Figure 3: Documentation in discharge letter

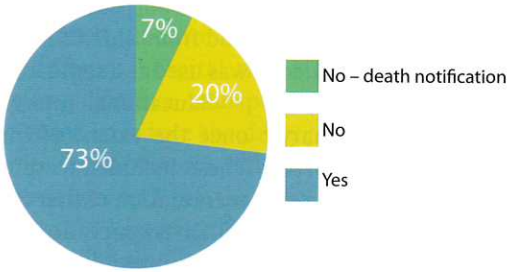
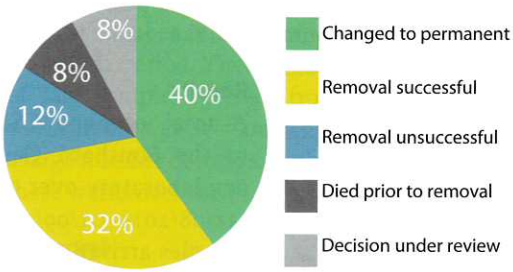


Figure 4: Fate of temporary filters



coming weeks – the outcome of which is not known yet – are discounted).

In the majority (76%) of cases, a discussion with a consultant haematologist on the subject of filter removal was documented. Some of the remainder may have been discussed and not documented, but it is impossible to be sure how many were not recorded due to poor record-keeping. An indication of poor record-keeping can be seen in the 27% of discharge summaries that failed to mention the insertion of a VC filter (20% if death notifications are excluded).

There is some room for improvement: the usual suspects of poor record-keeping and communication are seemingly impossible to eradicate altogether, but the introduction of a VC filter service to ensure clinicians have explored alternatives to VC filters and tracking patients to ensure removals are considered and carried out as early as possible for those patients in whom it is indicated has improved both appropriateness of insertion and the successful removal of temporary filters.

Since over a quarter (27%) of filters were technically impossible to remove when removal was attempted, and a further 18% required more than one attempt at removal before the filter could be successfully retrieved, it is very important to consider the alternatives to insertion.

Conclusion

The filter service and guideline have been instrumental in reducing the number of inappropriate filter insertions and increasing the proportion of temporary filters that are appropriately removed.

Following this audit, a standard operating procedure (SOP) for filter removal was devised to make the process of removal as smooth as the process of insertion has become.

A re-audit of VC filter insertion is suggested for the 12 months following the introduction of this SOP and re-enforcing of the guidelines, which will take place in early 2013.

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Delay in CSF sample delivery: is this a problem?

Background

Accurate cerebrospinal fluid (CSF) cell counts are essential in the management of suspected meningitis, and rapid transportation to the laboratory avoids lysis of cells.[1] CSF are high-value, non-repeatable specimens that involve a degree of patient discomfort with potential complications. Appropriate antibiotic therapy may be delayed with a detrimental effect on patient outcome and poses a significant clinical governance risk.

Objectives

The objectives of this audit were to elucidate:

1. The proportion of CSF samples received >6 hours since time taken to the laboratory.
2. The identification of the department and hospital from which the 'late' samples were received.
3. The month in which most 'late' samples were received and whether this corresponds to new doctors commencing work.
4. The gender of the patients identified as 'late' samples.
5. The time at which 'late' samples were taken and received by the laboratory.
6. The need to be aware of last collection times for specimens from the ward.
7. The effect of educational interventions on the arrival of CSF samples.

Dr Pauline Wright

Design

The number of samples received >6 hours since the time taken to the laboratory was identified over a one-year period (31/08/2010–01/09/2011) at Southern General Hospital and Victoria Infirmary Hospital, Glasgow. The data was further analysed identifying the gender, age, location, time of year and day the samples were taken. The audit standards were based on the criteria that all CSF samples should reach the laboratory within 6 hours of the sample being taken. The samples not processed were labelled with the code 'CC6OLD': cell count not performed as specimens more than 6 hours old.

The audit standards were based on:

- standard operating procedures on CSF samples for South Sector Microbiology Laboratories[1]
- 'Proper handling of CSF specimens before cytological examination'[2]

It has recently emerged that there may be a discrepancy in the validity of the 6-hour collection time. An alteration in the pH of CSF specimens can have an impact on bacterial survival and subsequent cell count results, so ideally CSF samples should be placed in an atmosphere containing 5% CO_2 as soon as possible after collection.[3] However, for the purpose of this audit, the 6-hour cut-off period from time CSF sample taken to time received was used as a standard.

