The background image shows the Palmerston North Hospital at dusk. The building is illuminated with warm lights, and its glass facade reflects the sky. In the foreground, a large, multi-tiered sign stands on a grassy area. The sign features the hospital's name in both English and Māori, the address '50 Ruahine street', and a 'smokefree' logo with the text 'Welcome to our Smokefree Hospital' and 'All Buildings and Grounds are smokefree'.

Reducing unnecessary laboratory blood testing in the intensive care unit: a provincial New Zealand perspective

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Introduction

- In the intensive care setting, certain laboratory tests are routinely performed to monitor and respond to the needs of our most unwell
- Inappropriate testing contributes to the significant problem of waste in healthcare
 - Financial cost
 - Labour wastage
 - Potential false positive results and follow-on treatments
 - Iatrogenic anaemia and subsequent transfusion requirements

Because that's how it's always been done

- Daily routine chest x-rays are now considered to be a low-yield and unnecessary test
- However daily or even multiple daily routine blood sampling for laboratory testing remains an entrenched practice in many units
- This was one of the main targets of the The Critical Care Societies Collaborative's "Choosing Wisely" campaign

Don't order diagnostic tests at regular intervals (such as every day), but rather in response to specific clinical questions.

Many diagnostic studies (including chest radiographs, arterial blood gases, blood chemistries and counts and electrocardiograms) are ordered at regular intervals (e.g., daily). Compared with a practice of ordering tests only to help answer clinical questions, or when doing so will affect management, the routine ordering of tests increases health care costs, does not benefit patients and may in fact harm them. Potential harms include anemia due to unnecessary phlebotomy, which may necessitate risky and costly transfusion, and the aggressive work-up of incidental and non-pathological results found on routine studies.

We need to do the tests for patient safety

- Previous studies* have demonstrated that removing long-term standing orders can reduce the number of these routine tests significantly
- This results in substantial cost savings, and often in a reduction in iatrogenic anaemia, without compromising patient safety or impacting patient outcomes
- *Merkeley et al. *J Crit Care* 2016; 31: 212-6.
Le Maguet et al. *Br J Anaesth* 2015;115(6):941-2.
Kumwilasiak et al. *Crit Care Med* 2008;36(11):2993-9.

Population

- Six bed combined intensive care and surgical high dependency unit
- Treats general medical and surgical patients including trauma, as well as haematology/ oncology, some paediatrics (cases of significant acuity are transferred) and O&G
- No neurosurgery or cardiothoracics

Intervention

- In the latter half of 2016 we shifted from “routine” blood testing to set schedules to a clinician directed approach
 - as outlined by consultant on morning ward rounds
- Testing is now performed only when required to answer a clinical question or to change management of a patient
- No admission “battery” of tests

Intervention

- We performed a retrospective observational study of our changes
- Aims:
 - to determine whether shifting from routine to when clinically required blood testing resulted in a lasting reduction in blood tests
 - what the associated cost savings in our ICU were
 - determine if this change impacted on patient morbidity or mortality or other outcomes.

Comparison

- Looked at blood tests and patient outcomes for a three-month period following the practice change and compared this with the same period one year earlier (prior to the change)
- Included all patients admitted to the ICU during the two periods:
1 December 2015 – 28 February 2016
and 1 December 2016 – 28 February 2017

Comparison

- Key measures of improvement:
 - total number of bloods tests ordered (by type)
 - total cost of laboratory blood tests for each period, as well as per patient admission and cost of tests per ICU day in each period
 - ICU LOS
 - ICU and hospital mortality
- Secondary outcomes:
 - units of red blood cells transfused
 - differences in the amount of patients requiring RRT or invasive ventilation

