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Using a simple handover to improve the timing of gentamicin levels

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Abstract

The aminoglycoside gentamicin is commonly used in many NHS trusts to cover gram negative organisms in intra-abdominal sepsis and sepsis of unknown origin. As a result it often forms an important part of thew "Sepsis 6" protocol on surgical wards. Despite it's effectiveness, the antibiotic is well known to have nephrotoxic and ototoxic side effects, making monitoring of serum levels vital. In Hairmyres Hospital, a busy district general hospital in Lanarkshire, levels are typically taken at six to 14 hour post-dose intervals, with the result guiding further gentamicin dosing.

A baseline measurement was performed highlighting that 42.2% of these levels were taken after the 14 hour limit. This was thought to have serious implications for patient's, as levels designed to protect them from side effects whilst maintain g an effective antimicrobial action were not being performed properly. As a result, a "gentamicin handover" was introduced to the wards in order to ease the workload on junior staff and improve handover between teams.

During our short project the number of late levels initially dropped to 33.3% after one week, falling further to 28.6% following the second week of intervention. From our results it is clear that while more intervention is required gentamicin prescription, this project highlights how a simple intervention to improve ward handover can create a very noticeable improvement in the quality of patient care within a small time period.

Problem

Within the surgical department of our small, yet very busy district hospital, gentamicin is used frequently among both acute admissions and down stream patients suffering from intra-abdominal sepsis and sepsis of unknown origin. Gentamicin dosing within the hospital is completed with an online calculator which takes into account the patient's ideal weight, height, creatinine clearance, and age. This gives staff a recommended single dose to be delivered at 24 or 48 hourly intervals. In addition to this, adequate dosing and potential side effects of gentamicin are avoided by taking serum levels that help determine the patient's ability to clear the antibiotic. It is recommended that these levels are taken at a six to 14 hour window in order to gain an adequate reflection of the patient's clearance.

Within our hospital, gentamicin serum levels are usually the responsibility of junior medical staff. Unfortunately the time frame of these levels often makes it difficult to administer gentamicin, take an appropriate blood sample, and prescribe the antibiotic within a single shift. This means that this process is often spread across day, evening, and night staff, and regardless of verbal handover this can often result in levels taken out-with the six to 14 hour window, often causing instances of late, and in rare occasions, missed doses of gentamicin.

Background

Gentamicin is a renally excreted aminoglycoside antibiotic commonly used to cover gram negative bacterial infections. It is often delivered intravenously within the surgical wards of many NHS trusts to treat intra-abdominal sepsis, upper urinary tract sepsis and sepsis of unknown origin and is thus a key feature of the "Sepsis 6" protocol outlined by the Surviving Sepsis Campaign.[1] Despite it's effectiveness, gentamicin is known to have severe ototoxic and nephrotoxic properties. These side effects can be exacerbated by a patient's age, renal function, weight, concurrent drug therapies, and certain comorbidities. As a result, gentamicin is typically prescribed as a single daily dose, which is individually calculated according to a patient's age, weight, height, gender and creatinine clearance. In addition, daily serum levels must be taken and the dosing regimen adjusted accordingly, in order to maintain both a both an adequate dose to combat infection and to avoid the onset of potentially severe side effects such as ototoxicity and acute kidney injury.[2]

It has been documented that collection of accurate gentamicin levels can prove difficult in practice, particularly on very busy, high turnover surgical wards. Previous quality projects gave improved the prescription of gentamicin by implementing an online calculator.[3] While our trust already utilises an online calculator for initial prescription, it has become clear that more intervention is needed to provide effective patient care.

Baseline measurement

In order to determine our current gentamicin level practices, data were gathered across our three surgical wards; surgical receiving, vascular, and general surgery. As a baseline measurement, all patient's who had their gentamicin doses calculated for the treatment of sepsis using the online calculator were included regardless of the infection's origin. However, patients who only received a single dose of the drug were not included.

Within a two week period, 34 patients (16 male, 18 female) were identified as suitable for inclusion in the project. Parameters recorded included patient demographics, total doses, total levels taken, time of prescription, actual time administered, time of level and whether or not this was compliant with the the six to 14 hour window.

During this period, a total 154 doses of gentamicin were administered and 128 levels were taken. Excluding the initial doses for the 34 patients observed, only 66 out of 120 doses (55%) were administered at the prescribed time. When observing the levels within the six to 14 hour recommended window, 54 out of 128 (42.2%) of levels were taken after 14 hours. When considering the cases of individual patient's it was found nine (26.5%) patients had all of their levels taken on time, while 12 (35.3%) did not have any levels taken within the appropriate time. Significantly, two separate incidents in two different patients noted improper trough measurement lead to missed antibiotic doses.

Design

After consideration of the issues discussed regarding blood levels, it was thought the most appropriate course of action would be to provide more stability among junior staff, who frequently found it difficult to keep track of various patient's and their antibiotics across wards. As a result, a "gentamicin handover" was introduced to the downstream surgical wards, with the intention of recording each patient on a single ward along with both their time of administration and six hour level time, thus providing junior staff unfamiliar with a particular ward clear and easy access to this important piece of patient information.

