decrease (34%) in the total number of physical examination observations per admission (PEOtot) from 1975 to 2011 ($p<0.001$).). (Figure 1).

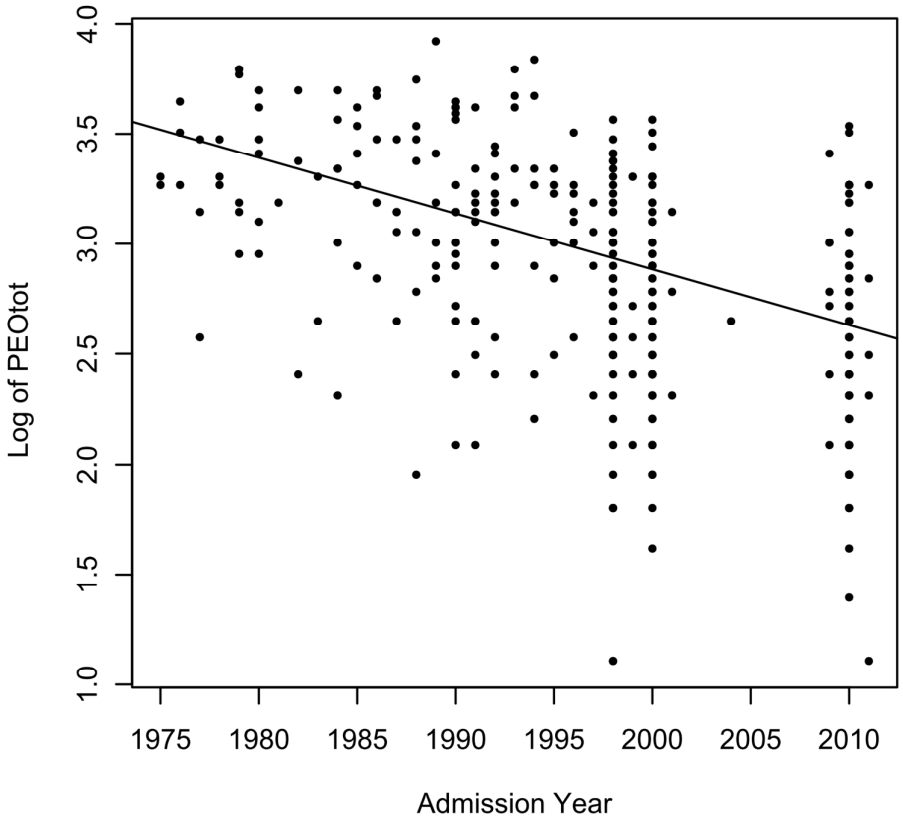

Figure 1: Total number of physical examination observations per admission (PEOtot) versus time.

There were significantly fewer (21%) total observations in surgical admission notes, compared to medical admission notes ($p<0.001$). Registrars recorded 12% fewer total observations compared to house surgeons ($p<0.001$). Statistical significance with respect to admission year group, specialty and level of experience of the admitting doctor in terms of predicting PEOtot was achieved by using the Wald χ^2 test. PEOtot was analysed as a negative binomial regression model (overdispersed data) by rendering the 'admission year' as a continuous variable and the 'admission ward' and 'doctor level of experience' as categorical variables.

With respect to the examination of the relevant system pertaining to the presenting complaint (RelSystem), we have found that this occurred in 94% of all admission notes (95%C.I.) and there was no statistically significant change over time ($p<0.1$). There was however a significant difference according to specialty, with surgical doctors less likely to have examined RelSystem compared to their medical counterparts (86% vs 98% respectively, $p<0.001$)). Further subanalysis of specialty and RelSystem with respect to year group showed no statistically significant differences except for the 2010s, in which 25% of surgical admissions did not record examination of the relevant system compared with 3% of medical admissions ($p<0.05$); (pre 1990s ($p>0.05$), 1990s ($p<0.1$) 2000s ($p<0.1$)).

There was no statistically significant difference overall between examination of the relevant system pertaining to their presenting complaint (RelSystem) with respect to level of experience of admitting doctor (registrar, house surgeon and trainee intern) ($p<0.01$). Further analysis by year groups shows a difference only for the 2010s, in which registrars documented RelSystem in 97% of admissions compared to 65% of house surgeons ($p<0.005$).

The total number of body systems examined (Nsystems) significantly declined over the study period, with a change of 1.184 mean body systems ($p<0.001$). (Figure 2).

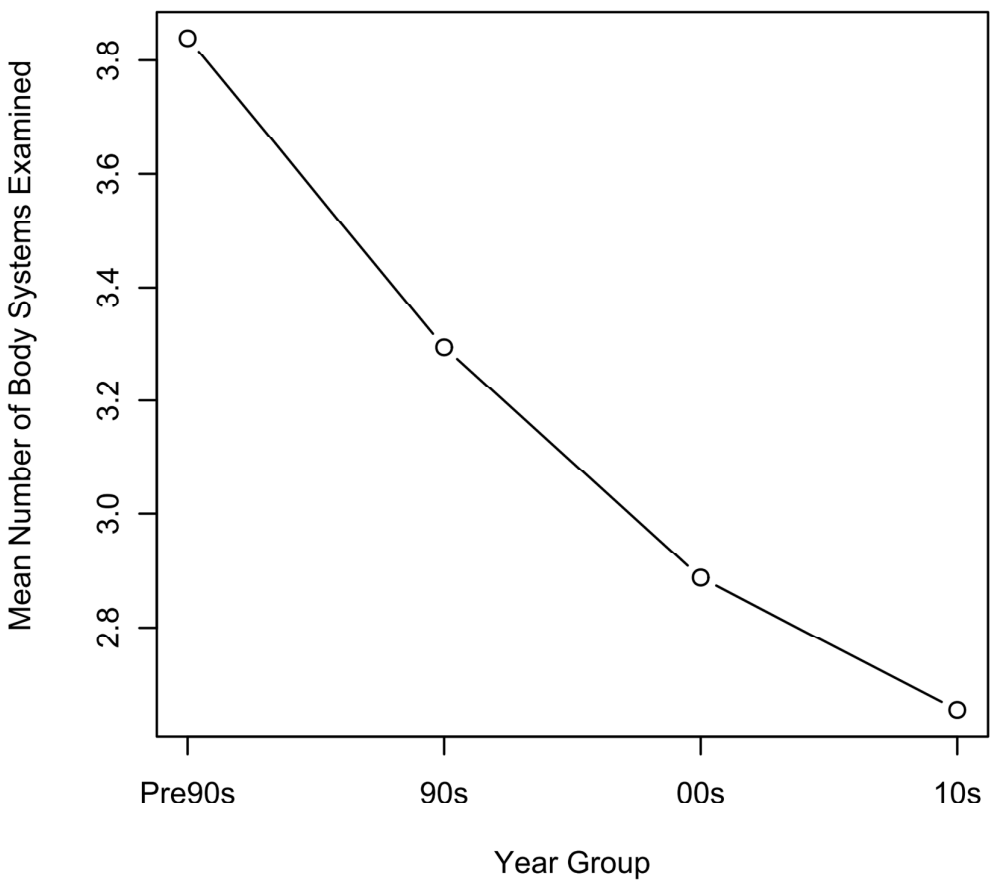

Figure 2: Mean number of body systems examined per year group.

The most commonly omitted body system was the central nervous system, across all the year groups.

There was a significant difference according to specialty between medical and surgical admissions, with surgical doctors examining less Nsystems than physicians ($p<0.01$). There were no significant differences between specialty within each of the year groups ($p<0.1$). With respect to the level of experience of the admitting doctor, there were no significant differences in Nsystems ($p>0.5$) or within year groups ($p<0.1$).

There was a significant decline over the study period in the percentage of admission notes with recorded examinations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character (χ^2 = 51.3, 47.8, 32.0, and 57.9, respectively, df = 1, $p < 0.001$). Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. There was no significant change in the frequency of recorded examinations for carotid bruits ($\chi^2 = 0.4$, df = 1, $p > 0.5$)). There was no year goup analysis performed for fundoscopy, as this was only documented in the pre 90s year group.). (Figure 3a)

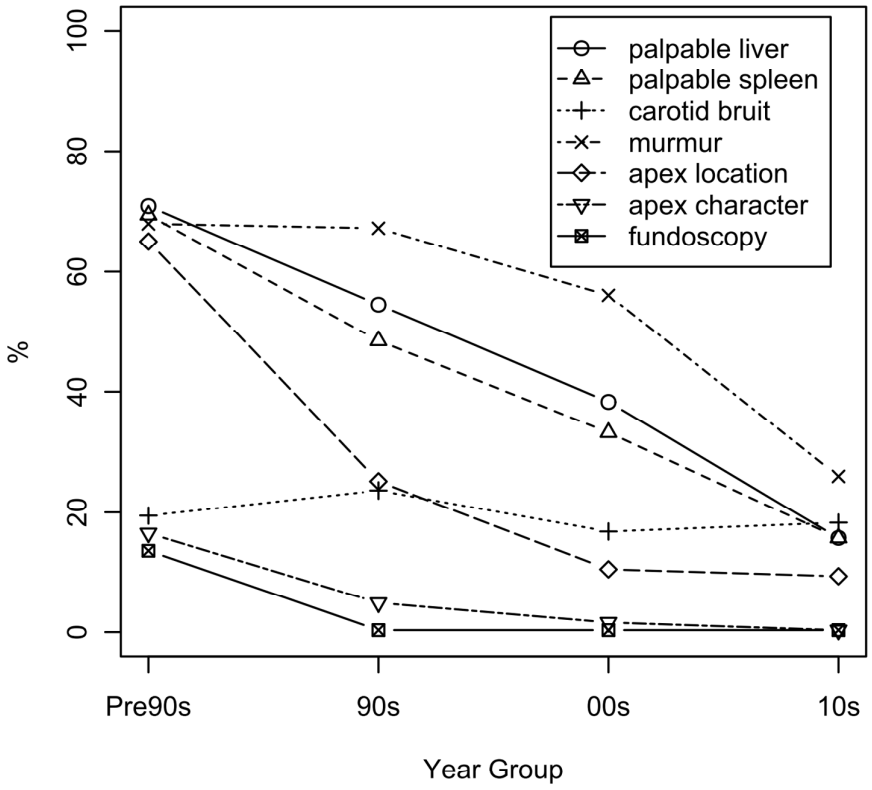

Figure 3a: Percentage of admission notes with recorded examinations for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

There were no changes over time with respect to positive cardiac murmur, palpable liver, palpable spleen, carotid bruit, and apex beat location and character ($\chi^2 = 0.01$, df = 1, $p > 0.5$ for cardiac murmur; $\chi^2 = 1.5$, 1.8, 1.7, 0.2, and 0.5 respectively, df = 1, $p > 0.5$ for the rest). This is probably due to the low frequency of positive findings within each of the year groups. Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. (Figure 3b).

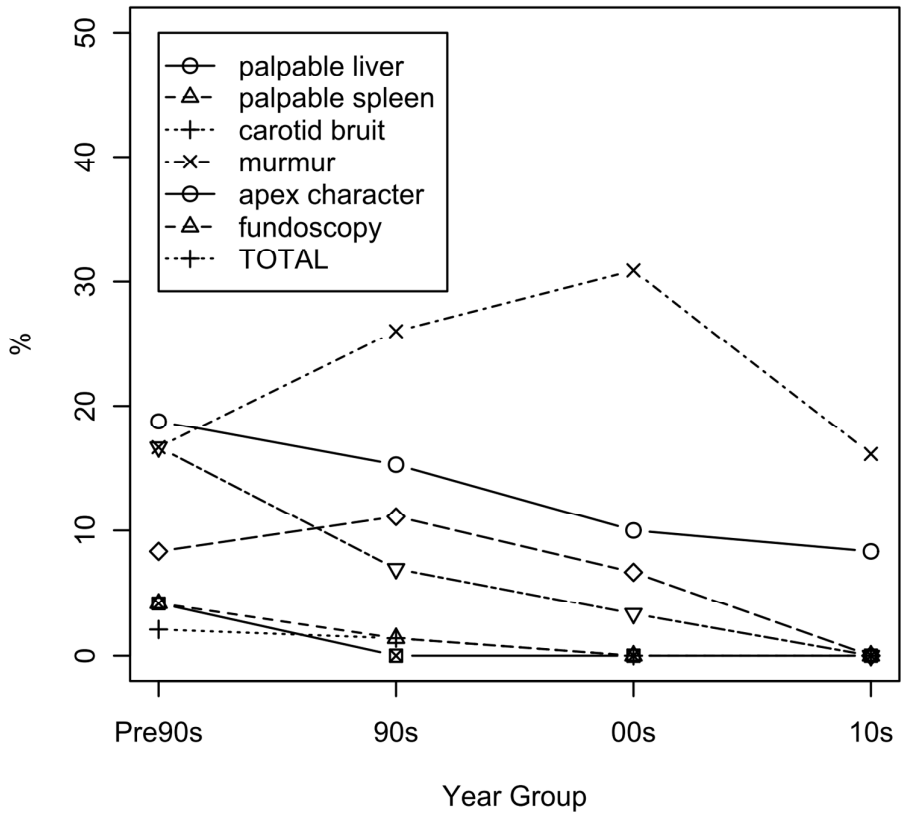

Figure 3b: Percentage of admission notes with positive findings for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

We found that the vast majority of admission notes documented heart rate, with approximately 50% in each year group documenting a heart rate divisible by five and no change over time with respect to the latter ($\chi^2 = 0.8$, df = 1, $p > 0.5$). Statistical analysis was provided by Cochran-Armitage testing, and 95% confidence intervals were used.