Educational interventions were implemented once the extent of the problem was recognised. These included lectures at FY1 teaching sessions, presentation of first-cycle audit findings at a Medical Division clinical governance meeting and the distribution of guidance notes on 'how to send a CSF sample' appropriately to wards. The audit was repeated post-intervention over a 6-month period and the results analysed as before.

Results

A total of 2556 CSF samples were received to the Southern General Hospital Microbiology laboratory over the initial 12-month period (31/08/2010–01/09/2011). Out of these, 58 (2.3%) samples arrived at the laboratory >6 hours after the sample had been taken. Post intervention, a total of 1310 CSF samples were received by the laboratory over a 6-month period (01/11/2011–30/04/2012) and, of these, 22 (1.68%) arrived >6 hours since sample taken.

The proportion of CSF samples that arrived at the laboratory after 6 hours compared to the total amount of samples received, i.e. 'late' samples, was recorded and further investigated.

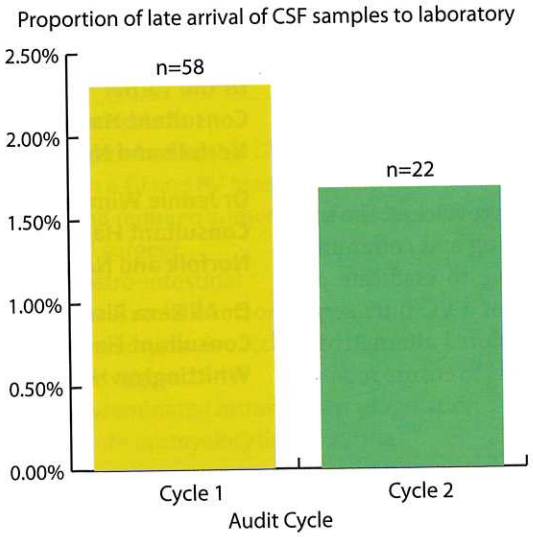

Figure 1: Reduction in the proportion of late CSF samples post intervention

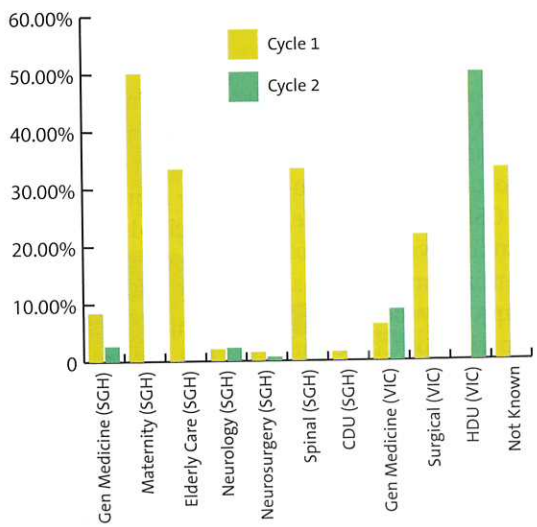

Figure 2: Hospital and ward type from which CSF sample was received >6 hours after collection time as a proportion of total samples received pre and post intervention

Gender

In both cycles of the audit, a higher proportion of CSF samples taken from females was received as 'late' samples compared to males. Overall, the total number of CSF samples taken from females was higher compared to males (1604 versus 950 in cycle 1). This may reflect certain conditions that require lumbar punctures having a predominance in females, such as benign intracranial hypertension, and a higher admission rate in females for headache investigation.

Location

Surprisingly in cycle 1, the greatest proportion of 'late' CSF samples arrived from the maternity ward. This relates to the fact that one out of a total of two samples received over a period of 12 months arrived more than 6 hours since time taken. Similarly only three samples were received over a 12-month period from the spinal ward and one of these arrived 'late', hence giving a higher proportion of the total.

The greatest number of samples arrived, as expected, from the neurology ward, and 2% of the samples arrived at the laboratory 'late' over the initial 12-month period. Post intervention, 2.2% of the total CSF samples arriving from the neurology ward arrived late, hence reflecting no improvement in the accurate sending of CSF samples from this particular ward.

In cycle 1 of the audit, samples arriving from the Victoria Infirmary as a whole accounted for

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26% of 'late' samples; this may relate to the delay in transit time from samples being transferred to a different hospital site. Further education and more effective transport means are therefore needed to reduce the delay in arrival of CSF samples from Victoria Infirmary. Post intervention, however, 27% of the total 'late' samples were from the Victoria Infirmary.