This intervention was deemed viable as it was designed with simplicity in mind, as junior staff would only require three pieces of information to ensure blood levels were compliant, therefore reducing the overall burden of both paper work and identification of patient's on gentamicin. Conformity with the intervention was further ensured as blank copies of the handover were made accessible alongside the gentamicin prescription forms and were readily available for printing on the wards.

Strategy

PDSA cycle 1. The problem of late gentamicin levels was discussed at the weekly lunchtime meeting with junior staff present. The problem of poor handover was identified and the handover form was agreed as a suitable intervention.

PDSA cycle 2. The handover were placed on the two downstream surgical wards and their use in improving prescribing and patient safety was discussed with the ward staff. An email was sent out containing the relevant information and an attached copy of the handover. Overall use of the handover was found to be high however it was noticed the uptake of the handover was better when a ward had a greater number of patient's on gentamicin. Data were gathered over a week during this cycle using the same baseline measurements are before.

PDSA cycle 3. Following the first cycle feedback was taken from the ward doctors regarding the effectiveness of the handover. The consensus was whilst a handover was a useful prompt to prescribe on time, the high turnover of patient's occasionally made it difficult to keep the form up to date and it would frequently become messy and hard to read because of alterations. Alterations were made and the results of first cycle were discussed with junior doctors, who were encouraged to persist with the handover.

PDSA cycle 4. Once again, the same variables were measured over a week to assess continued use of the form. The handover has continued to be used on the wards and was further modified to improve ease of use according to feedback of junior staff.

Post-measurement

During the first cycle, the prescribing practices on 22 (seven male, 15 female) patient's with a total of 76 doses were observed. Excluding the initial 22 doses, only 24 out of 54 (44.4%) were given on time, immediately highlighting the handover had little effect on administration of the antibiotic. A marked improvement was seen in the number of late levels however, with 21 out of 63 levels (33.3%) taken after 14 hours.

The second data set was composed of 17 patients (11 female, six male) receiving a total of 65 doses. Once again excluding the 17 initial doses, just 27 out of 48 (56.3%) of doses were given on time. Once again some improvement was seen in level times, with just 16 of 56 (28.6%) given after the 14 hour limit. Importantly, during both of the repeat cycles, no incidents of missed doses were reported as seen in the initial baseline measurement.

See supplementary file: ds5602.png - “Table of Results”

Lessons and limitations

The aim of this project was to improve an apparently simple, yet poorly performed ward task within a short four week period with a straightforward yet effective intervention. Lessons learned from this project include:

1. Designing the form with simplicity in mind was essential as it made what was required of the junior doctors immediately clear and also encouraged uptake of the form
2. During the PDSA cycles it became apparent that the handover form would need further adjustments to be more effective for use on wards. This could not have been anticipated in advance and taught us that feedback from staff was essential to quality improvement
3. While the project did show a slight improvement in blood sample levels overall, this did not take into account the direct effect this had on individual patients. If conducted over a longer period of time it would have been interesting to measure the effect this had on ototoxic and nephrotoxic side effects
4. The repeat PDSA cycles did highlight that while the handover improved prescription and levels among junior

doctors, it had little effect on administration by the nurses, and this may have been to the overall detriment of accurate gentamicin levels. It would therefore have been useful to have an intervention that helped ease workload and handover for both medical and nursing staff

5. Due to the short duration of this project, two weeks for baseline measurement and one week each for repeat cycles, we were unable to determine the long term sustainability and effectiveness of the intervention
6. A limitation of our intervention is that it has a narrow focus, benefiting only the small number of patient's on gentamicin. Further development of the handover to include other common ward jobs such as prescription of vancomycin and intravenous fluids would be beneficial in the future.

Conclusion

Prior to our intervention, the timing of gentamicin levels was poorly performed, with 42.2% of levels taken late and two episodes of missed doses were reported. The aim of this project was to ease the workload on junior medical staff and provide accurate, up to date information on patient's and their antibiotics on the downstream surgical wards using a simple intervention and therefore improve gentamicin level timing within just four weeks. Following introduction of our handover, the number of late levels fell to 28.6% and no further missed episodes occurred.

While it is clear further work is still needed, in particular improving administration of the antibiotic, this project shows that improvement in prescription in small, yet very busy surgical wards is very achievable with a simple intervention. Use of the handover has highlighted the accurate conduct of daily ward tasks is vital to overall patient safety and avoidance of unwanted side effects. In the future it may be useful to investigate how measures such as this have a direct effect on the ototoxic and nephrotoxic effects of gentamicin on inpatient populations and how this intervention can be implemented with both medical and nursing teams.

References

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Declaration of interests

Nothing to declare.

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Ethical approval

After consulting West of Scotland Research Ethics service guidelines, ethical approval was not sought as it did not meet the required criteria.