Discussion

Our results imply that there has been deterioration in the physical examination skills of junior doctors in Wellington Hospital from 1975 to 2010, after detailed analysis of the medical admission record notes. This is evident from the observed decline in the recorded total number of physical examination observations, total number of body systems examined and the number of recorded observations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character. In the author's opinion, this temporal deterioration could be due to the increased use and availability of complex diagnostic technology [8, 9] as well as the concurrent loss of confidence in physical examination skills. Busy workloads may necessitate substandard physical examinations and the resulting documentation. Low examination skill proficiency after initial training, and little opportunity to improve these skills [6, 7] and the resultant effect on student and teacher confidence further contribute to the demise of clinical examination. Recent anecdotal comments from undergraduate students attached to surgical wards at Wellington Hospital suggest that junior staff transmit a negative view toward the value of physical examination skills, thus creating a 'cyclic' phenomenom of further medical deskilling with each year of medical graduates.

Interestingly there has been no general decline in the examination of the relevant system pertaining to their presenting complaint (RelSystem). It could be argued that the latter

constitutes the 'bare minimum', and hence has suffered less than the other parts of the medical admission record.

We found that registrars recorded 12% fewer total observations than house surgeons. In the authors' opinion, this could be a reflection of the local admission process, for both medical and surgical patients. For many years, it has been the convention in Wellington that registrars assess and diagnose the patient before instigating appropriate initial therapy. Then the team house surgeon is called to finish the 'clerking' process – ie complete the history and examination of the admission, chart the patients medications and fluids etc. This is also the case for elective patients undergoing the preassesment process before their scheduled surgery, where the initial documentation of the patients medical problems is performed by an anaesthetist before the house surgeon interviews the patient. This may not reflect practice in all New Zealand or international hospitals.

It remains unclear why surgical admission notes contain less total observations and number of body systems than their medical counterparts. In the authors' opinion, physicians may arguably take a more holistic approach to their patients, and are hence more likely to examine more body systems and document a greater number of examination findings. The differential diagnoses of medical complaints may be broader than surgical complaints, warranting such a detailed assessment. Junior surgical staff are frequently time pressured as they are often on call for acute assessments, as well as being expected to be in the operating theatre. Surgical house officers are the only staff available to deal with the often complex medical issues in the surgical ward. If this time pressure is indeed a true factor in the declining standards of the surgical admission note,

greater surgical staffing resources could ameliorate this situation. Other measures that may help reduce the workload include the involvement of senior medical staff early in the admission process in managing complex medical problems. This is already occurring in some wards, with Consultant Geriatricians seeing elderly orthopaedic patients with hip fractures soon after admission. Certainly there is consensus regarding the benefits resulting from the routine involvement of an elderly care physician in such circumstances. [24] Many studies have shown shorter hospital stays, reduced mortality, improved placement on discharge although there is conflicting evidence regarding cost-savings. [24] While this apporach may indeed benefit hospitals and orthogeriatric patients, it may result in further clinical deskilling of junior doctors.

Surgical admisssion notes contained less examination of the relevant system pertaining to the persenting complaint compared to medical admission notes. This was especially true in the 2010s year group. In the authors' opinion, this could be again due to the surgical admission process, whereby the surgical registrar assesses the patient (and presumably examines the relevant system) but does not actually complete a full admission note, which is then completed by the surgical house officer. Anecdotal experience shows that in recent years, junior staff completing the admission note often do not feel it is necessary to repeat the examination of the relevant system, especially as further examination of a tender abdomen or fractured limb can cause discomfort. This is borne out by the subgroup analysis finding showing that in the 2010s year group the registrars documented RelSystem in 97% of admissions, compared to 65% of house surgeons.

There were several limitations to our study. These include its retrospective nature, the use of the "surrogate" marker of the medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, database restrictions in the medical records department meant we were only able to request medical admission files from 1998 onwards. The study could have had greater statistical impact if we were able to access large numbers of records from much earlier. We were able to obtain some earlier admission notes, when these were co-filed with more contemporary records, although these were not randomly selected. However these earlier notes were at least 10 years apart from the other records, there was only one older file per patient, and statistical analysis showed no difference in patient age across the year groups. This was single-centre study, hence further research is warranted at other national and international hospitals. Finally, our data was extracted by only one researcher, the first author, however this was closely supervised and verifed by two other researchers.

This is the second study from Wellington Hospital that has identified the declining quality of the hospital admission note with regard to physical examination. A previous Wellington study concluded that there has been a decline in the quality of the surgical house surgeon admission note (SHSurgAdN) when comparing 2005 and 2009 (Morgan TG, Dennet ER. Quality of House Surgeon Acute Surgical Admissions, 2005 vs 2009. (personal communication)). The authors found that the SHSurgAdN was comparatively deficient in the documentation of the relevant system examination and the cardio-respiratory examination, and that this deficiency had worsened over the intervening four years. This study faced similar limitations as the current study, ie it was single-centred, retrospective, the admission note was used as a surrogate for the assessment of the

junior doctors physical examination skills, and the admission process is complicated. However it was well designed and had good power, with 100 admission notes audited in total. This study differed from the current study in that it incorporated a house surgeon questionnaire, with questions on history taking as well as clinical examination. The currrent study involves the investigation of an even greater number of admissions over a longer time period, with more extracted data.

There are potential solutions to halt this decline in physical examination skills. Some local barriers to clinical competence have been identified and ways to improve this deficit have been suggested. [7] In the authors' opinion, these could include increased senior supervision of the admitting process including formative feedback and reflection, as well as a local cultural change enabling house surgeons to initially assess patients while senior staff provide supervision and guidance. This would require increased junior staffing or work-based changes to address workload issues, as well as commitment from senior colleagues to ensure that there is no compromise to patient safety. Finally, international evidence suggests that improved undergraduate curriculum especially bedside teaching and enhanced supervision of new doctors could redirect the current downward trend in physical examination. [6, 8, 10, 11]

During the audit process in this study, there was also significant variation in the history component of the admission note. The history is a vital part of the admission process, and is crucial to diagnostic success. [25, 26] Further research is warranted regarding the adequacy of history taking as evidenced by the admission record.

Competing interest statement: All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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- **Authorship and Contributorship statement:** The authors listed have made significant contributions to this paper. First author Ms. Oliver was involved in the extraction and processing of data, data analysis and interpretation, literature search, discussion points and initial draft formation. Second and corresponding author Dr Hunter is not only involved in an administrative and communication capacity but has contributed significantly with respect to study design, data extraction and analysis, interpretation and statistical analysis, literature search, and final paper revisions. Third author Dr Takayoshi is responsible for the statistical analysis and figures. Last author Associate Professor Galletly designed the study and was involved in the extraction of the data, interpretation of the data and critical review of the publication.

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Junior doctor skill in the art of physical examination: A retrospective study of the medical admission note over four decades

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Abstract.

Objectives To investigate the hypothesis that junior doctors' examination skills are deteriorating by assessing the medical admission note examination record.

Design Retrospective study of the admission record.

Setting Tertiary care hospital.

Methods: The admission records of 266 patients admitted to Wellington hospital between 1975 and 2011 were analysed, according to the total number of physical examination observations (PEOtot), examination of the relevant system pertaining to the presenting complaint (RelSystem), and the number of body systems examined (Nsystems). Subgroup analysis proceeded according to admission year, level of experience of the admitting doctor (registrar, house surgeon (HS) and trainee intern (TI)) and medical versus surgical admission notes. Further analysis investigated the trend over time in documentation with respect to cardiac murmurs, palpable liver, palpable spleen, carotid bruit, heart rate, fundoscopy, and apex beat location and character.

Results: PEOtot declined by 34% from 1975 to 2011. Surgical admission notes had 21% fewer observations than medical notes.

RelSystem occurred in 94% of admissions, with no decline over time. Medical notes documented this more frequently than surgical notes (98% and 86% respectively). There were no differences between registrars and HS, except for the 2010s subgroup (97% and 65% respectively).

Nsystems declined over the study period. Medical admission notes documented more body systems than surgical notes. There were no differences between registrars, house surgeons and trainee interns.

Fewer examinations were performed for palpable liver, palpable spleen, cardiac murmur and apex beat location and character over the study period. There was no temporal change in the positive findings of these observations or heart rate rounding.

Conclusions: There has been a decline in the admission record at Wellington hospital between 1975 and 2011, implying a deterioration in local doctors' physical examination skills. Measures to counter this trend are discussed.

Article Summary

Article focus

- There is well-documented international evidence supporting a declining standard in junior doctor physical examination skills in recent years.
- This study was conducted to address the research question that this deterioration has occurred locally in Wellington, New Zealand.

Key messages

- There has been a decline in the quantity and quality of the medical admission note examination records in this tertiary care centre between 1975 and 2011, which implies a decline in the examination skills of local junior doctors.
- Measures to address this decay in clinical ability include improved undergraduate curriculum, greater supervision of junior doctors, greater involvement of junior doctors in the admission process and increased staffing levels.

Strengths and limitations of this study

- This is a significant study involving large numbers of patient admission records over a substantial period of time (358 patient records over four decades) with a multitude of statistically robust outcome measures analysed.
- Our study is limited due to its retrospective nature, single-centre study, the use of the "surrogate" marker of the written medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, the data was extracted by only one researcher.

Introduction.

Thoughtful history taking and physical examination are recognised as fundamental to the practice of medicine. [1] Moreover, physicians rate physical examination as their most valuable skill. [2] It has also been shown that despite the current technology, physical examination remains important due to its diagnostic contribution,[3] positive effect on patient care [4] and cost reduction. [5]

There has been a well recognised international decline in the physical examination skills of doctors. Potential reasons for this deterioration include busy clinical workloads and lack of clinical teaching. [6, 7] However it is generally recognised that the most important influence has been the increased availability of specialised diagnostic equipment. [8, 9] Imaging technology such as ultrasound, CT and MRI have overshadowed the use of physical examination for diagnostic information. [8, 9] Although adding enormously to the cost of health care, these investigations are seen to be more accurate and less liable to litigation, than the more subjective art of physical examination. [8, 9] It has been argued that the overuse of this technology has also helped to erode the teaching and skill in physical diagnosis [8, 10] and that it may be undermining the value of these skills. [4] This is further impacted by the shift away from bedside teaching and supervision of physical examination skills during undergraduate years and early years of practice. [6, 10, 11] In the United States bedside teaching has fallen from 75% of clinical teaching in the 1960s [10] to 8-19% of clinical teaching in 2008. [12] Thus there are significant changes required from both the medical school and

hospital culture regarding physical examination skill acquisition, improvement and retention.

The medical record is a tool for communication between multiple health professionals, facilitating continuity of care and good patient management. [13] There have been a number of studies referencing the importance of the quality of the medical record. [14-19] The medical record is also a legal document and as such deserves the appropriate time and attention to ensure it is "comprehensive and accurate". [13] Some studies have looked into ways to improve documentation such as introducing a clinical note header section, [20] education and instruction [21, 22] and structured encounter forms [23] with positive results. There are currently no evidence based standards for best practice concerning adequacy of documentation of physical examination findings for Wellington Hospital, neither are there any clinical guidelines derived from expert opinion. Thus it is difficult to ascertain the expected minimum level of documentation. In order to retrospectively investigate examination practice over time we are reliant on this medical record for our information. The current study is inevitably an investigation into both the skills of doctors and their documentation practices, although our primary hypothesis is whether or not there has been a decline in the standards of junior doctors physical examination skills.

