

# **Provincial Plasma Audit Report**

**September 2009**

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## 1.0 Executive Summary

### Background and Purpose:

- Audits of frozen plasma use world-wide, including Ontario, indicate considerable inappropriate transfusion of frozen plasma when measured against published guidelines, which themselves lack an established objective basis.
- Transfusion of frozen plasma has a constellation of adverse consequences, especially transfusion-related acute lung injury (TRALI) and transfusion associated circulatory overload (TACO).
- The costs of frozen plasma transfusions are substantial and savings could accrue from the elimination of inappropriate use:
  - Reduction in the costs of collecting, processing, distribution and administration at the clinical level in hospital, of frozen plasma.
  - Diversion of frozen plasma no longer transfused to the manufacturing of plasma derivatives (IVIG and albumin) thereby reducing dependence on more expensive purchased plasma.
  - Reduction in the costs of managing complications of frozen plasma transfusion in hospital, in particular those cases requiring intensive care.

### Methods:

Seventy-six (49%) of eligible hospitals, representing 88% of frozen plasma consumption in Ontario, participated. Each participating hospital collected data on frozen plasma transfusions for 5 (not necessarily consecutive) days and submitted data using a web-based data tool designed for the purpose. Data on 573 orders for 2012 units of frozen plasma were received. Data on the indications for each transfusion encounter, including dose, were collected and the appropriateness of the clinical indication for each encounter was assessed according to criteria agreed in advance by a panel of 6 transfusion medicine physicians. Each encounter was classified into one of 3 categories – “appropriate”, “inappropriate” or “indeterminate” (where the data supplied was insufficient to allow assignment to one of the other 2 categories).

### Principal Findings:

- Orders for frozen plasma were deemed “appropriate” in 54.8% of cases, “inappropriate” in 28.6% and “indeterminate” in 16.6%.
- The majority of the sources of orders within the hospitals were identified as operating rooms, intensive care units, medical wards and emergency departments, providing guidance as to where best to focus measures for change.
- The most common indications cited were in support of surgical procedures and for reversal of anticoagulant effect.
- Hospitals indicating they had “guidelines” for frozen plasma transfusion had a significantly higher rate of transfusions deemed “appropriate”.
- Teaching hospitals had a lower rate of frozen plasma transfusions deemed “inappropriate”, but still had an “inappropriate” rate of almost 20%.

- The median dose of frozen plasma prescribed/administered was 2 units (equals 500mL) which is, for an adult, deemed less than the potentially effective amount.
- Only 29% of transfusions of frozen plasma met the criteria for both an “appropriate” indication and a sufficient dose.
- 54 or 2.7% of all units ordered were wasted for one or more of several reasons

### **Recommendations:**

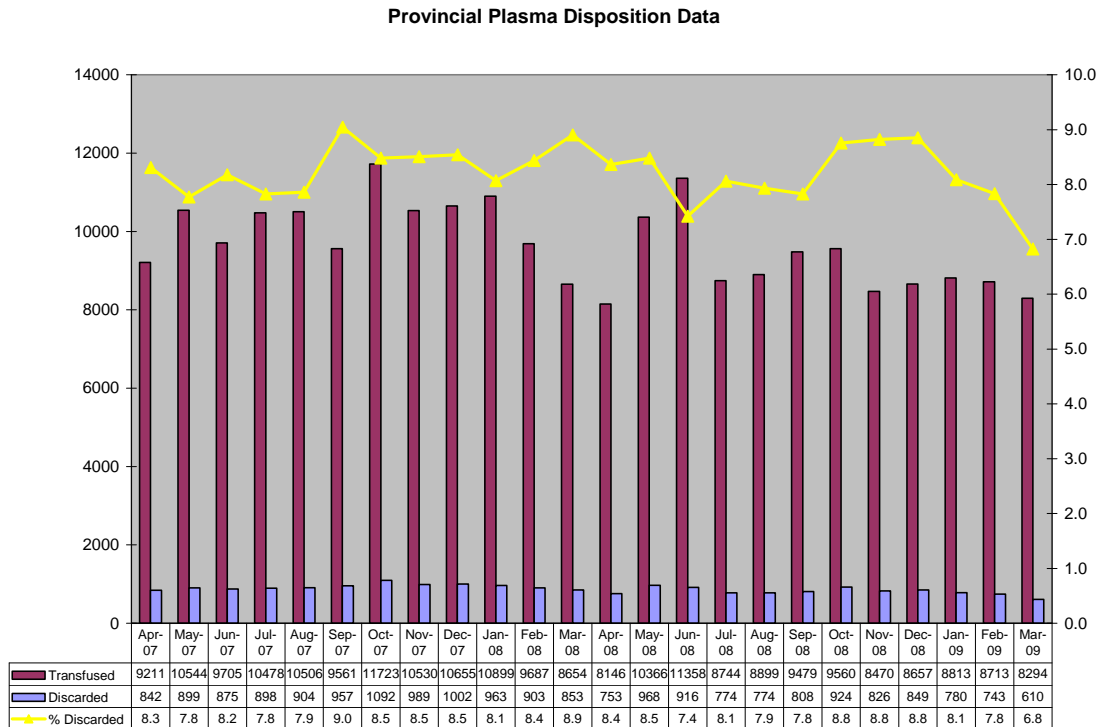
- Development and distribution of clinical practice recommendations including strategies for their implementation.
- A clear statement regarding conditions for which frozen plasma transfusion is **not** indicated should be issued.
- Clear guidance should be provided concerning the appropriate dose of frozen plasma to be prescribed to produce a significant improvement in hemostatic function, together with information on the associated risks of frozen plasma transfusion, especially TACO.
- Dissemination of advice on the use of Vitamin K **alone** for reversal of the effects of vitamin K antagonists (“warfarin effect”).
- Dissemination of information on the indications and procedures for use of prothrombin complex concentrates instead of frozen plasma for **urgent** reversal of the effects of vitamin K antagonists.
- Enhancement of general awareness of potential adverse consequences of transfusion of frozen plasma
- Longer term goals include assessment of the effectiveness of the introduction of the measures recommended above and promotion of random controlled clinical trials designed to obtain evidence to define the optimal clinical use of frozen plasma.

# Provincial Plasma Audit Report

*“Worldwide, the largest avoidable risk to patients from transfusion is probably due to the transfusion of fresh frozen plasma (FFP) for totally inappropriate or unproven clinical indications.”<sup>1</sup>*

## 2.0 Background and Purpose

An audit of frozen plasma transfusion was undertaken to ascertain the current ordering and utilization practices among Ontario hospitals. Despite the publication of many recommended guidelines for the use of frozen plasma, a significant proportion of frozen plasma transfusions do not meet the criteria set forth in these guidelines (See Appendix A for details and references). In addition, the use of frozen plasma generally has been growing steadily in many jurisdictions. It is noted that in Ontario, however, there has been a recent trend to decreased utilization of frozen plasma.



**Figure 1** Ontario Provincial Plasma Disposition data for FY 2007-2008 with the Purple bars representing the number of units transfused; the Blue bars representing the number of units Discarded; and the Yellow solid line representing the percentage of discarded plasma. Units discarded represent the frozen plasma units that are thawed and not transfused.

