Evaluating the Appropriateness of Red Blood Cell Transfusions: the Limitations of Retrospective Medical Record Reviews

ANNE-MARIE AUDET*
LAWRENCE T. GOODNOUGH† and CURTIS A. PARVIN‡

*MassPRO, 235 Wyman St, Waltham, MA 02154, USA
†Washington University Medical School, St Louis, Missouri, USA
‡Washington University Medical School, St Louis, Missouri, USA

Objective: Several studies have looked at the appropriateness of red blood cell transfusions, using retrospective chart reviews to assess compliance with guidelines. The goal of this study was to determine the quality of medical chart documentation, and assess the validity and the feasibility of using retrospective chart review data as part of a quality improvement (QI) program, to evaluate the appropriateness of peri-operative transfusions.

Design: The charts of 188 patients admitted for elective orthopedic surgery were reviewed. Both intra-operative and post-operative transfusion events (n = 353) were analyzed.

Results: Only 8% of post-operative transfusion events on the day of surgery and 35% of transfusion events on days after surgery were accompanied by documentation of blood loss and/or change in vital signs. Symptoms were recorded in only 10% of post-operative transfusion events. The rationale for transfusion was recorded in only 16% of post-operative transfusion events on the day of surgery, in 27% on post-operative days and in 95% of intra-operative transfusions. The documentation of rationale was not different for transfusion events involving autologous blood (31%) or allogeneic blood (32%). This study provided information on transfusion practices. Single unit transfusions occurred in only 47 and 34% of patients receiving autologous and allogeneic blood, respectively. Only 19% of patients transfused with more than one allogeneic blood unit were clinically reassessed between blood units, compared to 34% of patients receiving more than one autologous blood unit. We conclude that retrospective chart reviews are limited by inadequate documentation and may not be the optimal source of information to determine the appropriateness of a transfusion. Improved methods (e.g. prospective reviews, or other system-level data collection methods) are needed for QI programs to influence practice. Despite its limitations, the information obtained suggests that current practice could be improved.

Key words: Retrospective chart review, quality of care, appropriateness, red blood cell transfusion.

INTRODUCTION

Approximately two-thirds of all blood transfused yearly in the United States occurs in the peri-operative period [1,2]. Every year, a significant number of surgical patients are exposed to the potential risks of red blood cell-mediated hemolytic reactions and of transfusion-transmissible diseases. Adequate inventory of blood is also a significant and chronic concern. A number of different and coordinated

Submitted 1 February 1995; accepted 16 August 1995.
Correspondence: A.-M. Audet, MD, MSc, SM, MassPRO, 235 Wyman St, Waltham, MA 02154, USA. Tel: 617-890-0011 (Ext. 243); Fax: 617-890-5485.
efforts have been implemented to solve such problems and ultimately improve the quality of transfusion practices. One approach consists of relying on alternative and safer sources of blood [such as autologous blood or blood salvaged intra-operatively], as the sole source of red blood cells. Studies have demonstrated that autologous blood donations prior to elective surgery were a safe and effective way to reduce the use of allogeneic blood [3]. While this practice has been promoted via published guidelines[4,5] and consensus conference [1], recent studies in orthopedic [6] and cardiac [7] surgery patients have shown that this alternative is expensive.

A more cost-effective approach to reduce the use of allogeneic blood is to improve the appropriateness of blood transfusions. Physicians have traditionally used hematocrit thresholds to guide their transfusion decisions. This paradigm has recently been challenged [1,4,5]. Recognizing that patients can tolerate levels of hemoglobin much lower than what was previously believed, new guidelines recommend that decisions to transfuse be based primarily on the clinical assessment of individual patients, rather than arbitrary hematocrit thresholds. But new information usually takes time to infiltrate into the medical community and to be translated into practice [8]. It is thus important to define effective ways for new knowledge to influence and change physicians' transfusion practices [9, 10].