Methods

This retrospective study looked at admission records from patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975

and 2010. The records were randomly selected by National Health Index (NHI) number if the patient had been admitted during this time with certain medical diagnoses, as reflected by the "coding diagnosis" which enables clerical staff to enter the correct computer information about each admission. 1998 was the earliest year for which we could get a random NHI list generated. In this way we obtained 300 sets of patient admission records, 100 from 1998, 100 from 2000 and 100 from 2010, from the medical records department at Wellington Hospital. Out of each set of 100 records there were 50 general medical and 50 surgical admissions. The medical coding diagnoses were pneumonia, congestive heart failure, shortness of breath or chest pain. The surgical coding diagnoses were inguinal hernia, appendicitis, abdominal pain, fractured neck of femur or bowel obstruction. Many of these medical files included records from previous admissions to hospital. We included these older admission notes if they had been coded with the aforementioned diagnoses, and if there was at least 10 years temporal separation from the randomly selected admission and we used only one older admission per patient. Strict patient and staff confidentiality was maintained at all times.

The admission note from each record was examined and the relevant data was extracted by one researcher, the primary author, with verification and close supervision by two other researchers (the corresponding and final authors). This data was entered into a pre-developed spreadsheet. If there was no admission note, we examined the last documented examination in the emergency department before ward admission. This was generally performed by the registrar of the admitting ward. The data from this examination was then entered as stated previously.

We recorded the total number of physical examination observations (PEOtot) that were documented per admission. We also documented the number of major body systems that had been examined (NSystems). These were defined as the cardiovascular, gastrointestinal, respiratory and central nervous systems. We then noted whether the relevant system pertaining to the presenting complaint had been examined (RelSystem). We then analysed the data in terms of year groups, in order to look for temporal change.

We subsequently analysed the data according to whether it was a medical or surgical admission note, and the level of experience of the admitting doctor (registrars, house surgeons (HS) or trainee interns (TI)) with respect to PEOtot, Nsystems and RelSystem. We also performed year group analysis on these subgroups.

We also investigated whether there was documentation of particular examination observations, positive or negative. These were palpable liver, palpable spleen, carotid bruit, cardiac murmur, apex beat location and character and fundoscopy. We analysed whether the frequency of these documented observations changed over time. Of the admission notes documenting the performance of these examinations, we then examined the frequency of positive findings and any change over time.

Finally we investigated the documentation of heart rate. Of those admission notes with a heart rate value, we analysed the frequency with which the heart rate was given as a value perfectly divisible by five, suggesting a tendency of the admitting doctor toward

rounding the actual value and thus potential inaccuracy. We then examined for a change in this trend over time.

Results.

We examined 358 patient admission records, from 266 patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975 and 2010. For administrative reasons we were unable to obtain 34 of the ordered sets of notes. There was no statistically significant difference in the patients' age between the year groups, after Kruskal-Wallis analysis. A biostatistician performed all analyses.

As evidenced by the documentation in the hospital record admission notes, there has been a statistically significant decrease (34%) in the total number of physical examination observations per admission (PEOtot) from 1975 to 2011 ($p<0.001$).). (Figure 1).

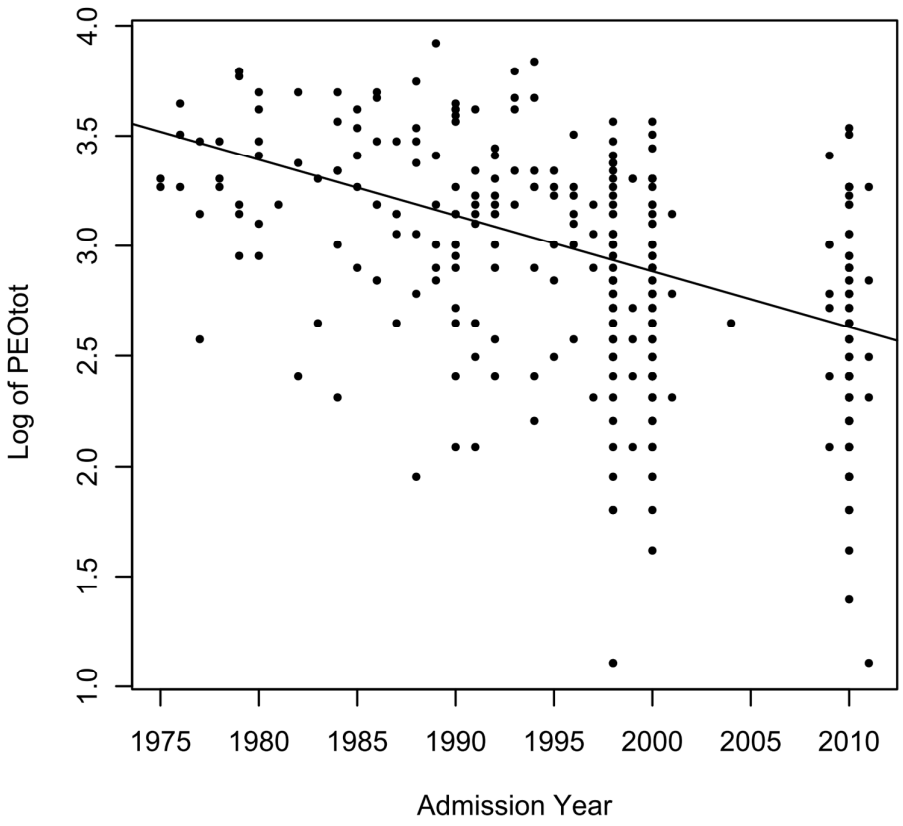

Figure 1: Total number of physical examination observations per admission (PEOtot) versus time.

There were significantly fewer (21%) total observations in surgical admission notes, compared to medical admission notes ($p<0.001$). Registrars recorded 12% fewer total observations compared to house surgeons ($p<0.001$). Statistical significance with respect to admission year group, specialty and level of experience of the admitting doctor in terms of predicting PEOtot was achieved by using the Wald χ^2 test. PEOtot was analysed as a negative binomial regression model (overdispersed data) by rendering the 'admission year' as a continuous variable and the 'admission ward' and 'doctor level of experience' as categorical variables.

With respect to the examination of the relevant system pertaining to the presenting complaint (RelSystem), we have found that this occurred in 94% of all admission notes (95%C.I.) and there was no statistically significant change over time (p<0.1). There was however a significant difference according to specialty, with surgical doctors less likely to have examined RelSystem compared to their medical counterparts (86% vs 98% respectively, p<0.001)). Further subanalysis of specialty and RelSystem with respect to year group showed no statistically significant differences except for the 2010s, in which 25% of surgical admissions did not record examination of the relevant system compared with 3% of medical admissions (p<0.05); (pre 1990s (p>0.05), 1990s (p<0.1) 2000s (p<0.1)).

There was no statistically significant difference overall between examination of the relevant system pertaining to their presenting complaint (RelSystem) with respect to level of experience of admitting doctor (registrar, house surgeon and trainee intern) (p<0.01). Further analysis by year groups shows a difference only for the 2010s, in which registrars documented RelSystem in 97% of admissions compared to 65% of house surgeons (p<0.005).

The total number of body systems examined (Nsystems) significantly declined over the study period, with a change of 1.184 mean body systems (p<0.001). (Figure 2).

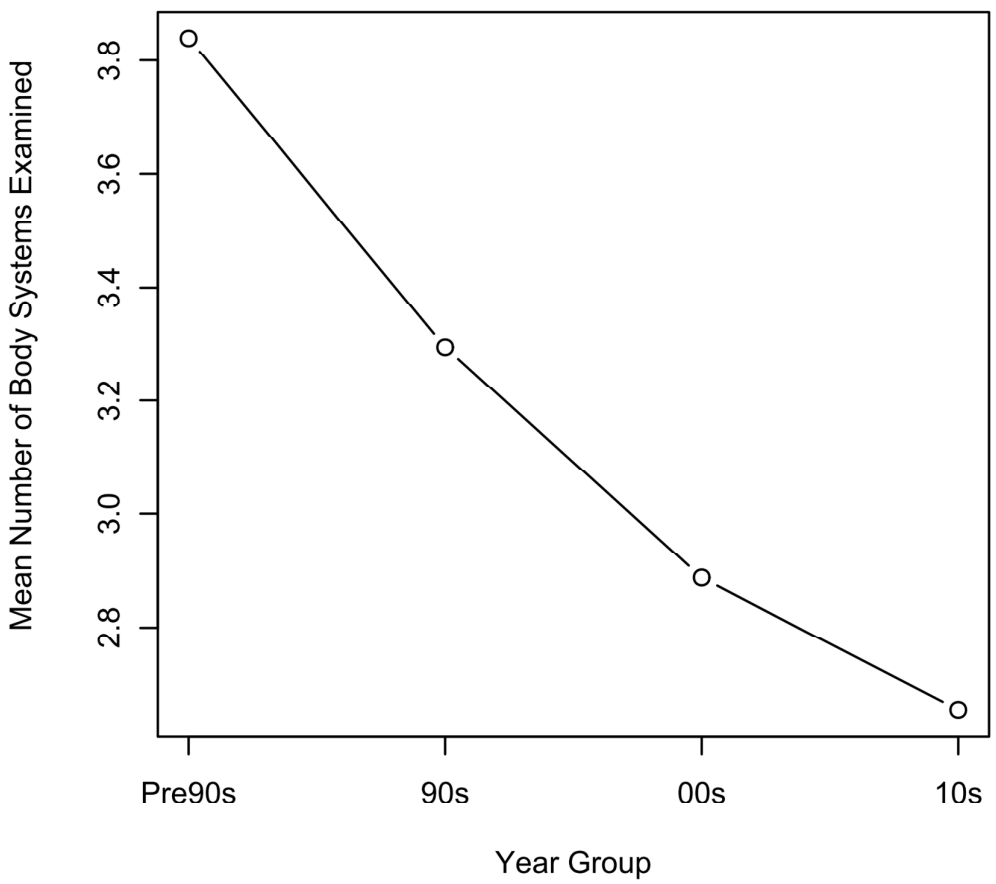

Figure 2: Mean number of body systems examined per year group.

The most commonly omitted body system was the central nervous system, across all the year groups.

There was a significant difference according to specialty between medical and surgical admissions, with surgical doctors examining less Nsystems than physicians ($p<0.01$). There were no significant differences between specialty within each of the year groups ($p<0.1$). With respect to the level of experience of the admitting doctor, there were no significant differences in Nsystems ($p>0.5$) or within year groups ($p<0.1$).

There was a significant decline over the study period in the percentage of admission notes with recorded examinations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character (χ^2 = 51.3, 47.8, 32.0, and 57.9, respectively, df = 1, $p < 0.001$). Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. There was no significant change in the frequency of recorded examinations for carotid bruits (χ^2 = 0.4, df = 1, $p > 0.5$)). There was no year goup analysis performed for fundoscopy, as this was only documented in the pre 90s year group.). (Figure 3a)

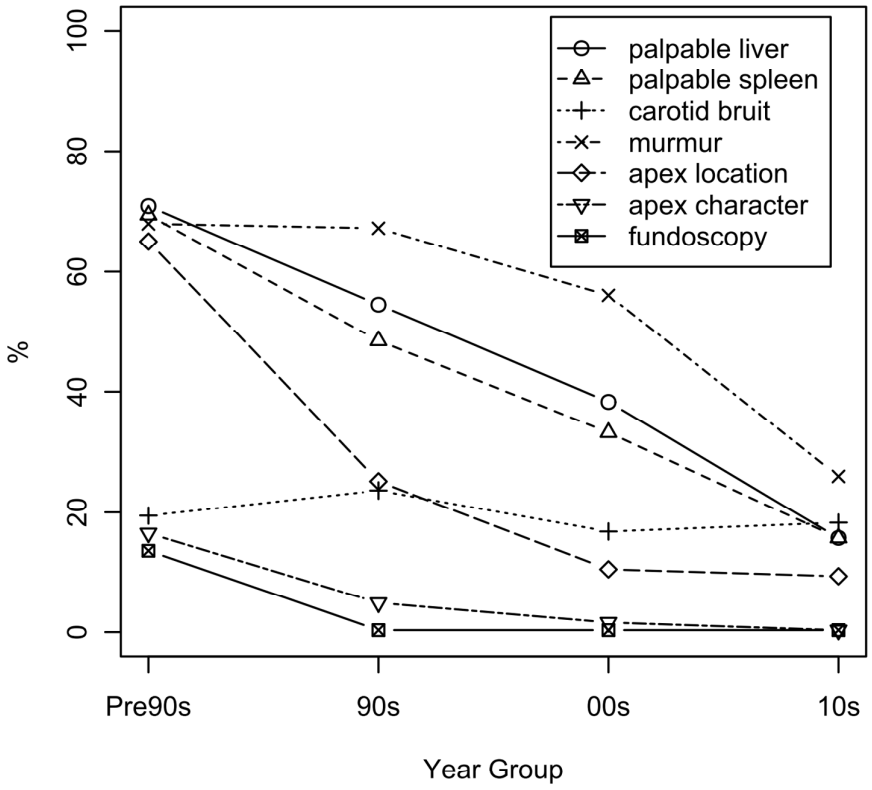

Figure 3a: Percentage of admission notes with recorded examinations for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

There were no changes over time with respect to positive cardiac murmur, palpable liver, palpable spleen, carotid bruit, and apex beat location and character ($\chi^2 = 0.01$, df = 1, $p > 0.5$ for cardiac murmur; $\chi^2 = 1.5$, 1.8, 1.7, 0.2, and 0.5 respectively, df = 1, $p > 0.5$ for the rest). This is probably due to the low frequency of positive findings within each of the year groups. Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. (Figure 3b).