Frozen plasma has been available since the 1950s. The primary indication for frozen plasma transfusion is the replacement of deficiencies of clotting factors. Generally, frozen plasma is transfused with the intent to correct the deficiencies of clotting factors in patients who are bleeding or prior to surgery or invasive procedures which may be associated with bleeding complications. Frozen plasma is available as fresh frozen plasma frozen within 8 hours of collection (FFP), and frozen plasma frozen within 24 hours of collection (FP 24). Two collection procedures are used;



recovery from single unit donations and by apheresis in 250 mL or 500 mL quantities. Frozen plasma contains essentially the same concentrations of clotting factors as fresh frozen plasma with the exception of factor VIII which may be reduced by up to 25%.<sup>2,3</sup> Since frozen plasma is no longer used for factor VIII replacement, these different variants are for practical purposes interchangeable and the term “frozen plasma” will be used here to include all of these variants of the product.

Over the last 40 years, safer and more effective alternatives to frozen plasma have become available for the treatment of inherited single clotting factor deficiencies such as hemophilia A or B, and for the multiple factor deficiencies associated with the use of vitamin K antagonists (e.g. warfarin) and vitamin K deficiency. Until recently, prothrombin concentrates available for use in Canada contained only three of the four vitamin K dependent factors, making the use of plasma still necessary.<sup>4</sup> Around the same time that this plasma audit was being performed, a commercial concentrate containing the four vitamin K dependant factors became licensed for use in Canada eliminating the need to use plasma for emergency reversal of vitamin K antagonists.<sup>5,6</sup>

Guidelines for prescribing frozen plasma have been compiled by several organizations over the last 20 years. These are summarized in appendix A and are broadly similar. They rest largely on evidence from observational studies and “expert opinion”. However, recent detailed scrutiny of the existing evidence indicates that the prophylactic use of frozen plasma is not significantly or consistently effective in many of the clinical settings in which it is used.<sup>7</sup> Further, while use of frozen plasma to correct clotting factor deficiency in bleeding patients would seem more justifiable, its effectiveness in this situation has not been demonstrated in any controlled clinical trial.

At least 10 audits have been performed in various jurisdictions using one or other of the sets of guidelines listed in appendix A; orders for or transfusion of frozen plasma have been deemed “inappropriate” in between 26 and 73% of cases (See Appendix B). Two audits in Ontario<sup>8,9</sup> each concluded that about half of frozen plasma transfusions were “inappropriate”. It should be noted that these 10 audits used a variety of criteria for assessment including the guidelines described above, which are inadequately supported by objective evidence.

Recently comparisons have been drawn between transfusion rates for red cells and plasma on the assumption that red cell transfusion practices are more uniform, being based on clearer evidence-based indications. Using this approach, the ratio of plasma to red cell consumption in 8 countries varied between 14 and 31 plasma units per 100 RBCs<sup>10</sup> with Canada at 27 plasma units per 100 RBCs.<sup>11</sup> [Note: a higher figure implies greater plasma use]. In Canada there is inter-Provincial variation in the range of 20 to 32/100 RBCs.<sup>12</sup> The range in medium-sized and large hospitals in Ontario is 3 to 50/100 RBCs.<sup>13</sup> These data do not distinguish between those hospitals that have services which may have increased plasma demand such as plasma exchange and the hospitals that do not. However, such programs are few and are unlikely materially to affect the overall conclusions. Thus it is difficult to see how truly consistent application of guidelines for prescribing frozen plasma could be consistent with such variability.

Through this audit of frozen plasma utilization, we are seeking to evaluate the appropriateness and variation in utilization as well as adequacy of dosage. Based on the information reviewed here, we anticipate that there will be significant inappropriate use and significant variation in use, which would offer opportunities for both cost savings and avoidance of complications associated with inappropriate transfusions.

### **3.0 Design and Methodology**

A prospective audit was undertaken of the clinical indications and laboratory data for all transfusion episodes of frozen plasma occurring in participating Ontario hospitals for any five days, not necessarily consecutive days, between September 22 and October 19, 2008. The days chosen for audit were left to the discretion of the hospital in order to maximize the numbers and enable each site to balance workload and staffing. The data were collected using a web-based audit tool developed for this audit (created in collaboration with Nextmove Inc.). Each site was pre-coded by their MAK code, which is assigned by Canadian Blood Services for any site receiving blood and blood components. Access was restricted to the hospital by user ID and password. Data variables for collection were chosen by a subgroup of the Plasma Steering Committee.

A pilot study involving four hospitals was conducted over a five day period from May 26 – 30, 2008. The pilot was used to test the functionality of the tool and to obtain feedback from the pilot hospitals regarding its use. Based on feedback from the participating hospitals, revisions were made to the audit tool prior to the formal conduct of the audit.

Elements required for identification of patients (first name, last name, hospital identification number) were entered on log sheets located only at the participating hospital. Patients were assigned an anonymous study code number which was used to enter and identify patients in the secure database.

The data elements collected included:

- Hospital site
- Patient care area
- Date of transfusion
- Patient identification by study code number
- Patient age (year of birth) and Gender
- Indication for plasma transfusion
- Number of units ordered
- Ordering physician specialty
- Final disposition of product (if not transfused)

### **4.0 Validation Procedures**

Verification and validation procedures took place during the data collection period and at the end of the final data entry period (October 2008). As part of the verification process, all the data were reviewed for any duplicate entries or any discrepant entries. 15 hospitals were contacted regarding thirty-six (36) problematic entries. 35/36 problematic entries were due to number of plasma units ordered not matching the number of plasma units transfused. In 29 cases the units transfused were the 500 mL apheresis units which are equivalent to two units. The remainder of cases was due to missing data. Staff reviewed 10% of the manual entry sheets from a random sample of participating hospitals and compared them to the web-based data for consistency to confirm a match between the two entries. There was a 98% (59/60) agreement rate between the manual entry sheets and the web-based data with all discrepancies found in the random sample being rectified.

It is concluded that discrepancies in the database in general were sufficiently rare that they

would not materially affect the analysis and /or conclusions.

### **Reporting Results to Participating Hospitals**

The details for each hospital’s individual patient/transfusion data together with the interpretation as “Appropriate”, “Inappropriate” or “Indeterminate” for each case are contained in Appendix C. The hospital identities are coded for confidentiality reasons. When this report is issued and copies sent to hospitals, individual participating institutions will be informed of their code so that they may review the interpretation of the data they submitted but will not be able to identify the source of any other institution’s data.

### **5.0 Determination of Appropriate/Inappropriate ratings for frozen plasma transfusions**

The criteria for assessing the appropriateness of each plasma order were developed by 6 volunteer Hematologists (see table 1). These criteria were based on published plasma guidelines, but the specific criteria for appropriateness were very liberal to avoid overestimating the number of inappropriate transfusions especially given the limited clinical and laboratory data that was collected as part of the audit. The indeterminate rating was used when there was insufficient evidence from the literature to judge appropriateness or insufficient clinical data were provided. Appropriate, inappropriate and indeterminate transfusions were subclassified by clinical indication.

Each order was reviewed and independently rated by two Hematologists. For any discrepancies in either the rating of appropriate, inappropriate or indeterminate, or the sub classification, the final rating was reached by consensus between the two hematologists.

**Table 1** Criteria developed for classification of orders for frozen plasma transfusion as “appropriate”, “inappropriate” or “indeterminate”.

