

# Rationalising Routine Pathology Investigations in the Intensive Care Unit

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## Abstract

Routine blood tests are costly and are ordered daily for patients in Intensive Care Units with no clear uniform guidelines in Australia. Junior Medical Officers (JMO) is routinely given this task of ordering daily blood tests, often without an understanding of the cost involved or of the significance of each test. This single centre, prospective, interventional study investigates the impact of having ICU specialists authorise routine daily blood tests in comparison to historical data where blood tests had been ordered by a JMO. Any adverse events in relation to not ordering blood tests were recorded. The number of patients admitted to the ICU, the median length of stay and Acute Physiology and Chronic Health Evaluation (APACHE) III scores were comparable during this time to historical data. The total number of tests decreased by 29% ( $P=0.0001$ ) and a decreased cost of 20% ( $P=0.0001$ ). The ordering of routine blood tests by ICU specialists resulted in significant decrease in blood tests and monetary savings with no adverse outcomes to patients.

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## Background

JMOs routinely order blood tests with minimal training in understanding the relevance and costs of daily tests. This results in a substantial monetary burden comprised of unwarranted testing. In a Gold Coast study surveyed Interns' knowledge on the costs of routine pathology, the results of which demonstrated a wide range in understandings of costs involved 1 rather alarmingly all of the 50 participants reported that they had inappropriately ordered investigations [1]. The reasons for this perhaps surround JMO fears of criticism from seniors or fears around adverse events to patients from not ordering tests. In Massachusetts USA, the development of written guidelines for routine blood tests in the ICU decreased the number of tests by 37% and the results were sustained in a year [2]. In New Zealand, the development of written guidelines for ordering routine blood tests resulted in a decrease in all blood tests performed by 16.6% and three years later there was still a 4% decrease in the cost of blood tests in comparison to before the development of the guidelines [3]. A study completed in Liverpool Hospital found that if ICU specialists authorised routine blood tests the ICU could save approximately \$323,000 (AU) per annum [4]. This study compared APACHE III scores, median length of stay and costs in comparison to historical data and this successfully demonstrated a significant monetary saving the ICU department with nil adverse outcomes. In Brisbane a multimodal approach

including: ICU specialists led pathology test ordering, staff education and new designs of pathology forms, over a six month period [5]. This study demonstrated a 28% reduction in tests performed and a net saving of over \$213,000 (AU) the six month study period. This significant cost reduction demonstrates that there is great potential for monetary savings from the current methods of routine blood test ordering that is currently present in ICUs. The above Australian single centre studies give clear indications that there is potential for significant monetary savings that could be gained by implementing strategies or protocols in ICUs in Australia around the ordering of routine blood tests. The studies were performed at large tertiary referral hospitals and an attempt to replicate a similar study in a smaller level 4 ICU was attempted in this study. The ICU at Fairfield is a combined ICU/ Coronary Care Unit that is a multidisciplinary 10 bed unit that historically had a Resident Medical officer order routine blood tests. The aim of the study was to assess the cost effectiveness of Intensivist run investigations at Fairfield Intensive care unit as a method to reduce the cost of routine blood tests.

## Methods

### Design

Single centre prospective interventional study in a multidisciplinary ICU/CCU. An ICU specialist was asked each day in regards to each patient the required blood tests from the 17/2/20- 17/4/20. A

summary of the actual number of tests performed and their costs were obtained from Sydney South West Pathology Service. This was compared to historical data from the 18/2/19-19/4/19 which was also provided by Sydney South West Pathology Service. The length-of-stay, number of patients per month, APACHE III severity score, adverse events, number of high-volume tests were recorded and compared to that of the historical data.

### Monitoring adverse events

All medical staff was instructed to monitor for any adverse events and complete the adverse event form in the patient folder. The form describes the adverse event, the severity and the time when the adverse event was detected. The form also allows for other adverse events not mentioned to be noted to allow for more reporting.

### Data collection and analysis

The breakdown of investigations ordered, and costs of investigations as billed to the Fairfield ICU/CCU department during the study and from the time of the historical data were obtained through Sydney Southwest Pathology. The data and costs were compared to the historical data along with data pertaining to the ICU admission numbers, length of stay and APACHE III scores. Nil external funding was provided. Ethics approval obtained from local district and given that the study had low/negligible risk the need for informed consent was waived. The data was tabulated for the entire duration of the study and p values were calculated through monthly values and a p value of <0.05 was considered significant.

### Results

Historical data is data from 2019 and Study data is that collected from the study in 2020. During the time of the study, the same number of ICU patients were admitted to the unit as the historical data, however more patients were admitted to the unit as this includes CCU patients. The APACHE III scores were slightly higher and median length was slightly reduced in comparison to historical data, however these were both not statistically significant.