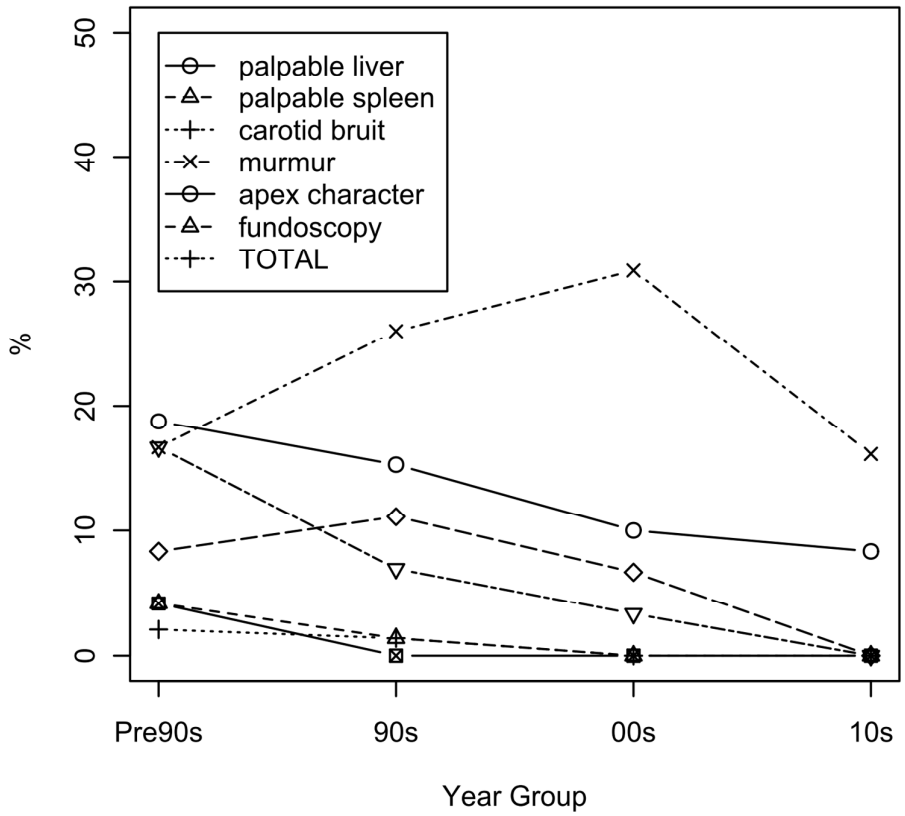

Figure 3b: Percentage of admission notes with positive findings for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

We found that the vast majority of admission notes documented heart rate, with approximately 50% in each year group documenting a heart rate divisible by five and no change over time with respect to the latter ($\chi^2 = 0.8$, df = 1, $p > 0.5$). Statistical analysis was provided by Cochran-Armitage testing, and 95% confidence intervals were used.

Discussion

Our results imply that there has been deterioration in the physical examination skills of junior doctors in Wellington Hospital from 1975 to 2010, after detailed analysis of the medical admission record notes. This is evident from the observed decline in the recorded total number of physical examination observations, total number of body systems examined and the number of recorded observations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character. In the author's opinion, this temporal deterioration could be due to the increased use and availability of complex diagnostic technology [8, 9] as well as the concurrent loss of confidence in physical examination skills. Busy workloads may necessitate substandard physical examinations and the resulting documentation. Low examination skill proficiency after initial training, and little opportunity to improve these skills [6, 7] and the resultant effect on student and teacher confidence further contribute to the demise of clinical examination. Recent anecdotal comments from undergraduate students attached to surgical wards at Wellington Hospital suggest that junior staff transmit a negative view toward the value of physical examination skills, thus creating a 'cyclic' phenomenom of further medical deskilling with each year of medical graduates.

Interestingly there has been no general decline in the examination of the relevant system pertaining to their presenting complaint (RelSystem). It could be argued that the latter

constitutes the 'bare minimum', and hence has suffered less than the other parts of the medical admission record.

We found that registrars recorded 12% fewer total observations than house surgeons. In the authors' opinion, this could be a reflection of the local admission process, for both medical and surgical patients. For many years, it has been the convention in Wellington that registrars assess and diagnose the patient before instigating appropriate initial therapy. Then the team house surgeon is called to finish the 'clerking' process – ie complete the history and examination of the admission, chart the patients medications and fluids etc. This is also the case for elective patients undergoing the preassesment process before their scheduled surgery, where the initial documentation of the patients medical problems is performed by an anaesthetist before the house surgeon interviews the patient. This may not reflect practice in all New Zealand or international hospitals.

It remains unclear why surgical admission notes contain less total observations and number of body systems than their medical counterparts. In the authors' opinion, physicians may arguably take a more holistic approach to their patients, and are hence more likely to examine more body systems and document a greater number of examination findings. The differential diagnoses of medical complaints may be broader than surgical complaints, warranting such a detailed assessment. Junior surgical staff are frequently time pressured as they are often on call for acute assessments, as well as being expected to be in the operating theatre. Surgical house officers are the only staff available to deal with the often complex medical issues in the surgical ward. If this time pressure is indeed a true factor in the declining standards of the surgical admission note,

greater surgical staffing resources could ameliorate this situation. Other measures that may help reduce the workload include the involvement of senior medical staff early in the admission process in managing complex medical problems. This is already occurring in some wards, with Consultant Geriatricians seeing elderly orthopaedic patients with hip fractures soon after admission. Certainly there is consensus regarding the benefits resulting from the routine involvement of an elderly care physician in such circumstances. [24] Many studies have shown shorter hospital stays, reduced mortality, improved placement on discharge although there is conflicting evidence regarding cost-savings. [24] While this apporach may indeed benefit hospitals and orthogeriatric patients, it may result in further clinical deskilling of junior doctors.

Surgical admisssion notes contained less examination of the relevant system pertaining to the persenting complaint compared to medical admission notes. This was especially true in the 2010s year group. In the authors' opinion, this could be again due to the surgical admission process, whereby the surgical registrar assesses the patient (and presumably examines the relevant system) but does not actually complete a full admission note, which is then completed by the surgical house officer. Anecdotal experience shows that in recent years, junior staff completing the admission note often do not feel it is necessary to repeat the examination of the relevant system, especially as further examination of a tender abdomen or fractured limb can cause discomfort. This is borne out by the subgroup analysis finding showing that in the 2010s year group the registrars documented RelSystem in 97% of admissions, compared to 65% of house surgeons.

There were several limitations to our study. These include its retrospective nature, the use of the "surrogate" marker of the medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, database restrictions in the medical records department meant we were only able to request medical admission files from 1998 onwards. The study could have had greater statistical impact if we were able to access large numbers of records from much earlier. We were able to obtain some earlier admission notes, when these were co-filed with more contemporary records, although these were not randomly selected. However these earlier notes were at least 10 years apart from the other records, there was only one older file per patient, and statistical analysis showed no difference in patient age across the year groups. This was single-centre study, hence further research is warranted at other national and international hospitals. Finally, our data was extracted by only one researcher, the first author, however this was closely supervised and verifed by two other researchers.

This is the second study from Wellington Hospital that has identified the declining quality of the hospital admission note with regard to physical examination. A previous Wellington study concluded that there has been a decline in the quality of the surgical house surgeon admission note (SHSurgAdN) when comparing 2005 and 2009 (Morgan TG, Dennet ER. Quality of House Surgeon Acute Surgical Admissions, 2005 vs 2009. (personal communication)). The authors found that the SHSurgAdN was comparatively deficient in the documentation of the relevant system examination and the cardio-respiratory examination, and that this deficiency had worsened over the intervening four years. This study faced similar limitations as the current study, ie it was single-centred, retrospective, the admission note was used as a surrogate for the assessment of the

junior doctors physical examination skills, and the admission process is complicated. However it was well designed and had good power, with 100 admission notes audited in total. This study differed from the current study in that it incorporated a house surgeon questionnaire, with questions on history taking as well as clinical examination. The currrent study involves the investigation of an even greater number of admissions over a longer time period, with more extracted data.

There are potential solutions to halt this decline in physical examination skills. Some local barriers to clinical competence have been identified and ways to improve this deficit have been suggested. [7] In the authors' opinion, these could include increased senior supervision of the admitting process including formative feedback and reflection, as well as a local cultural change enabling house surgeons to initially assess patients while senior staff provide supervision and guidance. This would require increased junior staffing or work-based changes to address workload issues, as well as commitment from senior colleagues to ensure that there is no compromise to patient safety. Finally, international evidence suggests that improved undergraduate curriculum especially bedside teaching and enhanced supervision of new doctors could redirect the current downward trend in physical examination. [6, 8, 10, 11]

During the audit process in this study, there was also significant variation in the history component of the admission note. The history is a vital part of the admission process, and is crucial to diagnostic success. [25, 26] Further research is warranted regarding the adequacy of history taking as evidenced by the admission record.

Competing interest statement: All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

- **Authorship and Contributorship statement:** The authors listed have made significant contributions to this paper. First author Ms. Oliver was involved in the extraction and processing of data, data analysis and interpretation, literature search, discussion points and initial draft formation. Second and corresponding author Dr Hunter is not only involved in an administrative and communication capacity but has contributed significantly with respect to study design, data extraction and analysis, interpretation and statistical analysis, literature search, and final paper revisions. Third author Dr Takayoshi is responsible for the statistical analysis and figures. Last author Associate Professor Galletly designed the study and was involved in the extraction of the data, interpretation of the data and critical review of the publication.

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Junior doctor skill in the art of physical examination: A retrospective study of the medical admission note over four decades

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Abstract.

Objectives To investigate the hypothesis that junior doctors' examination skills are deteriorating by assessing the medical admission note examination record.

Design Retrospective study of the admission record.

Setting Tertiary care hospital.

Methods: The admission records of 266 patients admitted to Wellington hospital between 1975 and 2011 were analysed, according to the total number of physical examination observations (PEOtot), examination of the relevant system pertaining to the presenting complaint (RelSystem), and the number of body systems examined (Nsystems). Subgroup analysis proceeded according to admission year, level of experience of the admitting doctor (registrar, house surgeon (HS) and trainee intern (TI)) and medical versus surgical admission notes. Further analysis investigated the trend over time in documentation with respect to cardiac murmurs, palpable liver, palpable spleen, carotid bruit, heart rate, fundoscopy, and apex beat location and character.

Results: PEOtot declined by 34% from 1975 to 2011. Surgical admission notes had 21% fewer observations than medical notes.

RelSystem occurred in 94% of admissions, with no decline over time. Medical notes documented this more frequently than surgical notes (98% and 86% respectively). There were no differences between registrars and HS, except for the 2010s subgroup (97% and 65% respectively).

Nsystems declined over the study period. Medical admission notes documented more body systems than surgical notes. There were no differences between registrars, house surgeons and trainee interns.

Fewer examinations were performed for palpable liver, palpable spleen, cardiac murmur and apex beat location and character over the study period. There was no temporal change in the positive findings of these observations or heart rate rounding.