<b>Code</b>	<b>Appropriate</b>
<b>A1</b>	<ul style="list-style-type: none"> <li>• Reversal of coumadin/warfarin or vitamin K deficiency</li> <li>• Bleeding</li> <li>• Pre- or post-transfusion INR &gt;1.5 and/or PTT &gt;1x upper limit of normal.</li> </ul>
<b>A2</b>	<ul style="list-style-type: none"> <li>• Coagulopathy other than coumadin or vitamin K deficiency</li> <li>• Urgent intervention or surgery</li> <li>• Pre- or post- transfusion INR &gt;1.5 and/or PTT&gt;1x upper limit of normal.</li> </ul>
<b>A3</b>	<ul style="list-style-type: none"> <li>• Coagulopathy other than coumadin or vitamin K deficiency</li> <li>• Bleeding</li> <li>• Pre- or post- transfusion INR &gt;1.5 and/or PTT &gt;1x upper limit of normal</li> </ul>
<b>A4</b>	<ul style="list-style-type: none"> <li>• “Massive transfusion”</li> <li>• Pre- or post- transfusion INR&gt;1.5 and/or PTT &gt;1x upper limit of normal</li> </ul>
<b>A5</b>	<ul style="list-style-type: none"> <li>• Apheresis/plasma exchange or TTP</li> <li>• Regardless of coagulation status</li> </ul>
<b>A6</b>	<ul style="list-style-type: none"> <li>• Peri-surgical bleeding</li> <li>• Pre- or post- transfusion INR&gt;1.5 and/or PTT&gt;1x upper limit of normal.</li> </ul>

<b>Inappropriate</b>	
<b>I1</b>	<ul style="list-style-type: none"> <li>• Reversal of coagulation defect due to coumadin/warfarin or vitamin K deficiency</li> <li>• Absence of bleeding</li> </ul>
<b>I2</b>	<ul style="list-style-type: none"> <li>• INR <math>\leq</math> 1.0 pre- transfusion/normal PTT (and normal post-procedure if available)</li> <li>• Irrespective of bleeding status or procedure status</li> </ul>
<b>I3</b>	<ul style="list-style-type: none"> <li>• INR 1.1 – 1.5 pre- transfusion/ normal PTT (and normal post-procedure if available)</li> <li>• Irrespective of bleeding status or procedure status</li> </ul>
<b>I4</b>	<ul style="list-style-type: none"> <li>• Heparin reversal (regardless of INR)</li> </ul>
<b>I5</b>	<ul style="list-style-type: none"> <li>• Volume replacement</li> </ul>
<b>I6</b>	<ul style="list-style-type: none"> <li>• Reversal of coagulation defect other than coumadin/warfarin or vitamin K or heparin</li> <li>• Pre- or post- transfusion INR<math>&gt;</math>1.5 and/or PTT<math>&gt;</math>1x upper limit of normal.</li> <li>• No bleeding or surgery/procedure</li> </ul>
<b>Indeterminate</b>	
<b>M1</b>	<ul style="list-style-type: none"> <li>• No laboratory coagulation data pre- or post- transfusion</li> </ul>
<b>M2</b>	<ul style="list-style-type: none"> <li>• No laboratory coagulation data pre- transfusion (with normal coagulation results post-procedure)</li> </ul>
<b>M3</b>	<ul style="list-style-type: none"> <li>• Abnormal coagulation – diagnosis unknown,</li> <li>• Not bleeding</li> <li>• Procedure unknown</li> </ul>
<b>M4</b>	<ul style="list-style-type: none"> <li>• “Massive transfusion”</li> <li>• Pre- or post- transfusion INR<math>&lt;</math>1.5 and/or PTT <math>&lt;</math>1x upper limit of normal or no laboratory coagulation data available</li> </ul>
<b>M5</b>	<ul style="list-style-type: none"> <li>• Abnormal coagulation pre- or post- transfusion</li> <li>• Bleeding unknown</li> </ul>

## **6.0 Provincial Plasma Audit Results**

### ***Participating hospitals***

Seventy-six of 155 eligible hospitals (49%) participated in the Provincial audit. (Minimal plasma usage and increased workload involved in taking part were common reasons for non-participation). The participating hospitals represent 88% of the frozen plasma transfused in the Province.<sup>13</sup> The hospital sites were classified into three different types of institutions: 16 small hospitals (< 100 beds), 44 community hospitals (> 100 beds) and 16 teaching hospitals (sites affiliated with an academic centre). The data collected primarily reflect plasma used by the adult population.

### ***Frozen plasma utilization***

Among the participating hospitals 65 sites had requests for frozen plasma and 11 sites had no requests for frozen plasma during the audit period. There were a total of 573 requests for 2012 units (250 ml equivalents). The total number of units transfused was 1909. The breakdown for the types of units transfused or otherwise disposed of is provided in Table 2 which incorporates aggregate data for all participating hospitals.

**Table 2** Units of various plasma products ordered, transfused or otherwise disposed of during the audit period.

Total number of reported orders	573
Total number of units ordered	2012
Total number of units transfused	1909*
FP/FFP units transfused	1308
Apheresis (250 mL)	55
Apheresis (500 mL)	211
Cryo-poor plasma	124
Units discarded	48
Units broken	6
Units ordered not thawed	49

\* 250 mL equivalents

The distribution of orders for frozen plasma by hospital classification, together with information on units transfused, ordered and not transfused, broken in processing or discarded is provided in Table 3.

**Table 3** Distribution of ordering, transfusion, and discarding of units of frozen plasma by hospital classification.

	All	Small Hospitals (n=10)	Community Hospitals (n=39)	Teaching Hospitals (n=16)
Total # of orders	573	22 (3.8%)	278 (48.5%)	273 (47.6%)
Median # orders per hospital (min-max)	573	1 (1-6)	6 (1-28)	11 (1-44)
# of units ordered	2012	61 (3.0%)	854 (42.4%)	1097 (54.5%)
Median # units ordered per hospital (min-max)	2012	2 (1-6)	2 (1-16)	4 (1-18)
# of units transfused	1909	60 (3.1%)	821 (43.0%)	1028 (53.9%)
Median # units transfused per hospital (min-max)	1909	2 (1-6)	2 (1-16)	4 (1-18)
# of units discarded	48	0	19	29
# of units broke	6	0	5	1
# of units ordered/ not thawed	49	1	9	39

Table 4 presents the data defining the clinical services from which orders for frozen plasma originated. General surgery, internal medicine and emergency physicians each represented greater than 10% of the total number of orders for frozen plasma. Critical care and cardiovascular surgery were the second and third largest users of frozen plasma in teaching hospitals but overall they represent 8.4% and 7.3% all frozen plasma orders, respectively.