The highest amount of 'late' CSF samples was taken from the neurology ward (17% of total 'late' samples in cycle 1). This was also where the highest number of samples was received over the 12-month period. There was also a large number of 'late' samples received from the neurosurgical wards in both cycle 1 and 2 of the audit, and again a large number of total samples were received from these wards over the 12 months.

Temporal

Figure 3 shows the month of arrival of CSF samples >6 hours after collection time as a proportion of total samples received.

Interestingly, the majority of CSF samples arriving to the laboratory >6 hours since collection time were in the months of August and February. This most likely corresponds to the commencement of new junior doctors on the wards, as this occurs within the first week of August, and a change over of medical staff that takes place in the month of February. It is therefore necessary to target these time periods and perhaps educate doctors and nursing staff on the process of sending CSF samples to the laboratory efficiently, to reduce the number of 'late' samples arriving.

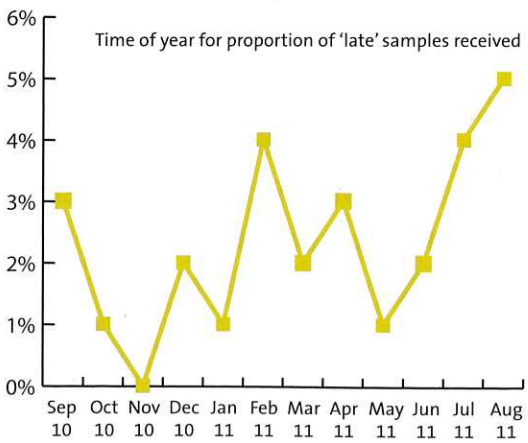
During the six month re-audit period, the highest percentage of 'late' CSF samples arrived during March. Unlike the previous results, this does not coincide with any change of medical staff.

In both audit cycles, the highest number of CSF samples more than 6 hours old arrived in between the hours of 09:00–12:00 (76% of total 'late' samples in cycle 1) to the laboratory. This may relate to the fact that some CSF samples taken overnight were kept and stored on the ward and the porters brought them to the laboratories in the morning during their usual rounds, along with any blood samples, etc. Overall, the highest number of samples arriving to the laboratory was between the hours of 09:00–12:00 (782/2556 in cycle 1), suggesting that most lumbar punctures had taken place in the mornings, perhaps directly after ward rounds. There was a slight improvement in the percentage of samples arriving between 09:00–12:00 post intervention, but not during other points in the day.

Of the 58 'late CSF samples, 16 had unknown collection times; 40 samples were therefore analysed. Most of the 'late' CSF samples on weekdays were taken between the hours of 15:00–17:00 (24% of total 'late' samples). This indicates that the majority of these samples were probably not directly phoned through to microbiology, but probably left to be picked up by the porter the following morning. The last pick-up by the porters for the majority of wards is before 16:00, so any sample taken after 15:00 must be phoned through the laboratory and a porter phoned to transport the sample. At the weekend, all the 'late' samples were taken before 15:00. The lumbar punctures therefore most likely take place after the consultant morning ward rounds. It is essential that at the weekend medical staff are aware that laboratories are still open and that the CSF samples are phoned through and sent via porter as soon as they are taken.

The results from the re-audit are very similar to the pre-intervention audit, with majority of samples being taken 15:00–17:00 on weekdays (23% of total 'late' samples).

Figure 3: Cycle 1



Conclusions

- Certain departments have a greater proportion of late CSF samples than others and therefore need to be targeted with further staff education measures.
- The majority of 'late' samples arrive between 09:00–12:00, suggesting they have been left overnight and picked up the following morning. The importance of phoning laboratories 'out of hours' needs to be emphasised.
- The majority of 'late' CSF samples are taken between 15:00–17:00 during weekdays. This may reflect a portering issue, of samples not being picked up in time and then left to the following morning.
- August is the month in which most 'late' CSF samples are received and this may coincide with the commencement of new doctors on the wards.

Recommendations for improvement

- Educational interventions were implemented upon recognition of the extent of the problem. These included lectures at FY1 teaching sessions (August 2011), presentation of first-cycle audit findings at a clinical governance meeting (October 2011) and the distribution of guidance

notes on 'How to send a CSF sample' appropriately to wards. These should be reiterated to ensure newer junior doctors are aware of the issues regarding late CSF samples.

- Summary sheets (see below) were designed and provided to all wards that are involved in sending CSF samples (August 2011). These can be pinned on the walls and used as an *aide memoire*.
- An NHS DOTS module will be created for junior medical staff, highlighting the process of phoning and sending microbiological specimens during and out of hours. This is currently in progress.