Conclusions: There has been a decline in the admission record at Wellington hospital between 1975 and 2011, implying a deterioration in local doctors' physical examination skills. Measures to counter this trend are discussed.

Article Summary

Article focus

- There is well-documented international evidence supporting a declining standard in junior doctor physical examination skills in recent years.
- This study was conducted to address the research question that this deterioration has occurred locally in Wellington, New Zealand.

Key messages

- There has been a decline in the quantity and quality of the medical admission note examination records in this tertiary care centre between 1975 and 2011, which implies a decline in the examination skills of local junior doctors.
- Measures to address this decay in clinical ability include improved undergraduate curriculum, greater supervision of junior doctors, greater involvement of junior doctors in the admission process and increased staffing levels.

Strengths and limitations of this study

- This is a significant study involving large numbers of patient admission records over a substantial period of time (358 patient records over four decades) with a multitude of statistically robust outcome measures analysed.
- Our study is limited due to its retrospective nature, single-centre study, the use of the "surrogate" marker of the written medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, the data was extracted by only one researcher.

Introduction.

Thoughtful history taking and physical examination are recognised as fundamental to the practice of medicine. [1] Moreover, physicians rate physical examination as their most valuable skill. [2] It has also been shown that despite the current technology, physical examination remains important due to its diagnostic contribution,[3] positive effect on patient care [4] and cost reduction. [5]

There has been a well recognised international decline in the physical examination skills of doctors. Potential reasons for this deterioration include busy clinical workloads and lack of clinical teaching. [6, 7] However it is generally recognised that the most important influence has been the increased availability of specialised diagnostic equipment. [8, 9] Imaging technology such as ultrasound, CT and MRI have overshadowed the use of physical examination for diagnostic information. [8, 9] Although adding enormously to the cost of health care, these investigations are seen to be more accurate and less liable to litigation, than the more subjective art of physical examination. [8, 9] It has been argued that the overuse of this technology has also helped to erode the teaching and skill in physical diagnosis [8, 10] and that it may be undermining the value of these skills. [4] This is further impacted by the shift away from bedside teaching and supervision of physical examination skills during undergraduate years and early years of practice. [6, 10, 11] In the United States bedside teaching has fallen from 75% of clinical teaching in the 1960s [10] to 8-19% of clinical teaching in 2008. [12] Thus there are significant changes required from both the medical school and

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The medical record is a tool for communication between multiple health professionals, facilitating continuity of care and good patient management. [13] There have been a number of studies referencing the importance of the quality of the medical record. [14-19] The medical record is also a legal document and as such deserves the appropriate time and attention to ensure it is "comprehensive and accurate". [13] Some studies have looked into ways to improve documentation such as introducing a clinical note header section, [20] education and instruction [21, 22] and structured encounter forms [23] with positive results. There are currently no evidence based standards for best practice concerning adequacy of documentation of physical examination findings for Wellington Hospital, neither are there any clinical guidelines derived from expert opinion. Thus it is difficult to ascertain the expected minimum level of documentation. In order to retrospectively investigate examination practice over time we are reliant on this medical record for our information. The current study is inevitably an investigation into both the skills of doctors and their documentation practices, although our primary hypothesis is that there has been a decline in the standards of junior doctors physical examination skills.

Methods

This retrospective study looked at admission records from patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975

and 2010. The records were randomly selected by National Health Index (NHI) number if the patient had been admitted during this time with certain medical diagnoses, as reflected by the "coding diagnosis" which enables clerical staff to enter the correct computer information about each admission. 1998 was the earliest year for which we could get a random NHI list generated. In this way we obtained 300 sets of patient admission records, 100 from 1998, 100 from 2000 and 100 from 2010, from the medical records department at Wellington Hospital. Out of each set of 100 records there were 50 general medical and 50 surgical admissions. The medical coding diagnoses were pneumonia, congestive heart failure, shortness of breath or chest pain. The surgical coding diagnoses were inguinal hernia, appendicitis, abdominal pain, fractured neck of femur or bowel obstruction. Many of these medical files included records from previous admissions to hospital. We included these older admission notes if they had been coded with the aforementioned diagnoses, and if there was at least 10 years temporal separation from the randomly selected admission and we used only one older admission per patient. Strict patient and staff confidentiality was maintained at all times.

Comment [SH1]: We wanted to get records from 1990, 2000 and 2010 however 1998 was the earliest we could get medical records from using the NHI number . However as explained we were then able to access earlier admission files from within these records, from as far back as 1975, but we only used one old admission file per patient and made sure there was at least 10 years temporal separation from the randomly selected admission. For statistical reasons we then grouped all admission records into pre-1990s, 1990s. 2000's and 2010s.

The admission note from each record was examined and the relevant data was extracted by one researcher, the primary author, with verification and close supervision by two other researchers (the corresponding and final authors). This data was entered into a pre-developed spreadsheet. If there was no admission note, we examined the last documented examination in the emergency department before ward admission. This was generally performed by the registrar of the admitting ward. The data from this examination was then entered as stated previously.

We recorded the total number of physical examination observations (PEOtot) that were documented per admission. We also documented the number of major body systems that had been examined (NSystems). These were defined as the cardiovascular, gastrointestinal, respiratory and central nervous systems. We then noted whether the relevant system pertaining to the presenting complaint had been examined (RelSystem). We then analysed the data in terms of year groups, in order to look for temporal change.

We subsequently analysed the data according to whether it was a medical or surgical admission note, and the level of experience of the admitting doctor (registrars, house surgeons (HS) or trainee interns (TI)) with respect to PEOtot, Nsystems and RelSystem. We also performed year group analysis on these subgroups.

We also investigated whether there was documentation of particular examination observations, positive or negative. These were palpable liver, palpable spleen, carotid bruit, cardiac murmur, apex beat location and character and fundoscopy. We analysed whether the frequency of these documented observations changed over time. Of the admission notes documenting the performance of these examinations, we then examined the frequency of positive findings and any change over time.

Finally we investigated the documentation of heart rate. Of those admission notes with a heart rate value, we analysed the frequency with which the heart rate was given as a value perfectly divisible by five, suggesting a tendency of the admitting doctor toward

rounding the actual value and thus potential inaccuracy. We then examined for a change in this trend over time.

Results.

We examined 358 patient admission records, from 266 patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975 and 2010. For administrative reasons we were unable to obtain 34 of the ordered sets of notes. There was no statistically significant difference in the patients' age between the year groups, after Kruskal-Wallis analysis. A biostatistician performed all analyses.

Comment [SH2]: This was indeed Dr Takayoshi

As evidenced by the documentation in the hospital record admission notes, there has been a statistically significant decrease (34%) in the total number of physical examination observations per admission (PEOtot) from 1975 to 2011 ($p<0.001$).). (Figure 1).

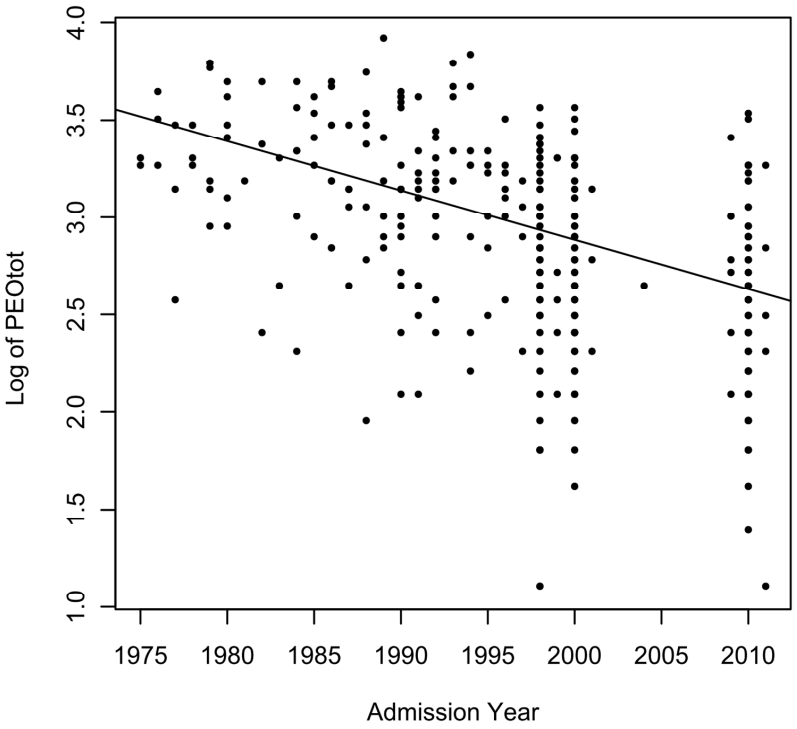

Figure 1: Total number of physical examination observations per admission (PEOtot) versus time.

There were significantly fewer (21%) total observations in surgical admission notes, compared to medical admission notes ($p<0.001$). Registrars recorded 12% fewer total observations compared to house surgeons ($p<0.001$). Statistical significance with respect to admission year group, specialty and level of experience of the admitting doctor in terms of predicting PEOtot was achieved by using the Wald χ^2 test. PEOtot was analysed as a negative binomial regression model (overdispersed data) by rendering the 'admission year' as a continuous variable and the 'admission ward' and 'doctor level of experience' as categorical variables.

With respect to the examination of the relevant system pertaining to the presenting complaint (RelSystem), we have found that this occurred in 94% of all admission notes (95%C.I.) and there was no statistically significant change over time ($p<0.1$). There was however a significant difference according to specialty, with surgical doctors less likely to have examined RelSystem compared to their medical counterparts (86% vs 98% respectively, $p<0.001$). Further subanalysis of specialty and RelSystem with respect to year group showed no statistically significant differences except for the 2010s, in which 25% of surgical admissions did not record examination of the relevant system compared with 3% of medical admissions ($p<0.05$); (pre 1990s ($p>0.05$), 1990s ($p<0.1$) 2000s ($p<0.1$)).

There was no statistically significant difference overall between examination of the relevant system pertaining to their presenting complaint (RelSystem) with respect to level of experience of admitting doctor (registrar, house surgeon and trainee intern) ($p<0.01$). Further analysis by year groups shows a difference only for the 2010s, in which registrars documented RelSystem in 97% of admissions compared to 65% of house surgeons ($p<0.005$).

The total number of body systems examined (Nsystems) significantly declined over the study period, with a change of 1.184 mean body systems ($p<0.001$). (Figure 2).

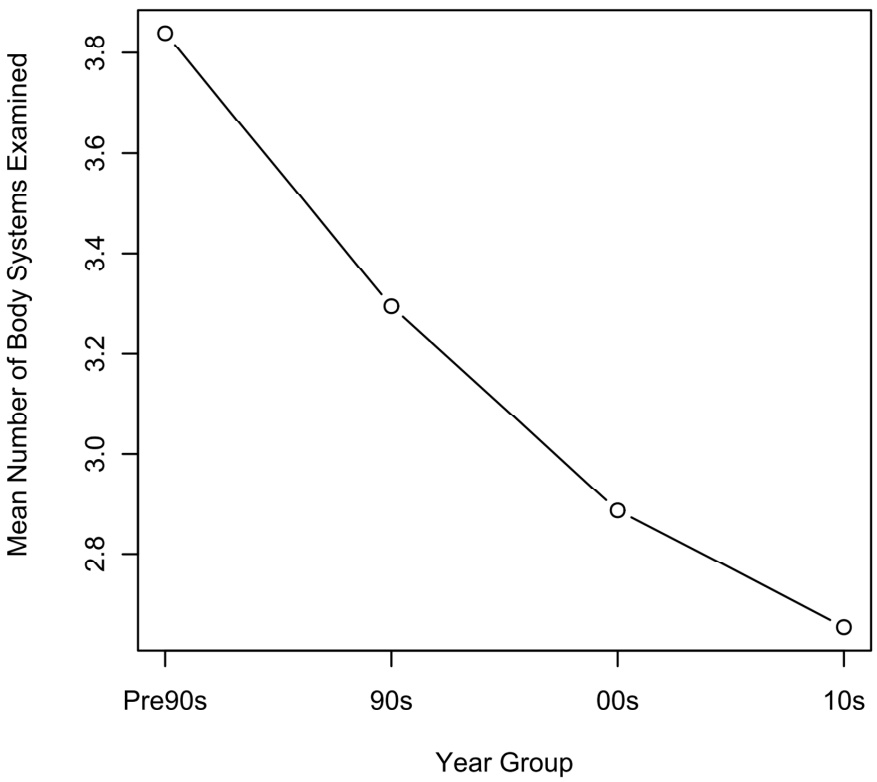

Figure 2: Mean number of body systems examined per year group.