**Table 4** Clinical services from which orders for frozen plasma originated.

Specialty	Total # of orders (%)	Small Hospitals # of orders (%)	Community Hospitals # of orders (%)	Teaching Hospitals # of orders (%)
Surgery: General	94 (16.4)	3 (13.6)	48 (17.3)	43 (15.8)
Internal Medicine	87 (15.2)	3 (13.6)	63 (22.7)	21 (7.7)
Emergency	72 (12.6)	4 (18.2)	48 (17.3)	20 (7.3)
Critical care: medicine	48 (8.4)		19 (6.8)	29 (10.6)
Surgery: Cardiovascular	42 (7.3)		4 (1.4)	38 (13.9)
Anaesthesia	33 (5.8)		15 (5.4)	18 (6.6)
General Practice/Family Medicine	31 (5.4)	11 (50.0)	19 (6.8)	1 (0.4)
Surgery: Orthopedic	24 (4.2)		16 (5.8)	8 (2.9)
Other	23 (4.0)		5 (1.8)	18 (6.6)
Hematology	21 (3.7)		3 (1.1)	18 (6.6)
Gastroenterology	20 (3.5)		10 (3.6)	10 (3.7)
Cardiology	15 (2.6)		4 (1.4)	11 (4.0)
Critical care: cardiac	15 (2.6)		5 (1.8)	10 (3.7)
Nephrology	12 (2.1)		7 (2.5)	5 (1.8)
Obstetrics & Gynecology	11 (1.9)	1 (4.6)	5 (1.8)	5 (1.8)
Surgery: Neurosurgery	9 (1.6)		2 (0.7)	7 (2.6)
Oncology	7 (1.2)		1 (0.4)	6 (2.2)
Respirology	4 (0.7)		2 (0.7)	2 (0.7)
Neonatology	2 (0.3)			2 (0.7)
Dermatology	1 (0.2)			1 (0.4)
Neurology	1 (0.2)		1 (0.4)	
Pediatrics	1 (0.2)		1 (0.4)	
<b>Other</b>				
Transplant program	9 (1.6)			9 (3.3)
Surgery: Vascular	4 (0.7)		1 (0.4)	3 (1.1)
Hospitalist	3 (0.5)		3 (1.1)	
Liver Transplant	2 (0.3)			2 (0.7)
Surgery: Urology	2 (0.3)			1 (0.4)
Nurse Practitioner	1 (0.2)		1 (0.4)	
Unknown	2 (0.3)			2 (0.7)
Urology				1 (0.4)
<b>Total</b>	<b>573</b>	<b>22</b>	<b>278</b>	<b>273</b>

Table 5 shows the location within the hospitals to which frozen plasma was issued and where transfusion of frozen plasma was assumed to have taken place. The operating room and the intensive care unit transfused 23.2% and 21.5% respectively of all the frozen plasma units transfused. The next most frequent areas for transfusion were general medical wards and the emergency department.

**Table 5** Hospital location to which frozen plasma was issued for transfusion.

Hospital location	Total # of orders (%)	Small Hospitals # of orders (%)	Community Hospitals # of orders (%)	Teaching Hospitals # of orders (%)
Operating Room (OR)	133 (23.2)	2 (9.1)	37 (13.3)	94 (34.4)
Intensive-Critical care (ICU)	123 (21.5)	1 (4.6)	67 (24.1)	55 (20.2)
Medical Ward	94 (16.4)	10 (45.4)	51 (18.4)	33 (12.1)
Emergency	84 (14.7)	7 (31.8)	54 (19.4)	23 (8.4)
Surgical Ward	38 (6.6)	1 (4.6)	36 (13.0)	1 (0.4)
Cardiovascular ICU	26 (4.5)		7 (2.5)	19 (7.0)
Apheresis	19 (3.3)			19 (7.0)
Recovery Room	18 (3.1)		3 (1.1)	15 (5.5)
Other	17 (3.0)	1 (4.6)	9 (3.2)	7 (2.6)
Coronary Care Unit	11 (1.9)		9 (3.2)	2 (0.7)
Dialysis	3 (0.5)		3 (1.1)	
Outpatient Clinic	3 (0.5)		1 (0.4)	2 (0.7)
Neonatal ICU	2 (0.3)			2 (0.7)
Diagnostic Imaging	1 (0.2)			1 (0.4)
Unknown	1 (0.2)		1 (0.4)	
<b>Other</b>				
Patient Room	4 (0.7)			4 (1.5)
Birthing Suite			1 (0.4)	
Obstetrics	2 (0.3)	1 (4.6)		
Telemetry	2 (0.3)		2 (0.7)	
Burn Ward	1 (0.2)			1 (0.4)
Transplant Unit	1 (0.2)			1 (0.4)
Rehabilitation	1 (0.2)		1 (0.4)	
Neurology ICU	1 (0.2)			1 (0.4)
Home Transfusion	1 (0.2)		1 (0.4)	
Medicine-Cardio	1 (0.2)		1 (0.4)	
<b>Plasma not issued</b>	3 (0.5)		3 (1.1)	
Total	573	22	278	273

Table 6 shows the broad indications for which frozen plasma was ordered. The most common indications leading to orders for frozen plasma were in connection with surgery (31.4%) and for anticoagulant reversal (20.2%).

**Table 6** Clinical indications for orders of frozen plasma

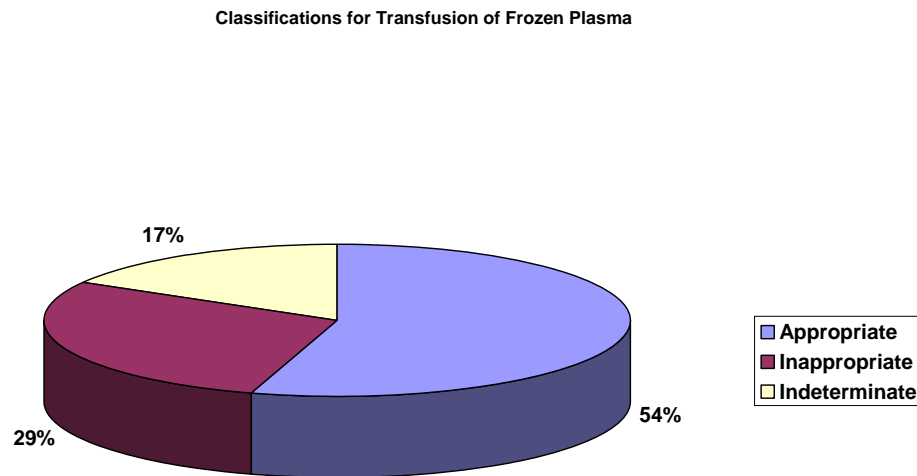
Procedure/ Clinical Indication	Total # of orders (%)	Small Hospitals # of orders (%)	Community Hospitals # of orders (%)	Teaching Hospitals # of orders (%)
Surgery	180 (31.4)	4 (18.2)	68 (24.5)	109 (39.9)
Anticoagulant Reversal	116 (20.2)	3 (13.6)	98 (35.3)	15 (5.5)
Coagulopathy (Liver disease, DIC, etc)	64 (11.2)		39 (14.0)	25 (9.2)
Massive Transfusion	42 (7.3)		17 (6.1)	25 (9.2)
GI Bleed	25 (4.4)	3 (13.6)	12 (4.3)	10 (3.7)
Other Bleed	23 (4.0)	4 (18.2)	11 (4.0)	8 (2.9)
Plasma exchange (therapeutic apheresis)	22 (3.8)		3 (1.1)	19 (7.0)
Drain/Line Insertion	10 (1.7)			10 (3.7)
Sepsis	11 (1.9)		6 (2.2)	5 (1.8)
Liver Transplant	8 (1.4)			8 (2.9)
Leukemia	7 (1.2)		1 (0.4)	6 (2.2)
Unknown	13 (2.3)		6 (2.2)	6 (2.2)
Image Guided Therapy	6 (1.0)	4 (18.2)	1 (0.4)	1 (0.4)
Thoracentesis	5 (0.9)			5 (1.8)
Paracentesis	4 (0.7)		4 (1.4)	
Central Line Placement	3 (0.5)			3 (1.1)
Volume Expansion	3 (0.5)		3 (1.1)	
Other Transplant	2 (0.3)			2 (0.7)
Trauma	2 (0.3)			2 (0.7)
Liver Biopsy	2 (0.3)			2 (0.8)
Cardiac Catheterization	1 (0.2)			1 (0.4)
Fine Needle aspirate	1 (0.2)		1 (0.4)	
Pleural Effusion	2 (0.3)		1 (0.4)	1 (0.4)
<b>Miscellaneous</b>	21 (3.7)	4 (18.2)	7 (2.5)	10 (3.7)
Total	573	22	278	273



## 7.0 Appropriateness of frozen plasma transfusions

### *Indications for transfusion of frozen plasma*

**Figure 2** Of the 573 requests for Frozen Plasma, 314 (54.8%) were classified as appropriate while 164 (28.6%) were inappropriate and 95 (16.6%) were indeterminate.



