Overutilization of serum electrolyte determinations in critical care units

Savings may be more apparent than real but what is real is of increasing importance

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Abstract. Electrolyte (E) utilization by medical and surgical house staff in the critical care units of a community teaching hospital was audited over a two-month period. One hundred forty-five patients involved in 708 patient days had 924 sets of electrolytes (SE). Of the 581 SE that were ordered as an additional set within 24 h, 10% were considered unnecessary and 65% could have had a single E substituted for the complete set. The conclusion of this study and literature review are: (1) Electrolytes are excessively ordered in the management of critical care patients. (2) When additional electrolyte data is required within 24 h, a single electrolyte will usually suffice. (3) Misutilization is equally prevalent among medical house staff and surgical house staff. (4) The cost savings to be realized from improved laboratory utilization are only a small percentage of the potential savings in charges. (5) No single, proven modality has been identified which will consistently, continually, and appropriately decrease laboratory overutilization.

Key words: Electrolyte determinations - Audit - Laboratory - Overutilization

Methods and materials
The community teaching hospital involved in this study, the Carney Hospital, is a 422-bed acute care institution affiliated with the Boston University School of Medicine. The Respiratory Care Unit (RCU) consisted of five beds and the Medical-Surgical Intensive Care Unit (ICU) consisted of eight beds. The hospital also has a six-bed Coronary Care Unit and a 12-bed Progressive Coronary Care Unit which minimize the need to place cardiac patients in the Respiratory Cardiac Unit (RC) or Intensive Care Unit (ICU). All patients admitted to the ICU and RCU are covered by house staff. The medical house staff is an independent program with 38 positions. The surgical house staff rotates from the Boston University Surgical Training Program. Almost all orders for laboratory tests are written by the house staff.

One hundred and forty-five patients, representing all the admissions to the RCU and ICU for the months of January and February 1982, were included in this study. The hospital chart of each patient was reviewed daily by the medical director. All sets of electrolytes or single electrolytes obtained were noted. The service and level of training of the ordering physician was recorded.

One set of electrolytes per patient per day was conceded as necessary. Whenever an additional electrolyte or set of electrolytes was obtained, the medical director made a determination of necessity. Usually the medical director was familiar with the clinical considerations involved with each patient. When necessary, the physicians' and nurses' notes were reviewed, or the ordering physician was questioned. Each additional set of electrolytes was classified as necessary, unnecessary, or single electrolyte indicated instead of a complete set.

A set of electrolytes was defined as consisting of sodium, potassium, chloride, and carbon dioxide con-
tent. Electrolyte measurements were made using Astra 8 Automated STAT/Routine Analyzer System\(^1\).

For purposes of calculating cost of tests to patients or their insurers, the following data was employed: the charge for a complete set of electrolytes was US$ 26 and the charge for a single electrolyte was US$ 12. The calculation to determine the overutilization charges for the ICU and RCU for the two months experience was: \(\text{number of unnecessary sets} \times \text{US$ 26} + \text{number of sets when a single electrolyte was necessary} \times \text{US$ 14} \). Multiplying the sum by six produced an annual approximation of charges.

For purposes of calculating the cost of tests to the provider (i.e. the hospital) the following data was employed: A technician's salary and benefit cost the hospital US$ 9.20 per hour. A complete set of electrolytes requires approximately 1 min of a technician's time and US$ 1.20 of supplies. A single electrolyte requires 45 s of a technician's time and 40 cents of supplies. The calculation to determine overutilization costs to the hospital for the 2-month experience in the ICU and RCU was: \(\text{number of unnecessary sets} \times [\text{US$ 1.20} + (\text{US$ 9.20/60})] + \text{number of sets when a single electrolyte was necessary} \times [\text{US$ 0.80} + (\text{US$ 9.20/240})] \). Multiplying the sum by six produced an annual approximation of costs.

Statistical analyses focused on comparisons among the services with respect to (a) the percentage of days in the hospital on which extra sets were requested, (b) the number of extra sets requested per day in hospital, (c) the percentage of extra sets in which no electrolytes were needed, (d) the percentage of extra sets in which none or only one electrolyte was needed. We employed two-way analysis of variance methods to evaluate differences among the units and services [37].

Results

A total of 924 sets of complete electrolytes and 24 individual electrolytes were measured in 145 patients over a period of 708 patient-days. Three hundred and forty-three of complete electrolytes were conceded as necessary since the study design conceded the first, or only, set of the day as not being subject to challenge. Therefore, 581 sets were at risk for evaluation. Twenty-four percent, 10%, and 65% were considered necessary or unnecessary, or only one electrolyte was considered necessary respectively (see Fig. 1).

When only one electrolyte was necessary, the necessary electrolyte was potassium 83% and sodium 17%.

There were no statistically significant differences in utilization when patients covered by the medical house staff were compared with patients covered by the surgical house staff (see Fig. 1).

The calculated unnecessary charges to the patient or insurer were US$ 41,268, while the unnecessary cost to the hospital was US$ 2396.

Discussion of results

The misutilization of automated laboratory tests exacts a financial and intellectual price [3, 13]. Financial wastage is perpetuated by the educationally lax, non-intellectual approach unintentionally condoned in many teaching hospitals [4, 25].

The problem of laboratory misutilization is not unique to electrolyte determinations or the critical care units. Electrolytes are frequently repeated during a hospitalization for no discernable reason [7]. Patients in intensive care units have been reported to average over two and a half times more chemical tests than patients on a general ward [14].

Relative to the multimillion dollar charges to health care consumers from a community teaching hospital, the annual expenditure of US$ 41,268 for overutilization of electrolyte determinations in critical care settings may not appear staggering. Less impressive is the actual cost savings of US$ 2396 for providing the unnecessary tests. Such disparity between reduced charges and the actual cost savings has been noted by others [11, 24]. Identified unnecessary wastage expense from overutilization of electrolyte determinations in the critical care setting remains relatively small and will never be completely eliminated. However, when the misspent dollars are extrapolated to all laboratory tests requested in a hospital, the institution could be realizing enough financial resources to support several personnel positions or purchase some new capital equipment. Thus, the savings to the accrued by minimizing over-utilization may be more apparent than real. However, what is real may be very

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\(^1\) Beckman Instruments, Inc., Brea, California