There is mounting evidence that some of the blood that is transfused is not always clinically indicated [11–16]. The rates of inappropriate transfusions have varied widely from 0.3 [17] to 49.6% [12]. It is difficult to compare these rates, because of the differences in the criteria used to define appropriate and inappropriate transfusions. The studies that have used only explicit and restrictive criteria suggest high inappropriate rates of transfusion [13,18]. On the other hand, those studies that have used implicit criteria, or have incorporated clinical variables in addition to hemoglobin values, have usually obtained lower rates of inappropriate practices [17]. Unfortunately, several of these studies [13,16,19] provide little detail about the criteria used to judge transfusion decisions, and none has explicitly discussed the limitations of retrospective medical chart review (i.e. when a criteria is used how and where the data are obtained to assess conformance of the criteria).

The goal of this study was to determine whether retrospective reviews of medical records can be used to describe practice patterns for use in quality improvement programs aimed at identifying and promoting appropriate transfusion practices. Traditional methods of utilization review [19–23] rely on retrospective reviews of medical charts in order to determine the appropriateness of blood transfusions, according to established guidelines. The aim of this study was to assess the quality of the documentation of the decision making process around peri-operative red blood cell transfusions, in order to provide information and guide initiatives for improving the quality of transfusion practices.

SUBJECTS AND METHODS

The charts of 188 patients admitted to one major teaching hospital in Cleveland for elective orthopedic surgery (ICD-9-CM 80.5, 81.0, 81.4, 81.5) over a three-year period for which a blood type and cross-match order was requested, were reviewed. Both intra-operative and post-operative transfusion events were examined, as well as the type of blood transfused: autologous vs allogeneic blood, or both. We defined a transfusion event as the transfusion of one or more units of red blood cells, after a documented clinician order. The practice guidelines recently developed and published by the American College of Physicians were used to define the clinical elements (clinical signs and symptoms, laboratory tests) that would be necessary to determine the quality of transfusion practices [4,5]. We abstracted information about the rationale for each transfusion event, using clinical variables related to patients' vital signs (blood pressure, heart rate), and symptoms (dizziness, angina, etc.) that preceded the transfusion event and that may have led to the decision to transfuse. We also recorded data such as the pre- and post-transfusion hematocrits. We analyzed peri-operative transfusion practices as a whole, but we also compared transfusion events taking place intra- and post-operatively. Transfusion events involving autologous blood were also compared to events involving allogeneic blood.
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Statistical significance was determined using Fisher's exact test statistics and the Student's *t*-test. Two-tailed tests were done and the alpha level chosen was 0.05.

RESULTS

A total of 353 transfusion events were analyzed, with a mean number of 1.88 transfusion events per patient. Details about the profile of these patients are found in Table 1. Sixty-five percent of patients were women and the mean age was 60 years. While most patients had no documentation of coexisting conditions, 20% had a documented history of ischemic heart disease and were on cardiac medication, 2.2% had a documented history of congestive heart failure and 3.4% had a documented history of transient ischemic attack or cerebro-vascular event.

1. Blood ordering and blood transfusion practices

We first examined all peri-operative transfusion events together. Seventy-six percent of all events occurred in the post-operative period: of these, 42% occurred the day of surgery, and 34% 1 day post-operatively, and the remainder occurred 2 or more days post-operatively. The maximum number of days post-operatively when a transfusion occurred was 9 days (Fig. 1). In almost all cases, transfusion events involved a single kind of blood, either autologous or allogeneic, but not both. Fifty-eight percent of all transfusion events involved the transfusion of autologous blood only and 40% involved allogeneic blood only. Only in 2.6% of cases were autologous and allogeneic blood both transfused during a single transfusion event.

Next, we examined blood ordering and transfusion practices. For 67% of patients, autologous blood had been ordered and was collected pre-operatively. In 74% of cases, between one and three units of autologous blood were available (Table 2), with six units being the maximum number of units ordered and available. Nearly one-half (48%) of autologous blood transfusion events consisted of single-unit transfusions. In contrast, transfusions involving allogeneic blood were ordered as single units in only 33% of post-operative events (Table 3), with two units or more ordered simultaneously in the majority (67%) of cases. The maximum number of allogeneic blood units ordered at once was four units. Only 49.1% of predeposited autologous blood units were transfused (Table 2). Nearly all (98%) of the allogeneic blood units ordered were transfused (Table 3).