314/573 (54.8%) of plasma orders classified as Appropriate  
164/573 (28.6%) of plasma orders classified as Inappropriate  
95/573 (16.6%) of plasma orders classified as Indeterminate

The most common indications deemed “appropriate” were in relation to surgery and for reversal of anticoagulant effect. The frequency of the various reasons for orders of frozen plasma that were deemed “inappropriate” or “indeterminate” are given in Table 7 in which the proportion of the different categories defined in Table 1 are listed in descending order.

**Table 7** Summary of frequency of reasons transfusion orders for frozen plasma were deemed “appropriate”, “inappropriate” or “indeterminate”.

<b>Code Defining “Appropriate”</b>	<b># of orders (%)</b>	<b>Code Description</b>
A3	96 (16.8)	<ul style="list-style-type: none"> <li>• Coagulopathy other than coumadin or vitamin K deficiency</li> <li>• Bleeding</li> <li>• Pre- or post- transfusion INR &gt;1.5 and/or PTT &gt;1x upper limit of normal</li> </ul>
A6	80 (14.0)	<ul style="list-style-type: none"> <li>• Peri-surgical bleeding</li> <li>• Pre- or post- transfusion INR&gt;1.5 and/or PTT&gt;1x upper limit of normal.</li> </ul>
A2	43 (7.5)	<ul style="list-style-type: none"> <li>• Coagulopathy other than coumadin or vitamin K deficiency</li> <li>• Urgent intervention or surgery</li> <li>• Pre- or post- transfusion INR &gt;1.5 and/or PTT&gt;1x upper limit of normal.</li> </ul>
A1	37 (6.4)	<ul style="list-style-type: none"> <li>• Reversal of coumadin/warfarin or vitamin K deficiency</li> <li>• Bleeding</li> <li>• Pre- or post-transfusion INR &gt;1.5 and/or PTT &gt;1x upper limit of normal.</li> </ul>
A4	35 (6.1)	<ul style="list-style-type: none"> <li>• “Massive transfusion”</li> <li>• Pre- or post- transfusion INR&gt;1.5 and/or PTT &gt;1x upper limit of normal</li> </ul>
A5	23 (4.0)	<ul style="list-style-type: none"> <li>• Apheresis/plasma exchange or TTP</li> <li>• Regardless of coagulation status</li> </ul>

<b>Code Defining “Inappropriate”</b>	<b># of orders (%)</b>	<b>Code Description</b>
I3	90 (15.7)	<ul style="list-style-type: none"> <li>• INR 1.1 – 1.5 pre- transfusion/ normal PTT (and normal post-procedure if available)</li> <li>• Irrespective of bleeding status or procedure status</li> </ul>
I1	41 (7.2)	<ul style="list-style-type: none"> <li>• Reversal of coagulation defect due to coumadin/warfarin or vitamin K deficiency</li> <li>• Absence of bleeding</li> </ul>
I6	15 (2.6)	<ul style="list-style-type: none"> <li>• Reversal of coagulation defect other than coumadin/warfarin or vitamin K or heparin</li> <li>• Pre- or post- transfusion INR&gt;1.5 and/or PTT&gt;1x upper limit of normal.</li> <li>• No bleeding or surgery/procedure</li> </ul>
I4	10 (1.7)	<ul style="list-style-type: none"> <li>• Heparin reversal (regardless of INR or PTT)</li> </ul>
I2	7 (1.2)	<ul style="list-style-type: none"> <li>• INR ≤ 1.0 pre- transfusion/normal PTT (and normal post-procedure if available)</li> <li>• Irrespective of bleeding status or procedure status</li> </ul>
I5	1 (0.2)	<ul style="list-style-type: none"> <li>• Volume replacement</li> </ul>

Code Defining “Indeterminate”	# of orders (%)	Code Description
M5	31 (5.4)	<ul style="list-style-type: none"> <li>Abnormal coagulation pre- or post- transfusion</li> <li>Bleeding unknown</li> </ul>
M1	27 (4.7)	<ul style="list-style-type: none"> <li>No laboratory coagulation data pre- or post- transfusion</li> </ul>
M2	17 (3.0)	<ul style="list-style-type: none"> <li>No laboratory coagulation data pre- transfusion (with normal coagulation results post-procedure)</li> </ul>
M3	12 (2.1)	<ul style="list-style-type: none"> <li>Abnormal coagulation – diagnosis unknown,</li> <li>Not bleeding</li> <li>Procedure unknown</li> </ul>
M4	8 (1.4)	<ul style="list-style-type: none"> <li>“Massive transfusion”</li> <li>Pre- or post- transfusion INR&lt;1.5 and/or PTT &lt;1x upper limit of normal or no laboratory coagulation data available</li> </ul>

### *Appropriateness of orders for transfusion of frozen plasma by hospital class*

The proportion of orders deemed “appropriate”, “inappropriate” or “indeterminate” by hospital class is shown in table 8. The only significant differences to emerge on comparison of the various categories was in respect of the teaching hospitals vs. the community hospitals for appropriate orders (higher proportion, 64.5% vs. 45.7%) and inappropriate orders (lower proportion, 19.4% vs. 36.7%); in both cases  $p < 0.0001$ .

**Table 8** Orders for frozen plasma for transfusion by class of hospital

Hospital size	Orders			Total
	Appropriate	Inappropriate	Indeterminate	
Small Hospital	11 (50.0%)	9 (40.9%)	2 (9.1%)	22
Community Hospital	127 (45.7%)	102 (36.7%)	49 (17.6%)	278
Teaching Hospital	176 (64.5%)	53 (19.4%)	44 (16.1%)	273
Total	314	164	95	573

***Appropriateness of orders for transfusion of frozen plasma by region***

The proportion of orders classified as “appropriate”, “inappropriate” or “indeterminate” did not differ significantly from one region of the Province to another and this was true regardless of the class of hospital being compared (Table 9).

**Table 9** Orders for frozen plasma for transfusion by region.

Region	Orders			Total
	Appropriate	Inappropriate	Indeterminate	
Central	150 (56.8%)	67 (25.4%)	47 (17.8%)	264
SW	119 (53.6%)	68 (30.6%)	35 (15.8%)	222
NE	45 (51.7%)	29 (33.3%)	13 (14.9%)	87
Total	314	164	95	573