Demographics

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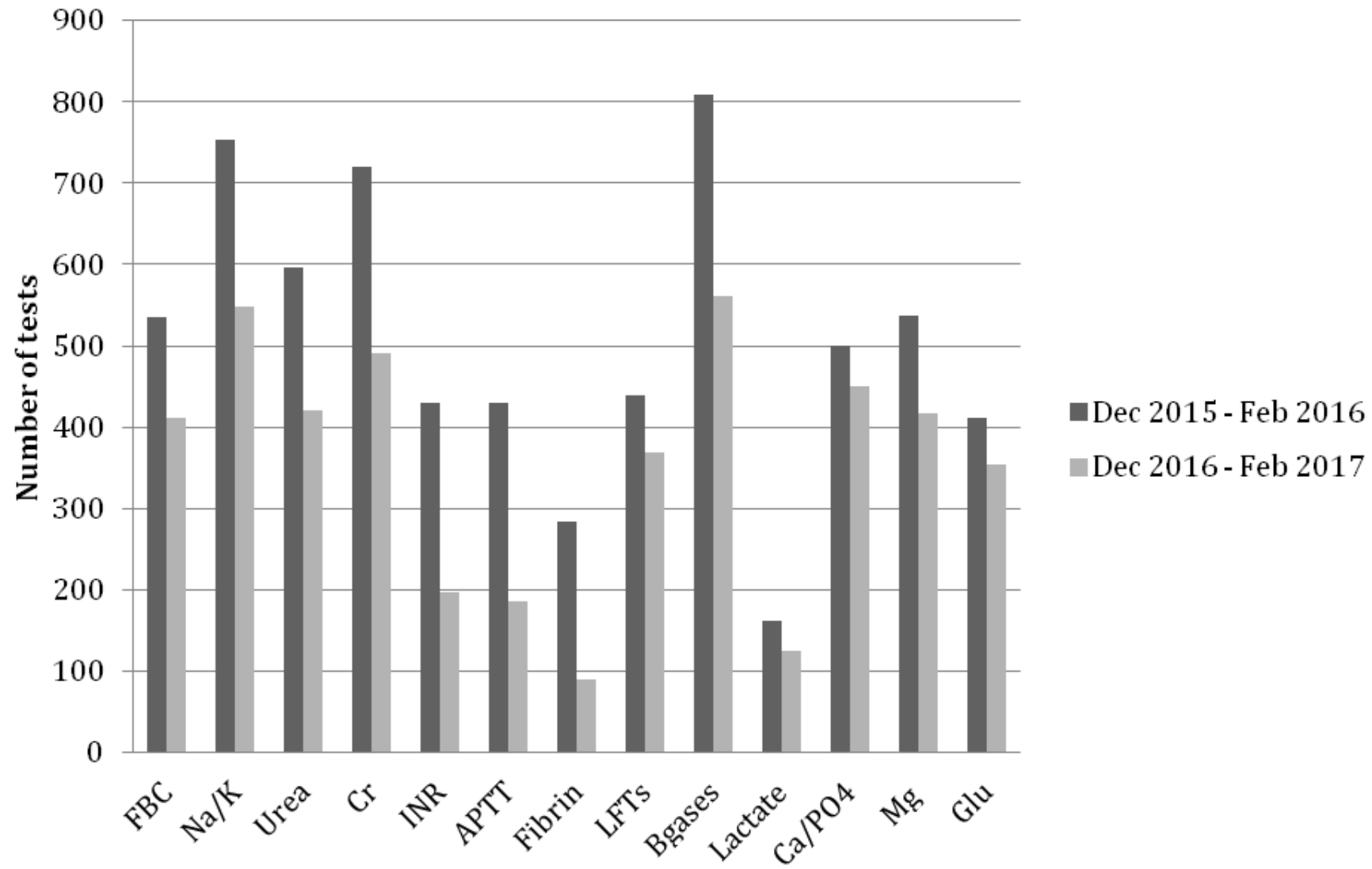
Parameter	Audit	Audit 2
Number of patients/ bed-days	123/435?	122/352?
Admission length <24hrs	48?	45?
Mean ICU LOS (days)	3.54?	2.89?
Mean age (years)	54.5?	54.2?
Gender (% female)	50.4?	45.1?
Admission type, %	?	?
Emergency/ Elective	9/114?	17/105?
Surgical/ Medical	71/52?	66/56?
Paediatric admissions (n)	7?	5?
Mechanical ventilation (%)	29.2?	30.3?
Dialysis in unit (n) CRRT/IHD	7/3?	7/1?
ICU mortality (n)	16*?	17?