2. Documentation of the rationale for red blood cell transfusions

As shown in Table 4, 82 (95%) of 86 intra-operative transfusion events were accompanied...
TABLE 2. Autologous blood ordering and transfusion practices

<table>
<thead>
<tr>
<th>Number of units obtained preoperatively per patient (% of patients)</th>
<th>Number of units transfused per patient (% of patients)</th>
<th>Number of units unused (% of patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One unit</td>
<td>6.5</td>
<td>47</td>
</tr>
<tr>
<td>Two units</td>
<td>40</td>
<td>47</td>
</tr>
<tr>
<td>Three units</td>
<td>27.2</td>
<td>5.5</td>
</tr>
<tr>
<td>Four units</td>
<td>20.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Five units</td>
<td>1.6</td>
<td>0</td>
</tr>
<tr>
<td>Six units</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

TABLE 3. Allogeneic blood ordering and transfusion practices

<table>
<thead>
<tr>
<th>Percent of 111 patients receiving blood</th>
<th>Number of units transfused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood ordered as a single unit</td>
<td>One unit 33.6</td>
</tr>
<tr>
<td>Blood ordered as two units</td>
<td>Two units 64.7</td>
</tr>
<tr>
<td>Blood ordered as four units</td>
<td>Three units 0.8</td>
</tr>
<tr>
<td>Number of units transfused</td>
<td>Four units 0.8</td>
</tr>
<tr>
<td></td>
<td>Number of units ordered but not transfused</td>
</tr>
<tr>
<td></td>
<td>None 97.3</td>
</tr>
<tr>
<td></td>
<td>One unit 2.7</td>
</tr>
</tbody>
</table>

by evidence on the anesthetic record of either a change in vital signs, blood loss, or both. In contrast, significantly fewer post-operative transfusion events had similar documentation on the day of surgery (68%, $p < 0.001$) and on post-operative days (35%, $p < 0.001$). Documentation of patients' symptomatology on post-operative days (defined as an explicit statement in the progress notes—i.e. a laboratory result indicating a low hematocrit level or a low blood pressure reading alone, were not considered sufficient documentation if they were not accompanied by a note to this effect) was found only in 13 (10%) of 155 transfusion events. Furthermore, post-operative transfusion events were accompanied by a recorded rationale for transfusion in only 18 (16%) of 112 events on the day of surgery and 42 (27%) of 155 events on post-operative days. The documented rationale was most frequently blood loss on the day of surgery, both intra- and post-operatively, and level of hematocrit on post-operative days (see Section 3 below).

When more than one unit of blood was transfused, we found that evidence of clinical reassessment between units was documented in 43 (73%) of 59 intra-operative events compared to only nine (17%) of 54 and four (4%) of 101 ($p < 0.001$) post-operative events on the day of surgery and days after surgery, respectively. Patients who were transfused autologous blood were just as likely to be clinically assessed prior to a transfusion event as patients transfused allogeneic blood (32 vs 19% respectively, $p = 0.055$) (Table 5). Evidence of patient consent was documented prior to only two (1%) of 155 transfusion events after the day of surgery. Finally, we found that the order to transfuse was written by housestaff physicians in 79 and 90% of post-operative cases on the day of surgery and on days after surgery, respectively.