***Effect of presence of “guidelines” on appropriateness of transfusion of frozen plasma***

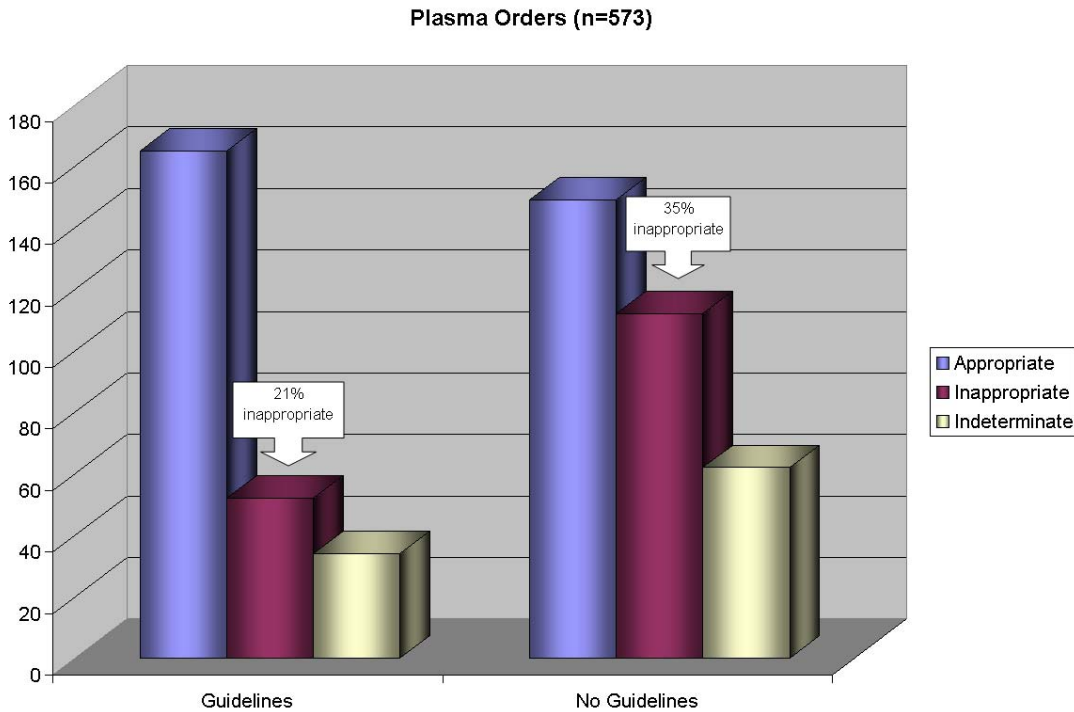
There was a significantly greater number of appropriate (65.7% vs. 46.3%) and correspondingly lower number of inappropriate transfusions (20.7% vs. 34.8%) in hospitals with “guidelines” for the appropriate use of frozen plasma as compared to those hospitals that did not have “guidelines” (see table 10 and figure 3). The audit tool posed the simple question “Does your facility have institutional guidelines for the use frozen plasma?” No attempt was made to acquire more detail concerning the nature and content of the “guidelines” in use.

There were 22 hospitals reporting the existence of “guidelines” and 43 hospitals did not have such “guidelines” for the use of frozen plasma. (11 hospitals did not report).

**Table 10** Significance of differences in proportion of orders deemed “appropriate”, “inappropriate” or “indeterminate” in hospitals with and without “guidelines” for transfusion of frozen plasma.

Orders	Guidelines	No Guidelines	P value
Appropriate	165 (65.7%)	149 (46.3%)	p<0.0001
Inappropriate	52 (20.7%)	112 (34.8%)	p<0.0003
Indeterminate	34 (13.5%)	61 (18.9%)	0.08

**Figure 3** Differences in proportion of orders deemed “appropriate”, “inappropriate” and “indeterminate” in hospitals with and without guidelines for transfusion of frozen plasma.

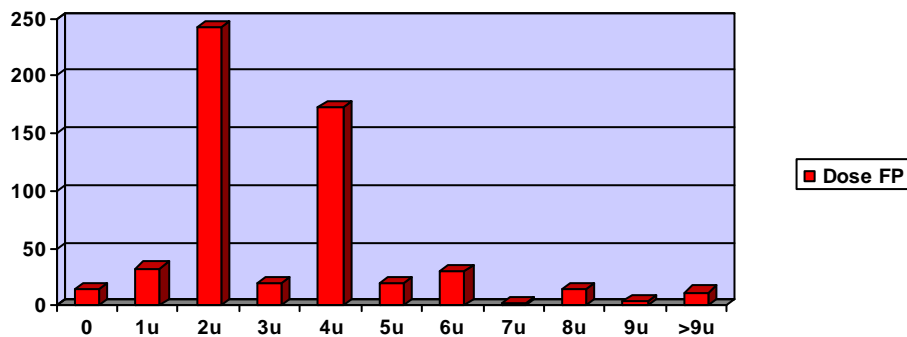


***Dose of frozen plasma transfusions***

The most common dose of frozen plasma transfused was 2 units (42.4% of transfusions) and the next most common dose was 4 units (30.2% of transfusions) (Figure 4). For an average 70 kg patient, the 2 unit dose represents a dose of about 7 ml/kg which is below the recommended dose of 10-15 mls/kg. Assuming a 70 kg patient weight, the 10-15 ml/kg recommended dose is equivalent to 3-4 250mL units.

When data on the appropriateness of the order for frozen plasma and for adequacy of dosage are combined, *only 29% of all transfusions met the criteria for both an appropriate indication and the recommended dose range.*

**Figure 4** Distribution of doses of plasma transfused as reported by audit participants (1 “unit” is equivalent to 250 mL of random donor plasma)



## **8.0 Conclusions and recommendations**

### ***Discussion***

Reviews of literature and of the results of the current audit reported here raise several issues for discussion which will lead to recommendations for improvement in practice.

Three main areas offer the opportunity for savings – reduced use of inappropriate frozen plasma transfusions, elimination of the expense of managing complications caused by inappropriate transfusions and increased self sufficiency for the production of Canadian source plasma protein products. This audit confirms that prescribing outside of guidelines is not uncommon. Thus, efforts are needed to ensure implementation of guidelines into practice which would reduce the use of frozen plasma and result in significant cost-savings for the Province. The “hidden” costs of complications caused by frozen plasma transfusions which should not have been given would be eliminated. Donor plasma can be re-directed for fractionation thus reducing the reliance on more expensive foreign sources. Furthermore, education of those prescribing and administering transfusions designed to prevent complications could be promoted through the outcomes of this audit.

### ***Adequacy of present guidelines***

Recent reviews of the published guidelines for use of frozen plasma (see appendix A) have emphasized their lack of foundation on high quality evidence, depending as they do largely on observational studies and “expert opinion” rather than on results of random controlled clinical trials.<sup>14</sup> There is a general lack of evidence that transfusion of frozen plasma is effective in preventing bleeding in a variety of clinical settings. Evidence is lacking that the results of laboratory tests designed to assess coagulation function are predictors of bleeding in populations likely to be treated with frozen plasma. Recent studies have confirmed that frozen plasma transfusion is ineffectual in correcting mild elevations of the international normalized ratio or prothrombin time.<sup>15,16</sup> Taken together, these observations suggest that there may be even more potential for reducing the use of frozen plasma transfusion beyond that to be achieved by following current published clinical practice guidelines.

Thus, guidelines used have significant deficiencies but at the time this audit was designed were the only generally recognized criteria available upon which to base an audit of Provincial use of frozen plasma. Since then, a new set of guidelines have been published which include a novel approach in attempting to define situations in which frozen plasma should not be used.<sup>17</sup>

### ***Examples of situations in which it is recommended that frozen plasma not be prescribed:<sup>17</sup>***

- Plasma should not be administered prophylactically to patients with normal coagulation tests submitted to high-risk surgery or invasive diagnostic procedures
- Plasma is not the first choice to neutralize anticoagulation with coumarin agents in bleeding patients and prothrombin complex concentrates should be given instead. The administration of plasma can be taken into consideration when no prothrombin complexes are available
- Plasma should not be given to correct hypovolemia in the absence of massive bleeding
- Plasma should not be used routinely for plasma exchange

### ***Previous audits using present guidelines***

This audit of frozen plasma use has involved more transfusions/patients than all but one of those listed in Appendix B. Those 10 audits of frozen plasma transfusion have been reported worldwide using the criteria of the guidelines listed in appendix A. Overall, between 26% and 73% of orders or transfusions of frozen plasma did not meet the specified criteria. Two of these studies were conducted in Ontario<sup>8,9</sup> and concluded that about half of transfusions of frozen plasma were “inappropriate”. Despite the publication of these two audits, no significant improvement in appropriate ordering practices has been demonstrated in Ontario during this audit.