	Audit 1	Audit 2	Difference
ICU admissions	123 [?]	122 [?]	1 [?]
ICU patient days	435 [?]	352 [?]	83 [?]
# patients with blood tests <6hrs before admission to ICU	65 [?]	47 [?]	18 [?]
FBC	536 [?]	411 [?]	125 [?]
Electrolytes	753 [?]	548 [?]	205 [?]
Creatinine	720 [?]	490 [?]	230 [?]
LFTs	439 [?]	368 [?]	71 [?]
Ca/PO4	500 [?]	450 [?]	50 [?]
INRs/aPTT/fibrinogen	430/429/283 [?]	197/186/90 [?]	233/243/193 [?]
Blood gases	808 [?]	561 [?]	247 [?]
Units of RBCs transfused/ # of patients transfused	26/10 [?]	25/8 [?]	1 less unit/ 2 less patients transfused [?]
Total laboratory test cost	\$38469 [?]	\$26095 [?]	\$12374 [?]
Average cost per admission	\$312.75 [?]	\$213.90 [?]	\$98.95 [?]
Average cost per patient day	\$88.43 [?]	\$74.13 [?]	\$14.30 [?]

Outcome

- Largest reduction in number of investigations ordered were
Creatinine (mean 6.4 → 4.3 p=0.042)
Electrolytes (mean 6.7 → 4.9 p=0.0886)
Blood gases (mean 7.2 → 5.0 p=0.05)
Coagulation studies (mean 3.8 → 1.7 p=0.0007)
- Moderate reduction in FBCs (at \$12.58 each this led to a reasonable cost saving) – mean 4.8 FBCs per patient pre to 3.7 post (p = 0.1432)