3. Hematocrit prior to transfusion (Table 4)

The number of transfusion events with recorded pre- and post-transfusion hematocrits, along with hematocrit levels, is detailed in Table 4. Blood transfusions were associated with recorded hematocrit levels in 54 (63%) of 86 intra-operative events. The lower post-transfusion hematocrit levels, compared to pre-transfusion levels, reflected on-going surgical blood loss. Post-operatively, on the day of surgery, only 50 (45%) of 112 transfusion events were accompanied by pre-transfusion hematocrit levels. Post-operative transfusion events after the day of surgery were more often accompanied by recorded hematocrit levels,
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<table>
<thead>
<tr>
<th>TABLE 4. Medical record documentation pertaining to blood transfusion events</th>
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<tbody>
<tr>
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<td></td>
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<tr>
<td>Number of events</td>
</tr>
<tr>
<td>Recorded symptoms</td>
</tr>
<tr>
<td>Recorded positive signs</td>
</tr>
<tr>
<td>Change in blood pressure</td>
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<tr>
<td>Change in heart rate</td>
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<tr>
<td>Blood loss</td>
</tr>
<tr>
<td>Recorded rationale</td>
</tr>
<tr>
<td>Recorded hemocrit</td>
</tr>
<tr>
<td>Pre-transfusion Hemocrit (%)</td>
</tr>
<tr>
<td>Post-transfusion Hemocrit (%)</td>
</tr>
<tr>
<td>Reassessment between blood units*</td>
</tr>
<tr>
<td>Documentation of informed consent</td>
</tr>
<tr>
<td>Source of written transfusion order</td>
</tr>
<tr>
<td>Attending physician</td>
</tr>
<tr>
<td>House staff</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
</tbody>
</table>

*Events where more than one unit transfused.

pared to post-operative events on the day of surgery (91 vs 45% respectively, \( p < 0.001 \)).

4. **Autologous compared to allogeneic transfusion events (Table 5)**

The mean number of allogeneic blood units per transfusion event was higher than the mean number of autologous blood units transfused: 2.02 vs 1.58 units, \( p < 0.001 \) (Table 5). For autologous blood transfusions, 95% of the events involved the transfusion of one (47.6%) or two (47.6%) units, with four being the maximum number of autologous blood units transfused at once (Table 2). For post-operative allogeneic blood transfusions, two units were transfused.

<table>
<thead>
<tr>
<th>TABLE 5. Comparison of autologous and allogeneic blood transfusion events*</th>
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<tbody>
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<td></td>
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<tr>
<td>Number of events</td>
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<td>Recorded symptoms</td>
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<td>Recorded signs</td>
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<tr>
<td>Change in blood pressure</td>
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<td>Change in heart rate</td>
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<td>Blood loss</td>
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<tr>
<td>Recorded rationale</td>
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<tr>
<td>Recorded hemocrit</td>
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<tr>
<td>Pre-transfusion Hemocrit (%)</td>
</tr>
<tr>
<td>Post-transfusion Hemocrit (%)</td>
</tr>
<tr>
<td>Mean number of units transfused</td>
</tr>
<tr>
<td>Reassessment between blood units†</td>
</tr>
<tr>
<td>Documentation of informed consent</td>
</tr>
</tbody>
</table>

*Where autologous blood or allogeneic blood only was transfused.
†Post-operative transfusion events where more than one unit was transfused.
transfused more frequently (66%) than one unit (33%) and the maximum number of units transfused at once was four units (Table 3). There was no difference in the documentation of patient symptoms, signs, rationale for transfusion, informed consent, in the case of transfusion events involving autologous or allogeneic blood. Patients were also not more likely to be re-assessed between units of allogeneic blood transfused. The only significant difference in the two groups of patients was that the pre-transfusion hematocrit of patients receiving allogeneic blood was slightly lower (29.1%) than that of patients receiving autologous blood (31.0%, \( p < 0.02 \)).

**DISCUSSION**

The results of this review of transfusion practices in patients undergoing elective orthopedic surgery underscore the difficulties inherent in attempting to translate the principles recommended in practice guidelines, into quantitative measures that reflect these principles. They illustrate the practical reality of using chart audits to evaluate quality (i.e. conformance to practice guidelines). In addition, the study provides information about the inadequacy of the medical record documentation, and the limitations it imposes on using data collected retrospectively to assess the quality and the appropriateness of blood transfusions. Although the focus was on blood transfusions, this was used as a model. The results could be applied to other clinical areas, and demonstrate the role of medical records as sources of data on quality of care. Our results demonstrate that, currently, charts present several limitations as sources of reliable and valid data on quality. Since they undoubtedly form a major source of information, improvements in documentation should be one of the priorities in most QI efforts. Achieving system-level improvements in data that are required to improve quality is crucial, especially as we move away from a "quality assurance" model where data are used to "police" care, to a "quality improvement" model where data are used by health-care providers to assist them in delivering quality care.