Even with guidelines with identifiable shortcomings, there remain a large number of transfusions of frozen plasma that should almost certainly not have been carried out.

### ***Adequacy of dosage of frozen plasma***

Only 29% of all frozen plasma transfusions administered during the audit met the criteria for both an appropriate indication and the recommended dosage range. Several recent reports have emphasized that the volumes of plasma required to correct *in vitro* clotting defects are usually greater than the doses commonly prescribed<sup>18-21</sup> and therefore raise the risk of transfusion-associated circulatory overload (TACO).

The generally accepted minimal effective dose is 10-15mL/kg of body weight<sup>22</sup> which translates to 750 – 1,000 mL for an average sized individual. Shulman and Bijsterveld<sup>21</sup> suggest that 2,000 mL would be required to reduce a high INR due to warfarin effect to less than 1.5.

### ***Adverse events associated with transfusion of frozen plasma***

The adverse events associated with the transfusion of frozen plasma have until recently been overshadowed by concerns regarding incompatible red cell transfusion and bacterial contamination principally associated with platelet use. Recently, frozen plasma has received more attention. Transfusion-related acute lung injury (TRALI) is mediated in many (but not all) cases by antibodies in donor plasma which react with recipient leucocytes, particularly in patients “primed” by co-morbid pulmonary complications.<sup>23</sup> The frequency of TRALI is hard to estimate but a figure of 1:5000 transfusions has some general support.<sup>22</sup> The fatality rate from TRALI is uncertain but a figure of 10% of cases is quoted. TRALI has proved the commonest cause of transfusion associated death in the UK SHOT hemovigilance program up to 2006;<sup>24</sup> 39 of 109 deaths were attributed to TRALI. Since the antibodies in donor plasma which mediate many cases of TRALI are commonly found in female donors who have been pregnant, female derived plasma has been eliminated as a source of frozen plasma with reduction but not complete prevention of TRALI. Thus, the UK SHOT program noted TRALI with a frequency of 1:65,000 units of frozen plasma transfused in 1999-2004 compared with 1:317,000 units in 2005-2006 after elimination of female derived plasma.<sup>24</sup>

Transfusion-associated circulatory overload (TACO) has been recognized for many years and represents the resultant effect of the volume and rate of transfusion, and the cardio-pulmonary status of the recipient. It is common but has only recently become reportable to hemovigilance schemes in North America and the UK. Estimates of frequency of TACO vary from 1:700 red cell transfusions in general<sup>25</sup> to 1:100 in elderly recipients.<sup>26</sup> Forty-nine of 321 transfusion associated deaths reported to the French Hemovigilance System from 1995-2002 were attributed to TACO.<sup>27</sup> Six of 7 transfusion fatalities reported to the Quebec Hemovigilance System in 2007 were attributed

to TACO.<sup>28</sup>

Major allergic reactions and bacterial contamination remain rare but serious complications of frozen plasma transfusion. Occasional cases of ABO incompatible transfusion reactions occur usually due to transfusion of high titre anti-A or anti-B plasma from group O donors. Minor adverse events, the precise frequency of which is unknown, include febrile reactions, minor allergic phenomena and transient hypotension.

Thus, transfusion of frozen plasma carries significant risks of severe, even fatal, adverse effects, the full significance of which is only now coming fully to light.

It should be noted that this audit was not designed to capture data on rates of transfusion reactions; this would require a larger study with provision for clinical follow-up and review.

### ***Limitations of the Data***

After evaluation of the audit data it was determined that there were some limitations to the data that needed to be disclosed.

Participating hospitals were unable to choose two clinical indications. (e.g. a site could not choose both anticoagulant reversal and preoperative);

The definition for minor bleeding and bleeding was stated in the audit questions however this information is often difficult to obtain without doing a full chart review;

During the audit period, a prothrombin complex concentrate containing factors II, VII, IX and X (Octaplex™) was introduced and its use was not considered in the development of the rating criteria;

The pilot included the patient's weight which proved to be inconsistently available and was therefore removed from the final audit tool;

Point of care coagulation testing may have been utilized for orders that did not have pre-transfusion coagulation results entered. This data may not have been available to the audit reporter;

The audit period chosen was for 5 days (not necessarily consecutive) which limits the amount of data collected.

### ***Lessons from this audit***

This audit has provided a valuable "snapshot" of current practice in transfusing frozen plasma in Ontario and provides a number of areas for improvement, both quantitatively and qualitatively.

- (i) Numerous transfusions (at least 29%) are given without meeting the indications defined by current guidelines. It has been suggested that reasons for not prescribing frozen plasma should be put forward and that recording of indications for specific transfusion orders would provide an element of clarity in decision-making.<sup>7</sup> Inappropriate transfusions confer risk without benefit to the recipient.
- (ii) The dose of frozen plasma administered (1 or 2 units) in about half of cases was insufficient to meet the usually accepted effective dose, thus exposing the recipient to risk with minimal benefit.
- (iii) Of all transfusions of frozen plasma audited, less than 30% were given both for an indication deemed appropriate and meeting the minimal dosage criteria.
- (iv) Significant numbers of frozen plasma transfusions were given for



indications regarded as clinically inappropriate such as reversal of heparin effect or “volume replacement” for which specific or better alternatives are available.

- (v) Hospitals associated with an academic medical centre (“teaching hospitals”) appear to have a lower rate of inappropriate transfusion of frozen plasma. Nevertheless, the rate of inappropriate use of frozen plasma in these institutions remains unacceptably high.
- (vi) The existence of hospital-specific protocols for ordering and issuing frozen plasma is associated with a significantly diminished proportion of inappropriate transfusions of frozen plasma. While such protocols themselves may not alone be sufficient to improve the appropriate use of blood products, they represent an essential part of an institutional culture that will improve their use.
- (vii) A considerable number of frozen plasma transfusions were given to reverse the effects of vitamin K antagonists. While it is unclear from the data collected how many of these were truly required on the basis of the clinical urgency of the situation, the recent licensing and availability of prothrombin complex concentrates in Canada (Octaplex™) and the judicious use of vitamin K alone should largely replace frozen plasma for this purpose.
- (viii) Evidence is accumulating worldwide that frozen plasma has its own pattern of serious adverse events, particularly TRALI and TACO. While the risk of TRALI has been mitigated by changes in donor acceptability criteria (exclusion of plasma where possible from female donors), the risk has not been eliminated. TACO is beginning to be more fully recognized as a serious, potentially fatal complication of transfusion in general, including plasma. The administration of a dose adequate to produce the desired effect enhances this risk.
- (ix) Financial savings and savings in morbidity and mortality could accrue from more rational use of frozen plasma. Financial savings could accrue from removing the cost of processing, distributing, storing and issuing the full quantities of frozen plasma currently consumed. An estimate of the cost of frozen plasma units that are inappropriately transfused is \$247,000 per month, (8500 units transfused per month x \$100 unit\* x 29%), approximately 3 million dollars annually. Plasma not required for transfusion as frozen plasma to patients could be diverted to production of IVIG from Canadian plasma, so reducing the cost of purchasing non-Canadian plasma for fractionation for Canadian IVIG consumption and increasing the security of the products for Canadians. The savings in suffering could accrue from the withholding of inappropriate transfusions, with concomitant financial savings from avoidance of the considerable expense of caring for these often severe and life-threatening complications.