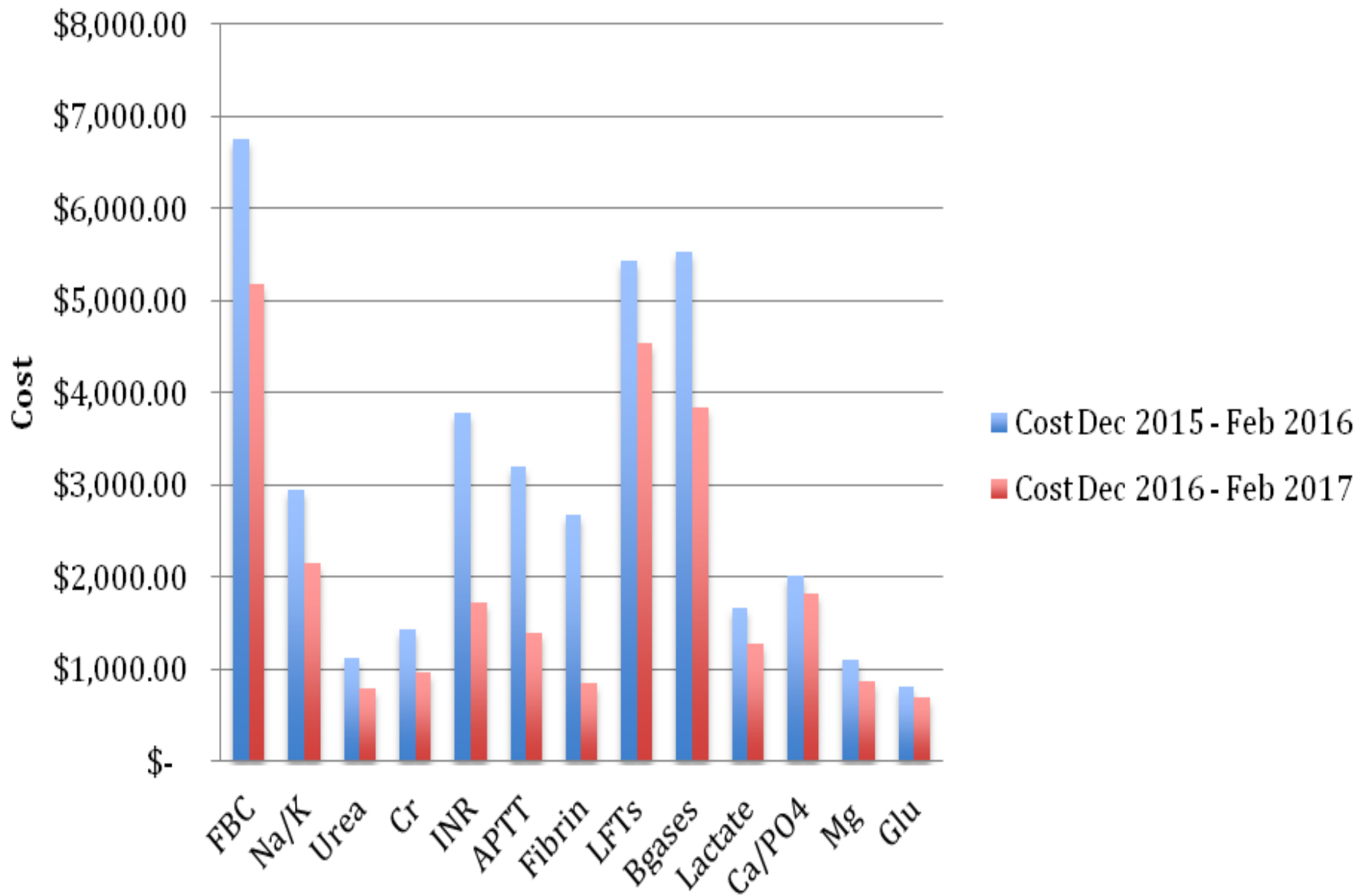
Total number of laboratory tests in each period by test type



Cost savings

- However there were 83 less ICU patient days in the second period with average LOS 3.54 days versus 2.89 in the pre-intervention group
- When adjusted to account for this discrepancy, the average cost of laboratory testing per patient day also fell post-practice change:
 - \$88.43/patient-day prior
 - \$74.13/patient-day in the 2016-2017 period

Total cost of laboratory blood tests by type



Secondary Measures

- Similar rates of CRRT and mechanical ventilation
- Population too small to show any significant change in mortality rates $p=0.72$ (although the absolute numbers were similar across both periods)
- Transfused a total of 26 units of RBCs to 10 patients over the control period and 25 units to eight patients in the post-practice change period ($p=0.46$)

Discussion

- A reduction in amount and frequency of lab testing provides a good opportunity for cost and blood savings and could be applied to varying degrees in all units
- Our reduction was less than we had hoped due to:
 - Difficulties forming/ reinforcing new habits, particularly out of hours (something common to all change initiatives)
 - Lack of positive reinforcement/ incentive for change
 - Ease of blood taking in the ICU setting

1

Don't order diagnostic tests at regular intervals (such as every day), but rather in response to specific clinical questions.

Many diagnostic studies (including chest radiographs, arterial blood gases, blood chemistries and counts and electrocardiograms) are ordered at regular intervals (e.g., daily). Compared with a practice of ordering tests only to help answer clinical questions, or when doing so will affect management, the routine ordering of tests increases health care costs, does not benefit patients and may in fact harm them. Potential harms include anemia due to unnecessary phlebotomy, which may necessitate risky and costly transfusion, and the aggressive work-up of incidental and non-pathological results found on routine studies.