Over the study period there was a 20% (P=0.0001) decrease in the cost of routine blood tests, and a 29% (P=0.0001) decrease in the total number of tests ordered in comparison to historical data. If this decrease in cost would have continued for a year this translates to a saving of approximately \$70,000 (AU). The number of high volume simple chemistry tests were reduced by 25% (P=0.005) which resulted in a significant cost reduction. There was a reduction of coagulation studies ordered by 56% in the study. ABG gas analysis however was the only item to increase during the study period by 8.4% (P=0.76) but this was not statistically significant (Table 1).

Only two additions over the study period were made by ICU specialists, both were CRPs that were added on to patients who had blood already collected that day and results were available within two hours. Both these additions were deemed by ICU specialists not to be adverse outcomes (Table 2).

Table 1: Number of ICU patients was admitted to the unit in 2019.

Demographics	Historical data ICU:CCU	Study data ICU:CCU	P value
Number of patients total	60:51 111 total	60:56 116 total	NS
APACHE III score median	42.7	47.2	NS
Median length of stay	69.7 hours	66.6 hours	NS

Table 2: Number of ICU patients was admitted to the unit in 2020.

Items	Historical Data	Study Data	Cost reduction	% Change Study	P Value*
Total Cost	\$64,663.40	\$53,072.91	-\$11,691.51	-20.1%	0.0001
Simple Chemistry	\$15,464.80	\$11,615.76	-\$3,849.04	-24.8%	0.005
FBC	\$6,823.46	\$5,313.10	-\$1,510.36	-22.1%	0.0002
Coagulation Studies	\$3,956.53	\$1,730.65	-\$2,225.88	-56.3%	0.0001
Blood Gas	\$4,269.77	\$4,627.91	+\$358.13	+8.4%	0.76 NS
Total Tests	4497	3191	-1306	-29%	0.0001

### Confounding factors

A confounding factor to this is that the unit at Fairfield Hospital is a combined Coronary Care Unit and ICU and lab data provided NSW Health Pathology was not able to separate or differentiate between ICU and CCU patients in the data they provided. The results reflect total investigations and costs of pathology for the entire unit and reductions are also made in comparison to the total number of tests and cost to the unit. Note that APACHE III and median length of stay in demographics were recorded only for ICU patients.

### Discussion

This study was performed over a two-month period in Sydney. The study compared data from the same unit and time of year. The study compared median length of stay, a measure of illness (APACHE III score), and number of patients and these were not statistically significant, which minimises their contribution as confounding factors. The strategy outlined above resulted in significant reductions in cost and numbers of routine blood tests ordered in an ICU without any adverse outcomes to patients. Items Historical Data Study Data Cost reduction % Change Study period P Value Total Cost \$64,663.40 \$53,072.91 -\$11,691.51 -20.1% 0.0001 Simple Chemistry \$15,464.80 \$11,615.76 -\$3,849.04 -24.8% 0.005 FBC \$6,823.46 \$5,313.10 -\$1,510.36 -22.1% 0.0002 Coagulation Studies \$3,956.53 \$1,730.65 -\$2,225.88 -56.3% 0.0001 Blood Gas \$4,269.77 \$4,627.91 +\$358.13 +8.4% 0.76 NS Total Tests 4497 3191 -1306 -29% 0.0001. There were statistically significant reductions in the number of all routine tests performed except ABGs. This may be explained by the notion that a senior medical officer is more likely to be the one to request ABG monitoring schedules in certain groups of patients, rather than leave the JMO to decide on frequency of ABG monitoring. The study demonstrates that the strategy of a JMO ordering of daily blood tests in an ICU without any supervision

or guidance leads to unnecessary blood tests being ordered which results in unwarranted monetary expenditure. Given the significant savings established in this study and that found in similar studies, protocols and guidelines should be established by State and Federal Health departments as there are large financial incentives to their establishment. The establishment of such guidelines would also allow for improved resources allocation. The significant reduction in unnecessary blood tests is importantly also better for patients. This reduction in blood test requests also decreases the work load on phlebotomists and nursing staff in ICU to collect the requested blood. It also decreases the load on laboratories running these investigations. Similar studies in other ICUs have been found to be safe and further studies outside of ICUs could also yield positive results.

## Limitations

The design of a single centre study and limited time frame are both limiting factors in this study. The Fairfield unit being composed of both ICU and CCU and the inability to differentiate between these in the data received from Sydney South West Pathology is also a limiting factor. Although no adverse outcomes were noted this could be an underrepresentation due to a failure

## References

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to recognise. The results should be validated through a large multicentre study throughout various states and territories of Australia which will invariably have different costs and processes for ordering pathology.

## Conclusion

The study demonstrates a strategy in which routine blood tests in ICU can safely be reduced and consequently result in significant savings. Strategies, protocols or guidelines should be established at state and federal levels to reduce the number and cost of unnecessary blood tests being performed. Senior medical officers ordering routine blood tests, education and established guidelines on ordering routine pathology should be further studied and explored in larger trials.

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