The limitations of chart review are likely generalizable to other institutions in the USA, as well as in other countries. Additional barriers to evaluating the quality of transfusion practices may exist outside the USA. Indeed, tracking individual units transfused is relatively easy, given that units are obtained through the American Red Cross. In many states, hospitals also report their blood product use on a quarterly basis to the State Department of Public Health. In countries where such tracking is nonexistent, or where commercial blood is used on a widespread basis, monitoring the appropriateness of transfusions may be more difficult, and different monitoring systems will be required to ensure quality. Despite these limitations, the study contributes some interesting insights on current blood ordering and transfusion practices, that suggest directions for improving peri-operative blood transfusions.

Our results demonstrate the lack of explicit information about the indications for transfusion (symptoms, signs, rationale for transfusion, clinical reassessment between units transfused, informed consent). This was especially apparent for post-operative transfusions (Table 4). On the other hand, intra-operative decisions (blood losses, changes in vital signs) were well documented. This suggests that efforts are needed to improve the documentation of the rationale for post-operative transfusion events. Such a finding is also supported by Saxena et al. [14], who found that 39% of transfusion events were not even mentioned by a clinician in the medical chart (except as an order).

The results also indicate that retrospective review of care may not be the optimal way to obtain the information required for assessing the quality of transfusion practices. This raises questions about the reliability and the validity of currently available information from appropriateness studies. The criteria that have been used to classify transfusion events into an appropriate, inappropriate, or indeterminate category have varied, being either restrictive or liberal [15]. Some have used explicit criteria only, implicit criteria only, or a combination of both. Most studies have relied on information obtained retrospectively from the medical records. However, in the majority of cases, there was no discussion of the limitation of the charts as the predominant source of information to judge appropriateness. What is clearly important is that the appropriateness criteria be de-
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fined, and that the source of the information required to assess conformance to these criteria be stated.

The results of this study clearly illustrate the need for reliable and valid sources of information, in order to effectively gauge the quality of transfusion practice, and to promote high quality care through quality improvement programs. More interactive methods (as opposed to retrospective reviews) that are closely related to the time of the transfusion decision and the actual ordering of blood may be best suited to this particular clinical issue. For example, computerized ordering methods or transfusion-specific forms could be designed to record the information prospectively for concurrent quality review, at the time the blood is ordered, rather than after it is transfused [24]. Studies have shown that real-time validation of transfusion through the use of algorithms can improve practice [24,25] and outcomes [26,27]. Prospective and concurrent audits of platelet transfusions have been effective in decreasing the use of platelet concentrates by 56%, at a tertiary care medical center [28]. Strategies such as a one-on-one educational process (“academic detailing”) have also been shown to decrease the number of inappropriate blood transfusions among surgeons and anesthesiologists [29].

Despite the limitation of retrospective medical record reviews, our study does provide some insights into current transfusion practices. Recently developed guidelines recommend that transfusion decisions be based on the clinical assessment of patients, rather than arbitrary traditions such as hematocrit thresholds [1,4,5,30]. The low prevalence of pre-transfusion hematocrit data in our study suggests that transfusion events on the day of surgery (both intra- and post-operatively) are based on blood loss. In the days following surgery, our review suggests a reliance on hematocrit thresholds. For example, one post-operative order was as follows: “Transfuse two units. Check hematocrit level in the morning. If hematocrit < 30 transfuse two more units”. The fact that the mean pre-transfusion Hct was close to 30% also suggests that this threshold is still being used to guide decisions. Clinical assessment between blood units transfused was done in only a minority (43%) of cases; in most cases, clinical signs and symptoms that should guide clinicians in their decision to transfuse were either absent or not recorded in the chart. We also found that documentation of rationale, reassessment between units and informed consent for autologous blood units was not different than that observed for allogeneic blood. This is an important observation, since while allogeneic blood units have greater transfusion risks than autologous blood units, whether different criteria should be used for the transfusion of autologous and allogeneic blood is controversial [31]. Indeed, the greatest risk from a blood transfusion is a clerical error leading to the transfusion of a wrong unit and a fatal transfusion reaction. In addition, transfusion can lead to significant volume overload—the so-called “Transfusion-Associated Circulatory Overload (TACO)”. In a recent study of transfusion practices, this complication was found in 1% of all patients. In the majority of cases, autologous blood was transfused and led to congestive heart failure, necessitating intensive care and increasing the length of stay (Mark Popovsky, MD, Director of the Massachusetts’ Red Cross, personal communication). This underscores the importance of developing guidelines for the use of autologous blood, to avoid the practice by which if autologous blood is available, it is transfused regardless of need. This issue is being explored by the National Heart, Lung and Blood Institute and recommendations about the appropriate use of autologous blood should be forthcoming in the next year.