Re-audit

Plan to re-audit in January 2014, to ensure the above interventions have had an impact of reducing late CSF samples.

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Acknowledgements

Special thanks to Jim Lamb and Bill Cowan.

References

1. *Standard operating procedures on CSF samples for South Sector Microbiology Laboratories.* 11 July 2011. Authorised by C Stewart.
2. Kluge H *et al.* Proper handling of CSF specimens before cytological examination. In: *Atlas of CSF Serology*, 2007, pp 7–8.
3. Cunniffe J *et al.* Effect of pH changes in cerebrospinal fluid specimens on bacterial survival and antigen test results. *Journal of Clinical Pathology* 1996;49:249–253.

Appendix 1: Audit action plan

An audit on the late arrival of CSF samples to the laboratory

Audit recommendation	Objective	Action	Timescale	Barriers and constraints	Outcome	Monitoring
Reduce the late arrival of CSF samples from the neurology, neurosurgical and general medical wards in particular	Try to reduce the proportion of late CSF samples to <1%	Educational interventions by presentation, DOPS modules and summary sheets	9 months	Transport barriers, i.e. time taken to taxi, targeting new doctors as constantly changing over		
Prevent CSF samples being left overnight for next day collection	Completely stop CSF samples from being left overnight	Educational interventions by presentation, DOPS modules and summary sheets	9 months	Educational interventions may not target all individuals		
Ensure junior doctors in particular are aware about the protocol of sending a CSF sample	Teach all junior medical doctors early in their training the procedure to follow when sending a CSF sample	Teaching should be targeted to August	6 months	Educational interventions may not target all individuals also individuals may forget and need reminders		

Appendix 2
CSF samples: Microbiology, Southern General Hospital and Victoria Infirmary Hospital

Introduction

The prompt arrival of CSF samples at the microbiology laboratory is essential for a cell count, particularly for the acute management of patients with suspected meningitis. Accurate cell count and analysis of CSF cannot be undertaken on samples MORE THAN 6 HOURS OLD.

Audit findings

- A total of 2556 CSF samples arrived to microbiology laboratory over 12-month period from 31/08/2011 to 01/09/2011 and, of these, 58 (2.3%) arrived more than 6 hours since time collected.
- Highest number of 'late' samples taken from NEUROLOGY (17% of total 'late' samples) and NEUROSURGERY (22% of total 'late' samples).
- AUGUST is the month in which most 'late' CSF samples are received (17% of total 'late' samples) and this may coincide with the commencement of new doctors on the wards.
- The majority of 'late' samples arrive between 09:00–12:00 (76% of total 'late' samples), suggesting they are have been left overnight and picked up the following morning.
- The majority of 'late' CSF samples are taken between 15:00–17:00 during weekdays (24% of total 'late' samples).

Guidance on sending CSF specimens to the bacteriology

For full guidance on sending specimens to the laboratory, including how to fill out the request form, please visit: www.staffnet.ggc.scot.nhs.uk/Acute/Diagnostics/All%20Laboratory%20Medicine/Microbiology/BacteriologySGH/Pages/Bacteriology%20Department%20SGH.aspx

1. Collect at least 0.5 ml CSF fluid and put into three white-topped bottles if possible, using strict aseptic technique, labelling specimens with patient details.
2. Fill out bacteriology request form with all relevant details (as per user manual), INCLUDING DATE AND TIME SAMPLE TAKEN and any relevant CLINICAL DETAILS (*anti-microbial treatment*, allergy to antibiotics, site sampled, history of foreign travel, date of onset and duration of illness).
3. During normal laboratory hours (Monday–Friday, 8:45–17:00) PHONE THE MICROBIOLOGY department (61701) to ensure priority processing. Send sample via PORTER urgently.
4. For samples from Victoria Infirmary campus, contact porters and inform that is urgent/emergency sample and requires immediate delivery to microbiology at SGH. Arrange taxi via switchboard for collection of specimen.
5. For out-of-hours, CONTACT THE ON-CALL BMS (biomedical scientist) for SGH via switchboard and inform them of urgent sample.
6. Results of these specimens will then be phoned back to the ward/requestor as appropriate.

Clinical audit templates

Clinical audit templates on a range of topics in cellular pathology are now available online. These templates provide a step-by-step guide to planning an audit. All the templates can be downloaded and adapted for local or individual use from www.rcpath.org/clinical-effectiveness/clinical-audit/clinical-audit-templates

For further information please contact Maria Marrero Feo, Senior Clinical Effectiveness Coordinator, on maria.marrero@rcpath.org