The most commonly omitted body system was the central nervous system, across all the year groups.

There was a significant difference according to specialty between medical and surgical admissions, with surgical doctors examining less Nsystems than physicians ($p<0.01$). There were no significant differences between specialty within each of the year groups ($p<0.1$). With respect to the level of experience of the admitting doctor, there were no significant differences in Nsystems ($p>0.5$) or within year groups ($p<0.1$).

There was a significant decline over the study period in the percentage of admission notes with recorded examinations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character (χ^2 = 51.3, 47.8, 32.0, and 57.9, respectively, df = 1, $p < 0.001$). Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. There was no significant change in the frequency of recorded examinations for carotid bruits ($\chi^2 = 0.4$, df = 1, $p > 0.5$)). There was no year goup analysis performed for fundoscopy, as this was only documented in the pre 90s year group.). (Figure 3a)

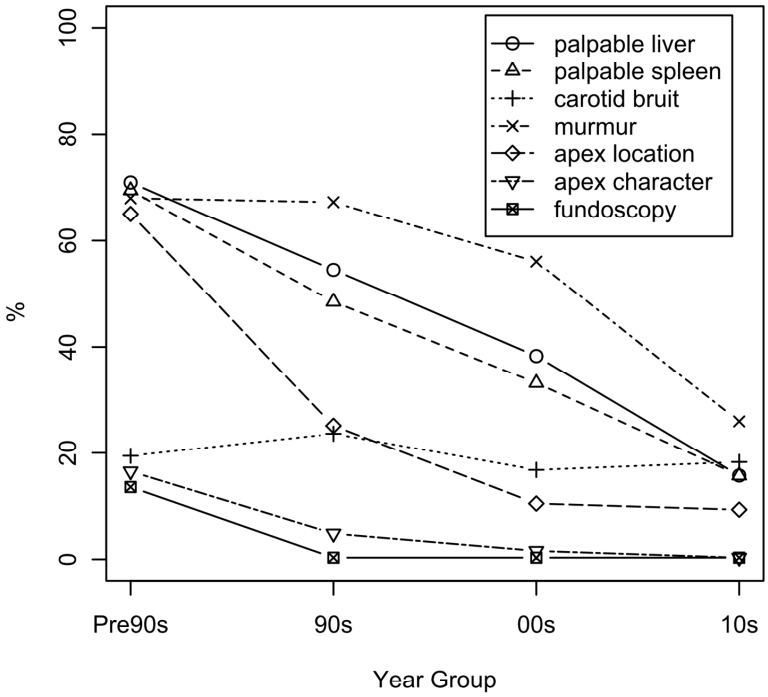

Figure 3a: Percentage of admission notes with recorded examinations for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

There were no changes over time with respect to positive cardiac murmur, palpable liver, palpable spleen, carotid bruit, and apex beat location and character ($\chi^2 = 0.01$, df = 1, $p > 0.5$ for cardiac murmur; $\chi^2 = 1.5$, 1.8, 1.7, 0.2, and 0.5 respectively, df = 1, $p > 0.5$ for the rest). This is probably due to the low frequency of positive findings within each of the year groups. Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. (Figure 3b).

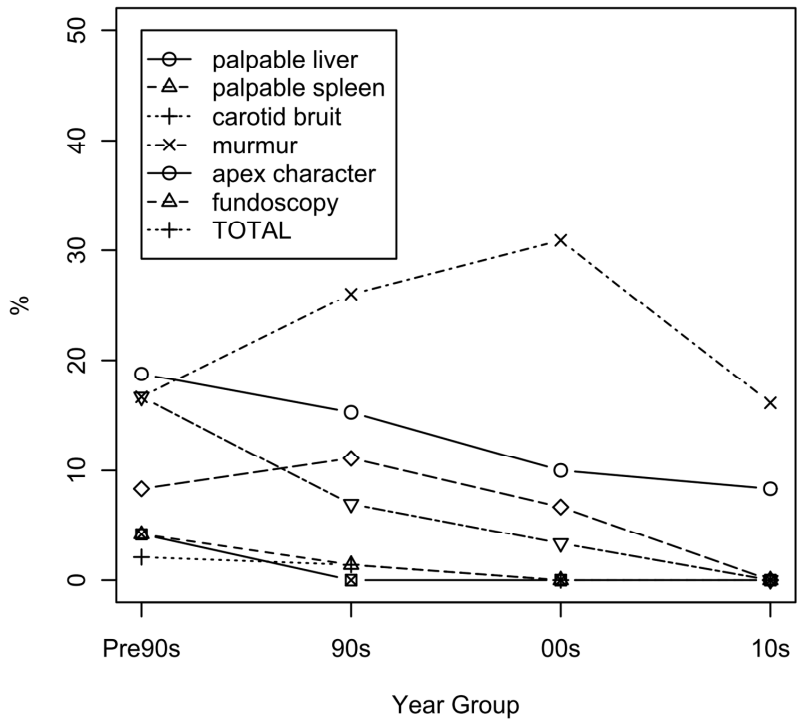

Figure 3b: Percentage of admission notes with positive findings for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

We found that the vast majority of admission notes documented heart rate, with approximately 50% in each year group documenting a heart rate divisible by five and no change over time with respect to the latter ($\chi^2 = 0.8$, df = 1, $p > 0.5$). Statistical analysis was provided by Cochran-Armitage testing, and 95% confidence intervals were used.

Discussion

Our results imply that there has been deterioration in the physical examination skills of junior doctors in Wellington Hospital from 1975 to 2010, after detailed analysis of the medical admission record notes. This is evident from the observed decline in the recorded total number of physical examination observations, total number of body systems examined and the number of recorded observations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character. In the author's opinion, this temporal deterioration could be due to the increased use and availability of complex diagnostic technology [8, 9] as well as the concurrent loss of confidence in physical examination skills. Busy workloads may necessitate substandard physical examinations and the resulting documentation. Low examination skill proficiency after initial training, and little opportunity to improve these skills [6, 7] and the resultant effect on student and teacher confidence further contribute to the demise of clinical examination. Recent anecdotal comments from undergraduate students attached to surgical wards at Wellington Hospital suggest that junior staff transmit a negative view toward the value of physical examination skills, thus creating a 'cyclic' phenomenom of further medical deskilling with each year of medical graduates.

Interestingly there has been no general decline in the examination of the relevant system pertaining to their presenting complaint (RelSystem). It could be argued that the latter

constitutes the 'bare minimum', and hence has suffered less than the other parts of the medical admission record.

We found that registrars recorded 12% fewer total observations than house surgeons. In the authors' opinion, this could be a reflection of the local admission process, for both medical and surgical patients. For many years, it has been the convention in Wellington that registrars assess and diagnose the patient before instigating appropriate initial therapy. Then the team house surgeon is called to finish the 'clerking' process – ie complete the history and examination of the admission, chart the patients medications and fluids etc. This is also the case for elective patients undergoing the preassesment process before their scheduled surgery, where the initial documentation of the patients medical problems is performed by an anaesthetist before the house surgeon interviews the patient. This may not reflect practice in all New Zealand or international hospitals.

It remains unclear why surgical admission notes contain less total observations and number of body systems than their medical counterparts. In the authors' opinion, physicians may arguably take a more holistic approach to their patients, and are hence more likely to examine more body systems and document a greater number of examination findings. The differential diagnoses of medical complaints may be broader than surgical complaints, warranting such a detailed assessment. Junior surgical staff are frequently time pressured as they are often on call for acute assessments, as well as being expected to be in the operating theatre. Surgical house officers are the only staff available to deal with the often complex medical issues in the surgical ward. If this time pressure is indeed a true factor in the declining standards of the surgical admission note,

greater surgical staffing resources could ameliorate this situation. Other measures that may help reduce the workload include the involvement of senior medical staff early in the admission process in managing complex medical problems. This is already occurring in some wards, with Consultant Geriatricians seeing elderly orthopaedic patients with hip fractures soon after admission. Certainly there is consensus regarding the benefits resulting from the routine involvement of an elderly care physician in such circumstances. [24] Many studies have shown shorter hospital stays, reduced mortality, improved placement on discharge although there is conflicting evidence regarding cost-savings. [24] While this apporach may indeed benefit hospitals and orthogeriatric patients, it may result in further clinical deskilling of junior doctors.

Surgical admisssion notes contained less examination of the relevant system pertaining to the persenting complaint compared to medical admission notes. This was especially true in the 2010s year group. In the authors' opinion, this could be again due to the surgical admission process, whereby the surgical registrar assesses the patient (and presumably examines the relevant system) but does not actually complete a full admission note, which is then completed by the surgical house officer. Anecdotal experience shows that in recent years, junior staff completing the admission note often do not feel it is necessary to repeat the examination of the relevant system, especially as further examination of a tender abdomen or fractured limb can cause discomfort. This is borne out by the subgroup analysis finding showing that in the 2010s year group the registrars documented RelSystem in 97% of admissions, compared to 65% of house surgeons.

There were several limitations to our study. These include its retrospective nature, the use of the "surrogate" marker of the medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, database restrictions in the medical records department meant we were only able to request medical admission files from 1998 onwards. The study could have had greater statistical impact if we were able to access large numbers of records from much earlier. We were able to obtain some earlier admission notes, when these were co-filed with more contemporary records, although these were not randomly selected. However these earlier notes were at least 10 years apart from the other records, there was only one older file per patient, and statistical analysis showed no difference in patient age across the year groups. This was single-centre study, hence further research is warranted at other national and international hospitals. Finally, our data was extracted by only one researcher, the first author, however this was closely supervised and verifed by two other researchers.

This is the second study from Wellington Hospital that has identified the declining quality of the hospital admission note with regard to physical examination. A previous Wellington study concluded that there has been a decline in the quality of the surgical house surgeon admission note (SHSurgAdN) when comparing 2005 and 2009 (Morgan TG, Dennet ER. Quality of House Surgeon Acute Surgical Admissions, 2005 vs 2009. (personal communication)). The authors found that the SHSurgAdN was comparatively deficient in the documentation of the relevant system examination and the cardio-respiratory examination, and that this deficiency had worsened over the intervening four years. This study faced similar limitations as the current study, ie it was single-centred, retrospective, the admission note was used as a surrogate for the assessment of the

junior doctors physical examination skills, and the admission process is complicated. However it was well designed and had good power, with 100 admission notes audited in total. This study differed from the current study in that it incorporated a house surgeon questionnaire, with questions on history taking as well as clinical examination. The currrent study involves the investigation of an even greater number of admissions over a longer time period, with more extracted data.

There are potential solutions to halt this decline in physical examination skills. Some local barriers to clinical competence have been identified and ways to improve this deficit have been suggested. [7] In the authors' opinion, these could include increased senior supervision of the admitting process including formative feedback and reflection, as well as a local cultural change enabling house surgeons to initially assess patients while senior staff provide supervision and guidance. This would require increased junior staffing or work-based changes to address workload issues, as well as commitment from senior colleagues to ensure that there is no compromise to patient safety. Finally, international evidence suggests that improved undergraduate curriculum especially bedside teaching and enhanced supervision of new doctors could redirect the current downward trend in physical examination. [6, 8, 10, 11]

During the audit process in this study, there was also significant variation in the history component of the admission note. The history is a vital part of the admission process, and is crucial to diagnostic success. [25, 26] Further research is warranted regarding the adequacy of history taking as evidenced by the admission record.

Competing interest statement: All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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Authorship and Contributorship statement: The authors listed have made significant contributions to this paper. First author Ms. Oliver was involved in the extraction and processing of data, data analysis and interpretation, literature search, discussion points and initial draft formation. Second and corresponding author Dr Hunter is not only involved in an administrative and communication capacity but has contributed significantly with respect to study design, data extraction and analysis, interpretation and statistical analysis, literature search, and final paper revisions. Third author Dr Takayoshi is responsible for the statistical analysis and figures. Last author Associate Professor Galletly designed the study and was involved in the extraction of the data, interpretation of the data and critical review of the publication.

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Junior doctor skill in the art of physical examination: A retrospective study of the medical admission note over four decades

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Abstract.

Objectives To investigate the hypothesis that junior doctors' examination skills are deteriorating by assessing the medical admission note examination record.

Design Retrospective study of the admission record.

Setting Tertiary care hospital.