The new paradigm proposed for prudent transfusions discourages the belief that if one is to transfuse blood, at least two units should be transfused [5]. Our results suggest that such a belief may still be prevalent among clinicians. In the majority of cases, two or more units of either autologous or allogeneic blood were ordered and transfused during a single transfusion event. In only 34% of cases were single units of allogeneic blood transfused. Delays from the time of order to the time when patients actually receive the blood may prompt physicians to order a high number of units in anticipation of potentially urgent situations. Such preventive practices could be legitimate if the clinician did assess the clinical status of the patient between blood units. Our results suggest that this is not
the case, since 97% of the allogeneic blood units ordered were transfused. Modifications in transfusion practices should also address the blood ordering process.

Education programs will also need to focus on informed consent, since discussions with patients were documented in only 1% of post-operative transfusions involving allogeneic blood and in only 1.3% of transfusions involving autologous blood. This is especially noteworthy, since the study institution did not have a specific consent form for in-hospital transfusions. Finally, although our study found that housestaff physicians wrote the transfusion order in the majority of cases (90%), the actual decision-maker was unknown. Previous studies have found that senior physicians influence the transfusion behavior of other physicians [32–34], so that educational interventions should target all physicians who are involved at any time in the transfusion event.

Although the context for this study was one major teaching hospital in the USA, the results have broader relevance in terms of the importance of quality assurance programs as they relate to transfusion of blood products. Every day, thousands of patients are exposed to a procedure (i.e. transfusion) that carries significant risks and that is costly. Blood products are also in limited supply and problems with inventory are chronic. Improving the appropriateness of the use of blood is therefore essential to provide the optimal care for patients, and should be considered in any quality assurance program, whatever its structure (e.g. transfusion committees reviewing care retrospectively, prospective evaluation of the need for transfusions, transfusion profiles at the physician level). Data on actual practices are thus essential, to describe current care and to follow trends. Medical records are often the sole source of information, and are in many cases inadequate. This issue will require system-level approaches to improve the quality of documentation and of clinical databases. This may even be more of a challenge in countries where the source and provision of blood products are less regulated than in the USA. Still, given the risks and the cost of blood products, their appropriate use should be among the priorities of any health care system.

In conclusion, our study clearly emphasizes the need for: (1) reliable and valid sources of information to effectively measure quality (appropriateness) of care on an ongoing basis, (2) improving the documentation of this process, (3) the dissemination of guidelines about prudent strategies for blood transfusions, and (4) quality improvement programs to improve the quality of transfusion practices. Specifically, education and quality improvement programs should emphasize informed consent, single unit transfusions and documentation of transfusion rationale, with clinical reassessment between transfusion events. A combination of education and prospective methods to assess quality might be synergistic. Now that there is good evidence to suggest that automatic transfusion triggers should be abandoned, there is also a need to develop clinically useful criteria to assist physicians who will need to evaluate patients with regard to signs, symptoms and coexisting conditions that put the anemic patient at risk.

REFERENCES

8. Kosecoff J, Kanouse D E, Rogers WH, McCloskey L, Monroe-Winslow C and Brook R H, Effects of the National Institutes of Health con-
Evaluating appropriateness of blood transfusion through chart review  


22. Rubenstein L V, Kahn K L, Harrison E R, et al., Implicit Review of the Medical Record: A Method for Measuring the Quality of In-Hospital Medical Care and a Summary of Quality Changes Following Implementations of the Medicare Prospective Payment System. RAND (N-3033), Santa Monica, CA, 1991.