2

Don't transfuse red blood cells in hemodynamically stable, non-bleeding ICU patients with a hemoglobin concentration greater than 7 g/dL.

Most red blood cell transfusions in the ICU are for benign anemia rather than acute bleeding that causes hemodynamic compromise. For all patient populations in which it has been studied, transfusing red blood cells at a threshold of 7 g/dL is associated with similar or improved survival, fewer complications and reduced costs compared to higher transfusion triggers. More aggressive transfusion may also limit the availability of a scarce resource. It is possible that different thresholds may be appropriate in patients with acute coronary syndromes, although most observational studies suggest harms of aggressive transfusion even among such patients.

3

Don't use parenteral nutrition in adequately nourished critically ill patients within the first seven days of an ICU stay.

For patients who are adequately nourished prior to ICU admission, parenteral nutrition initiated within the first seven days of an ICU stay has been associated with harm, or at best no benefit, in terms of survival and length of stay in the ICU. Early parenteral nutrition is also associated with unnecessary costs. These findings are true even among patients who cannot tolerate enteral nutrition. Evidence is mixed regarding the effects of early parenteral nutrition on nosocomial infections. For patients who are severely malnourished directly prior to their ICU admission, there may be benefits to earlier parenteral nutrition.

4

Don't deeply sedate mechanically ventilated patients without a specific indication and without daily attempts to lighten sedation.

Many mechanically ventilated ICU patients are deeply sedated as a routine practice despite evidence that using less sedation reduces the duration of mechanical ventilation and ICU and hospital length of stay. Several protocol-based approaches can safely limit deep sedation, including the explicit titration of sedation to the lightest effective level, the preferential administration of analgesic medications prior to initiating anxiolytics and the performance of daily interruptions of sedation in appropriately selected patients receiving continuous sedative infusions. Although combining these approaches may not improve outcomes compared to one approach alone, each has been shown to improve patient outcomes compared with approaches that provide deeper sedation for ventilated patients.

5

Don't continue life support for patients at high risk for death or severely impaired functional recovery without offering patients and their families the alternative of care focused entirely on comfort.

Patients and their families often value the avoidance of prolonged dependence on life support. However, many of these patients receive aggressive life-sustaining therapies, in part due to clinicians' failures to elicit patients' values and goals, and to provide patient-centered recommendations. Routinely engaging high-risk patients and their surrogate decision makers in discussions about the option of foregoing life-sustaining therapies may promote patients' and families' values, improve the quality of dying and reduce family distress and bereavement. Even among patients pursuing life-sustaining therapy, initiating palliative care simultaneously with ongoing disease-focused therapy may be beneficial.

Discussion

- Overlaps with PBM (strategies aimed to boost and conserve the patient's own blood and reducing iatrogenic anaemia)
- As a consequence of increased awareness and improved blood conservation, patients usually require fewer transfusions of allogeneic blood products
- Our study was too small and the time-frame not long enough to exhibit a clear benefit in reduction of transfusion requirements

Discussion

- Our results were slightly skewed with the reduced patient days in the post intervention group but still reduced costs per patient day
- Spreading this evidence-based intervention to other ICUs could have a significant impact with potential to reduce wastage and for significant savings in larger units
- Changes may be even harder to implement in larger teams/ units

Limitations

- A single-centre study in a small regional medical-surgical ICU
- Small population that may not reflect the full spectrum of patients seen in other ICUs (no cardiac or neurological surgery patients)
- Retrospective study lacking the ability to look into additional outcomes or measures

Conclusion

- We audited the impacts of a shift away from routine or to schedule blood testing to that done only to answer a clinical question or effect change in management in the intensive care.
- We demonstrated a significant reduction in unnecessary tests and associated costs without impacting on patient outcomes.
- This methodology could have a significant impact in terms of both expenditure and reductions in wastage in other ICUs and healthcare settings.

Questions? Comments?

- Thank you for your time