Methods: The admission records of 266 patients admitted to Wellington hospital between 1975 and 2011 were analysed, according to the total number of physical examination observations (PEOtot), examination of the relevant system pertaining to the presenting complaint (RelSystem), and the number of body systems examined (Nsystems). Subgroup analysis proceeded according to admission year, level of experience of the admitting doctor (registrar, house surgeon (HS) and trainee intern (TI)) and medical versus surgical admission notes. Further analysis investigated the trend over time in documentation with respect to cardiac murmurs, palpable liver, palpable spleen, carotid bruit, heart rate, fundoscopy, and apex beat location and character.

Results: PEOtot declined by 34% from 1975 to 2011. Surgical admission notes had 21% fewer observations than medical notes.

RelSystem occurred in 94% of admissions, with no decline over time. Medical notes documented this more frequently than surgical notes (98% and 86% respectively). There were no differences between registrars and HS, except for the 2010s subgroup (97% and 65% respectively).

Nsystems declined over the study period. Medical admission notes documented more body systems than surgical notes. There were no differences between registrars, house surgeons and trainee interns.

Fewer examinations were performed for palpable liver, palpable spleen, cardiac murmur and apex beat location and character over the study period. There was no temporal change in the positive findings of these observations or heart rate rounding.

Conclusions: There has been a decline in the admission record at Wellington hospital between 1975 and 2011, implying a deterioration in local doctors' physical examination skills. Measures to counter this trend are discussed.

Article Summary

Article focus

- There is well-documented international evidence supporting a declining standard in junior doctor physical examination skills in recent years.
- This study was conducted to address the research question that this deterioration has occurred locally in Wellington, New Zealand.

Key messages

- There has been a decline in the quantity and quality of the medical admission note examination records in this tertiary care centre between 1975 and 2011, which implies a decline in the examination skills of local junior doctors.
- Measures to address this decay in clinical ability include improved undergraduate curriculum, greater supervision of junior doctors, greater involvement of junior doctors in the admission process and increased staffing levels.

Strengths and limitations of this study

- This is a significant study involving large numbers of patient admission records over a substantial period of time (358 patient records over four decades) with a multitude of statistically robust outcome measures analysed.
- Our study is limited due to its retrospective nature, single-centre study, the use of the "surrogate" marker of the written medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, the data was extracted by only one researcher.

Introduction.

Thoughtful history taking and physical examination are recognised as fundamental to the practice of medicine. [1] Moreover, physicians rate physical examination as their most valuable skill. [2] It has also been shown that despite the current technology, physical examination remains important due to its diagnostic contribution,[3] positive effect on patient care [4] and cost reduction. [5]

There has been a well recognised international decline in the physical examination skills of doctors. Potential reasons for this deterioration include busy clinical workloads and lack of clinical teaching. [6, 7] However it is generally recognised that the most important influence has been the increased availability of specialised diagnostic equipment. [8, 9] Imaging technology such as ultrasound, CT and MRI have overshadowed the use of physical examination for diagnostic information. [8, 9] Although adding enormously to the cost of health care, these investigations are seen to be more accurate and less liable to litigation, than the more subjective art of physical examination. [8, 9] It has been argued that the overuse of this technology has also helped to erode the teaching and skill in physical diagnosis [8, 10] and that it may be undermining the value of these skills. [4] This is further impacted by the shift away from bedside teaching and supervision of physical examination skills during undergraduate years and early years of practice. [6, 10, 11] In the United States bedside teaching has fallen from 75% of clinical teaching in the 1960s [10] to 8-19% of clinical teaching in 2008. [12] Thus there are significant changes required from both the medical school and

hospital culture regarding physical examination skill acquisition, improvement and retention.

The medical record is a tool for communication between multiple health professionals, facilitating continuity of care and good patient management. [13] There have been a number of studies referencing the importance of the quality of the medical record. [14-19] The medical record is also a legal document and as such deserves the appropriate time and attention to ensure it is "comprehensive and accurate". [13] Some studies have looked into ways to improve documentation such as introducing a clinical note header section, [20] education and instruction [21, 22] and structured encounter forms [23] with positive results. There are currently no evidence based standards for best practice concerning adequacy of documentation of physical examination findings for Wellington Hospital, neither are there any clinical guidelines derived from expert opinion. Thus it is difficult to ascertain the expected minimum level of documentation. In order to retrospectively investigate examination practice over time we are reliant on this medical record for our information. The current study is inevitably an investigation into both the skills of doctors and their documentation practices, although our primary hypothesis is that there has been a decline in the standards of junior doctors physical examination skills.

Methods

This retrospective study looked at admission records from patients admitted to Capital and Coast District Health Board (Wellington and Kenepuru Hospitals) between 1975

and 2010. The records were randomly selected by National Health Index (NHI) number if the patient had been admitted during this time with certain medical diagnoses, as reflected by the "coding diagnosis" which enables clerical staff to enter the correct computer information about each admission. 1998 was the earliest year for which we could get a random NHI list generated. In this way we obtained 300 sets of patient admission records, 100 from 1998, 100 from 2000 and 100 from 2010, from the medical records department at Wellington Hospital. Out of each set of 100 records there were 50 general medical and 50 surgical admissions. The medical coding diagnoses were pneumonia, congestive heart failure, shortness of breath or chest pain. The surgical coding diagnoses were inguinal hernia, appendicitis, abdominal pain, fractured neck of femur or bowel obstruction. Many of these medical files included records from previous admissions to hospital. We included these older admission notes if they had been coded with the aforementioned diagnoses, and if there was at least 10 years temporal separation from the randomly selected admission and we used only one older admission per patient. Strict patient and staff confidentiality was maintained at all times.

The admission note from each record was examined and the relevant data was extracted by one researcher, the primary author, with verification and close supervision by two other researchers (the corresponding and final authors). This data was entered into a pre-developed spreadsheet. If there was no admission note, we examined the last documented examination in the emergency department before ward admission. This was generally performed by the registrar of the admitting ward. The data from this examination was then entered as stated previously.

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rounding the actual value and thus potential inaccuracy. We then examined for a change in this trend over time.

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As evidenced by the documentation in the hospital record admission notes, there has been a statistically significant decrease (34%) in the total number of physical examination observations per admission (PEOtot) from 1975 to 2011 ($p<0.001$).). (Figure 1).

There were significantly fewer (21%) total observations in surgical admission notes, compared to medical admission notes ($p<0.001$). Registrars recorded 12% fewer total observations compared to house surgeons ($p<0.001$). Statistical significance with respect to admission year group, specialty and level of experience of the admitting doctor in terms of predicting PEOtot was achieved by using the Wald χ^2 test. PEOtot was analysed as a negative binomial regression model (overdispersed data) by rendering

the 'admission year' as a continuous variable and the 'admission ward' and 'doctor level of experience' as categorical variables.

With respect to the examination of the relevant system pertaining to the presenting complaint (RelSystem), we have found that this occurred in 94% of all admission notes (95%C.I.) and there was no statistically significant change over time ($p<0.1$). There was however a significant difference according to specialty, with surgical doctors less likely to have examined RelSystem compared to their medical counterparts (86% vs 98% respectively, $p<0.001$)). Further subanalysis of specialty and RelSystem with respect to year group showed no statistically significant differences except for the 2010s, in which 25% of surgical admissions did not record examination of the relevant system compared with 3% of medical admissions ($p<0.05$); (pre 1990s ($p>0.05$), 1990s ($p<0.1$) 2000s ($p<0.1$)).

There was no statistically significant difference overall between examination of the relevant system pertaining to their presenting complaint (RelSystem) with respect to level of experience of admitting doctor (registrar, house surgeon and trainee intern) ($p<0.01$). Further analysis by year groups shows a difference only for the 2010s, in which registrars documented RelSystem in 97% of admissions compared to 65% of house surgeons ($p<0.005$).

The total number of body systems examined (Nsystems) significantly declined over the study period, with a change of 1.184 mean body systems ($p<0.001$). (Figure 2).

The most commonly omitted body system was the central nervous system, across all the year groups.

There was a significant difference according to specialty between medical and surgical admissions, with surgical doctors examining less Nsystems than physicians ($p<0.01$). There were no significant differences between specialty within each of the year groups ($p<0.1$). With respect to the level of experience of the admitting doctor, there were no significant differences in Nsystems ($p>0.5$) or within year groups ($p<0.1$).

There was a significant decline over the study period in the percentage of admission notes with recorded examinations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character ($\chi^2 = 51.3$, 47.8, 32.0, and 57.9, respectively, df = 1, $p < 0.001$). Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. There was no significant change in the frequency of recorded examinations for carotid bruits ($\chi^2 = 0.4$, df = 1, $p > 0.5$)). There was no year goup analysis performed for fundoscopy, as this was only documented in the pre 90s year group.). (Figure 3a)

There were no changes over time with respect to positive cardiac murmur, palpable liver, palpable spleen, carotid bruit, and apex beat location and character ($\chi^2 = 0.01$, df =

1, $p > 0.5$ for cardiac murmur; $\chi^2 = 1.5$, 1.8, 1.7, 0.2, and 0.5 respectively, df = 1, $p > 0.5$ for the rest). This is probably due to the low frequency of positive findings within each of the year groups. Statistical analysis was performed by Cochran-Armitage testing, and 95% confidence intervals were used. (Figure 3b).

We found that the vast majority of admission notes documented heart rate, with approximately 50% in each year group documenting a heart rate divisible by five and no change over time with respect to the latter ($\chi^2 = 0.8$, df = 1, $p > 0.5$). Statistical analysis was provided by Cochran-Armitage testing, and 95% confidence intervals were used.

Discussion

Our results imply that there has been deterioration in the physical examination skills of junior doctors in Wellington Hospital from 1975 to 2010, after detailed analysis of the medical admission record notes. This is evident from the observed decline in the recorded total number of physical examination observations, total number of body systems examined and the number of recorded observations for palpable liver, palpable spleen, cardiac murmur and apex beat location and character. In the author's opinion, this temporal deterioration could be due to the increased use and availability of complex diagnostic technology [8, 9] as well as the concurrent loss of confidence in physical examination skills. Busy workloads may necessitate substandard physical examinations and the resulting documentation. Low examination skill proficiency after initial

training, and little opportunity to improve these skills [6, 7] and the resultant effect on student and teacher confidence further contribute to the demise of clinical examination. Recent anecdotal comments from undergraduate students attached to surgical wards at Wellington Hospital suggest that junior staff transmit a negative view toward the value of physical examination skills, thus creating a 'cyclic' phenomenom of further medical deskilling with each year of medical graduates.

Interestingly there has been no general decline in the examination of the relevant system pertaining to their presenting complaint (RelSystem). It could be argued that the latter constitutes the 'bare minimum', and hence has suffered less than the other parts of the medical admission record.

We found that registrars recorded 12% fewer total observations than house surgeons. In the authors' opinion, this could be a reflection of the local admission process, for both medical and surgical patients. For many years, it has been the convention in Wellington that registrars assess and diagnose the patient before instigating appropriate initial therapy. Then the team house surgeon is called to finish the 'clerking' process – ie complete the history and examination of the admission, chart the patients medications and fluids etc. This is also the case for elective patients undergoing the preassesment process before their scheduled surgery, where the initial documentation of the patients medical problems is performed by an anaesthetist before the house surgeon interviews the patient. This may not reflect practice in all New Zealand or international hospitals.

It remains unclear why surgical admission notes contain less total observations and number of body systems than their medical counterparts. In the authors' opinion, physicians may arguably take a more holistic approach to their patients, and are hence more likely to examine more body systems and document a greater number of examination findings. The differential diagnoses of medical complaints may be broader than surgical complaints, warranting such a detailed assessment. Junior surgical staff are frequently time pressured as they are often on call for acute assessments, as well as being expected to be in the operating theatre. Surgical house officers are the only staff available to deal with the often complex medical issues in the surgical ward. If this time pressure is indeed a true factor in the declining standards of the surgical admission note, greater surgical staffing resources could ameliorate this situation. Other measures that may help reduce the workload include the involvement of senior medical staff early in the admission process in managing complex medical problems. This is already occurring in some wards, with Consultant Geriatricians seeing elderly orthopaedic patients with hip fractures soon after admission. Certainly there is consensus regarding the benefits resulting from the routine involvement of an elderly care physician in such circumstances. [24] Many studies have shown shorter hospital stays, reduced mortality, improved placement on discharge although there is conflicting evidence regarding cost-savings. [24] While this apporach may indeed benefit hospitals and orthogeriatric patients, it may result in further clinical deskilling of junior doctors.

Surgical admisssion notes contained less examination of the relevant system pertaining to the persenting complaint compared to medical admission notes. This was especially true in the 2010s year group. In the authors' opinion, this could be again due to the surgical admission process, whereby the surgical registrar assesses the patient (and

presumably examines the relevant system) but does not actually complete a full admission note, which is then completed by the surgical house officer. Anecdotal experience shows that in recent years, junior staff completing the admission note often do not feel it is necessary to repeat the examination of the relevant system, especially as further examination of a tender abdomen or fractured limb can cause discomfort. This is borne out by the subgroup analysis finding showing that in the 2010s year group the registrars documented RelSystem in 97% of admissions, compared to 65% of house surgeons.

There were several limitations to our study. These include its retrospective nature, the use of the "surrogate" marker of the medical record to reflect clinical examination skills, and the confusing admission process, whereby doctors will see a patient but not necessarily "admit" them. In addition, database restrictions in the medical records department meant we were only able to request medical admission files from 1998 onwards. The study could have had greater statistical impact if we were able to access large numbers of records from much earlier. We were able to obtain some earlier admission notes, when these were co-filed with more contemporary records, although these were not randomly selected. However these earlier notes were at least 10 years apart from the other records, there was only one older file per patient, and statistical analysis showed no difference in patient age across the year groups. This was single-centre study, hence further research is warranted at other national and international hospitals. Finally, our data was extracted by only one researcher, the first author, however this was closely supervised and verifed by two other researchers.

This is the second study from Wellington Hospital that has identified the declining quality of the hospital admission note with regard to physical examination. A previous Wellington study concluded that there has been a decline in the quality of the surgical house surgeon admission note (SHSurgAdN) when comparing 2005 and 2009 (Morgan TG, Dennet ER. Quality of House Surgeon Acute Surgical Admissions, 2005 vs 2009. (personal communication)). The authors found that the SHSurgAdN was comparatively deficient in the documentation of the relevant system examination and the cardio-respiratory examination, and that this deficiency had worsened over the intervening four years. This study faced similar limitations as the current study, ie it was single-centred, retrospective, the admission note was used as a surrogate for the assessment of the junior doctors physical examination skills, and the admission process is complicated. However it was well designed and had good power, with 100 admission notes audited in total. This study differed from the current study in that it incorporated a house surgeon questionnaire, with questions on history taking as well as clinical examination. The currrent study involves the investigation of an even greater number of admissions over a longer time period, with more extracted data.

There are potential solutions to halt this decline in physical examination skills. Some local barriers to clinical competence have been identified and ways to improve this deficit have been suggested. [7] In the authors' opinion, these could include increased senior supervision of the admitting process including formative feedback and reflection, as well as a local cultural change enabling house surgeons to initially assess patients while senior staff provide supervision and guidance. This would require increased junior staffing or work-based changes to address workload issues, as well as commitment from senior colleagues to ensure that there is no compromise to patient

safety. Finally, international evidence suggests that improved undergraduate curriculum especially bedside teaching and enhanced supervision of new doctors could redirect the current downward trend in physical examination. [6, 8, 10, 11]

During the audit process in this study, there was also significant variation in the history component of the admission note. The history is a vital part of the admission process, and is crucial to diagnostic success. [25, 26] Further research is warranted regarding the adequacy of history taking as evidenced by the admission record.

Competing interest statement: All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare: no support from any organisation for the submitted work; no financial relationships with any

organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.

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Data Sharing

No additional data available.

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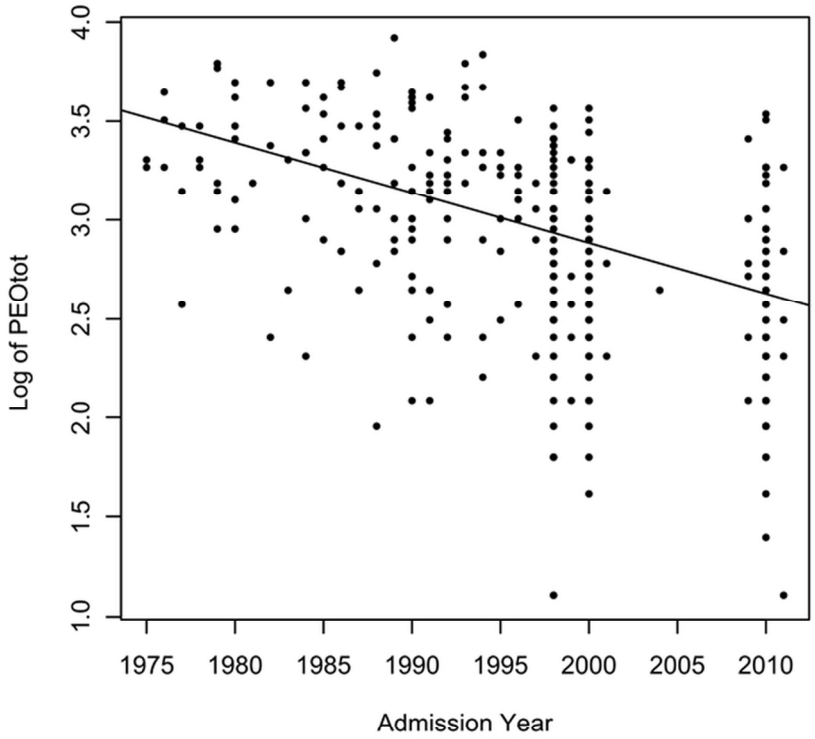

Figure 1: Total number of physical examination observations per admission (PEOtot) versus time.

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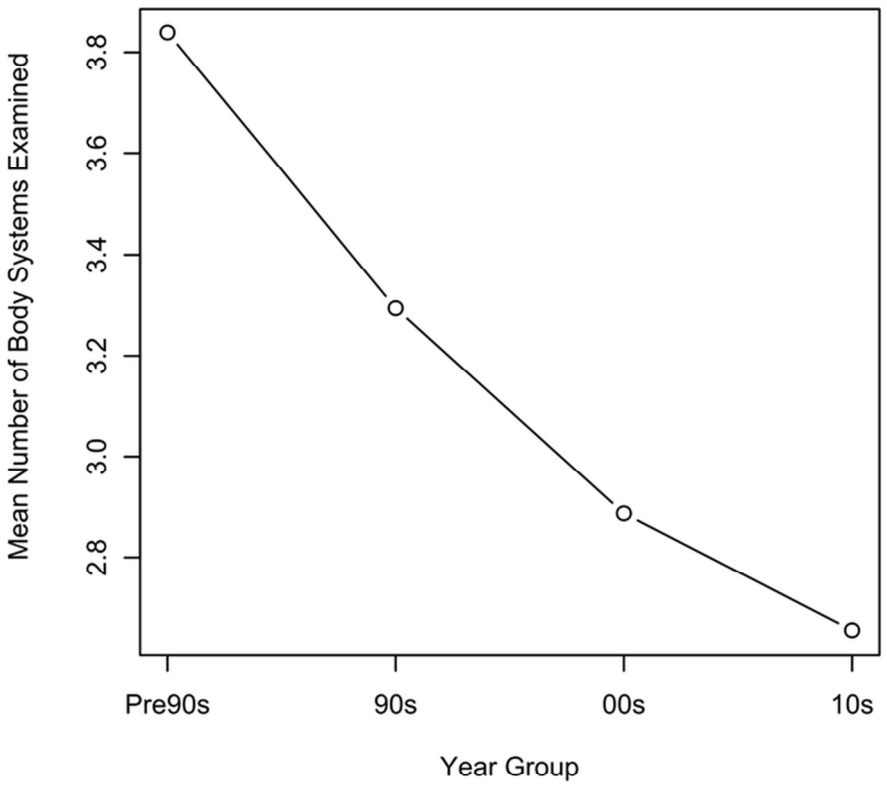

Figure 2: Mean number of body systems examined per year group.

99x90mm (300 x 300 DPI)

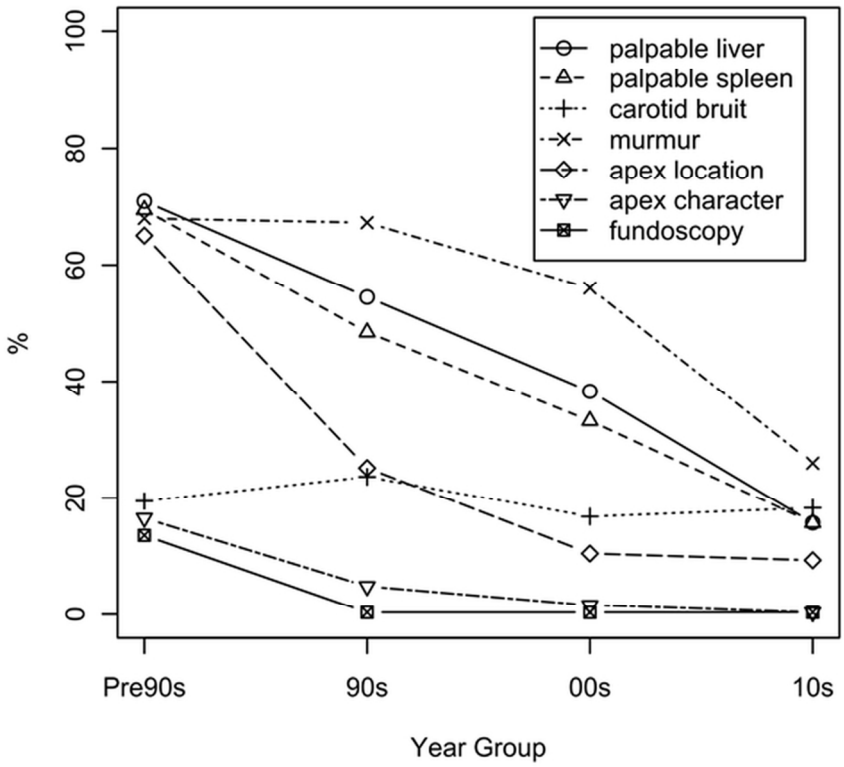

Figure 3a: Percentage of admission notes with recorded examinations for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

93x90mm (300 x 300 DPI)

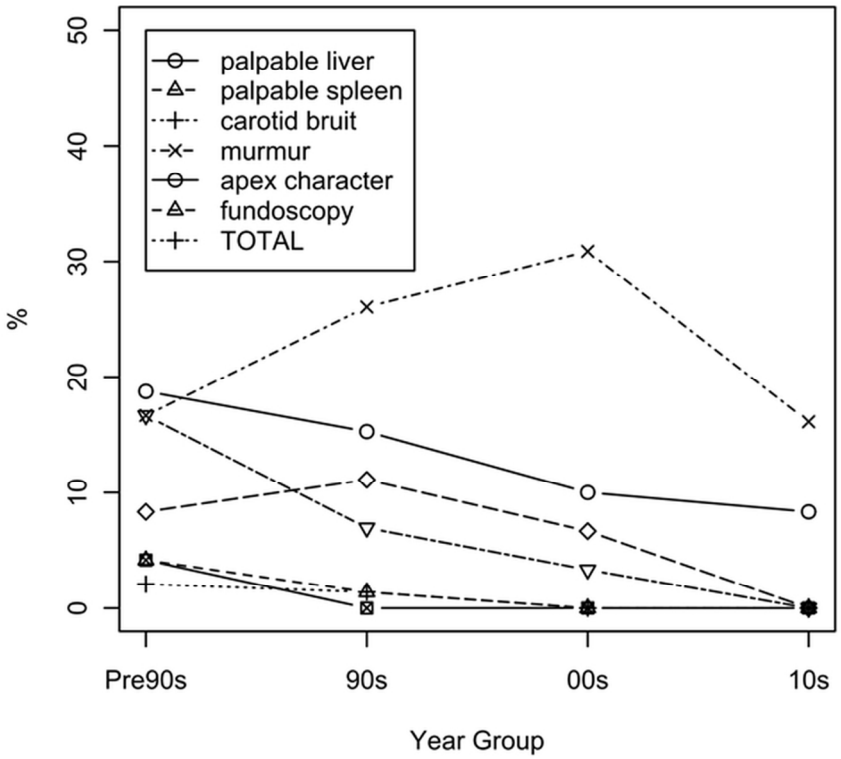

Figure 3b: Percentage of admission notes with positive findings for palpable liver, palpable spleen, carotid bruit, murmur, apex location, apex character and fundoscopy versus year group.

97x90mm (300 x 300 DPI)