\* Cost estimate from CBS is \$99 for 1 unit of frozen plasma (fiscal year 2007/8 estimate)

## **Recommendations for improvement in frozen plasma transfusion practice**

It is clear that there is a need and opportunity for improvement in transfusion practice in respect of frozen plasma. Vigorous educational measures suggested by the outcomes of this audit which can be undertaken promptly include:

- (i) introduction of clinical practice recommendations including strategies for implementation;
- (ii) a clear statement of conditions for which frozen plasma transfusion is *not* indicated should be issued;
- (iii) a clear statement concerning the adequacy of the dose of frozen plasma required to produce a significant improvement in hemostatic function together with the risk of adverse effects of such dosage;
- (iv) dissemination of advice on the use of vitamin K alone for reversal of the effects of vitamin K antagonists (VKA) (“warfarin effect”) where time permits;
- (v) dissemination of information on indications and procedures for the use of prothrombin complex concentrates for urgent reversal of VKA effects;
- (vi) enhanced general awareness of the potential adverse consequences of transfusion of frozen plasma

### ***Proposed future steps***

- (i) The implementation of new clinical practice recommendations should be further evaluated to determine the uptake and effectiveness in improving transfusion practice in respect of frozen plasma.
- (ii) Randomized controlled trials should be carried out to determine the effectiveness of frozen plasma in various clinical settings in which it is now commonly used, with a view to establishing objective evidence as to its efficacy or otherwise;
- (iii) Well-designed multi-centre random controlled trials should be mounted to determine the optimal transfusion policy for resuscitation and massive transfusion to address the optimal relative proportion of red cells, platelets and frozen plasma.

## **9.0 Acknowledgements**

ORBCoN would like to acknowledge the following:

The Transfusion Medicine Staff at all participating facilities

The Ministry of Health and Long Term Care for providing funding to support this audit

The Plasma Audit Criteria/Coding Working Group: Dr. Jeannie Callum, Dr. Peter Pinkerton, Dr. Alan Tinmouth, Dr. Cyrus Hsia, Dr. Donnie Arnold and Dr. Yulia Lin

The Plasma Audit Report Writing Committee: Dr. Alan Tinmouth, Mr. Troy Thompson, Dr. Jeannie Callum, Dr. Peter Pinkerton and Dr. Donnie Arnold

The Provincial Plasma Audit Steering Committee

McMaster Transfusion Research Program (MTRP)

Special thanks to: Dr. Ben Saxon, former Medical Director of the Toronto Centre CBS for his foresight in suggesting the concept of holding a provincial plasma audit “day”, the catalyst to making this happen.

## Appendix A – Summary of Published Guidelines for the Use of Fresh Frozen Plasma

<b>Guideline</b>	<b>Single factor deficiency</b>	<b>Multiple factor deficiency</b>	<b>Reversal of warfarin effect</b>	<b>Liver disease</b>	<b>Surgical bleeding, massive transfusion</b>	<b>Volume replacement</b>
British Committee for Standards in Haematology <sup>29, 30</sup>	No safe fractionated product available	Multiple factor deficiencies with severe bleeding +/- DIC	Only in presence of severe bleeding. Partial effect only	Doubtful value. Monitor coagulation for effectiveness	If, and amount, guided by timely tests of coagulation	Not indicated
College of American Pathologists <sup>31</sup>	No safe fractionated or single factor product available	Active bleeding. PT 1.5x mid-point normal range, PTT 1.5x top of normal range	Active bleeding or urgent surgery	No specific recommendation	Active bleeding or before invasive procedure + laboratory evidence of coagulopathy	Contra-indicated
Canadian Medical Association <sup>32</sup>	Concentrates preferred	Active bleeding or urgent surgery with significant increase in PT, INR or PTT	Severe bleeding or urgent surgery. Pro-thrombin complex preferred.	Actual bleeding. PT, INR, PTT elevated. Not indicated for pre-procedure prophylaxis if INR= $\leq$ 2.0	Severe bleeding in presence if possible of laboratory evidence of coagulopathy	Not indicated
Australian Natl. Health and Med. Res. Council <sup>33</sup>	Specific factors if available	Active bleeding	Life-threatening bleeding	May be appropriate with active bleeding and evidence of coagulopathy.	Bleeding with coagulopathy	Not indicated
American Society of Anesthesiologists <sup>34</sup>	Only if specific concentrates are not available	Microvascular bleeding. PT or PTT $>$ 1.5x normal	Urgent reversal	No comment	Active bleeding when timely laboratory tests are not available	Contra-indicated

Appendix B - Previous Audits of Prescribing or Use of Fresh Frozen Plasma

<b>Reference</b>	<b>Data Year and Country</b>	<b>Guideline Used</b>	<b>% Inappropriate use and comment</b>
Jones et al. <sup>35</sup>	UK 1996	BCSH <sup>28</sup>	<b>37%</b> of 41 patients, 216 units
Prabitha et al. <sup>36</sup>	Malaysia 1998	Unknown	<b>69%</b> of 931 transfusions, 2665 units
Luk et al. <sup>8</sup>	Canada 1999	Canadian <sup>31</sup>	<b>45%</b> of 358 patients, 2372 units
Schofield et al. <sup>37</sup>	Australia 2000	Australian <sup>32</sup>	<b>63%</b> of 669 patients
Chng et al. <sup>38</sup>	Singapore 2001	College of American Pathologists <sup>30</sup>	<b>73%</b> of 359 transfusions, 932 units
Kakkar et al. <sup>39</sup>	India 2002-3	BCSH <sup>28</sup>	<b>60%</b> of 504 transfusions, 1761 units
Hui et al. <sup>40</sup>	Australia 2002-3	Australian <sup>32</sup>	<b>26%</b> inappropriate/indeterminate, 70/268 transfusions
Atkinson <sup>41</sup>	UK 2004-5	BCSH <sup>28</sup>	<b>32%</b> of 137 transfusions, 114 patients
Yeh et al. <sup>42</sup>	Taiwan 2003-4	BCSH <sup>28</sup>	<b>70%</b> of 8,248 orders, 38,772 units
Lauzier et al. <sup>9</sup>	Canada 2001-2	Canadian <sup>31</sup>	<b>47.6%</b> 225 orders, 547 units, 76 ICU patients

## Appendix C - Site Specific Data

Site 1

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	2.10-5.00	N/A	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate

Site 2

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
2	1.10-1.50	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
3	5.10-10.00	2.10-5.00	N/A	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
4	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
5	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
6	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
7	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
8	2.10-5.00	1.60-2.00	N/A	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
9	2.10-5.00	1.60-2.00	N/A	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
10	1.60-2.00	1.60-2.00	Within normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
11	1.60-2.00	1.60-2.00	N/A	N/A	No bleeding	Surgery	A2	Appropriate
12	1.60-2.00	1.60-2.00	N/A	N/A	No bleeding	Surgery	A2	Appropriate
13	1.60-2.00	1.10-1.50	Within normal range	N/A	No bleeding	Anticoagulant Reversal-Unknown	I6	Inappropriate
14	1.60-2.00	1.10-1.50	N/A	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate

Site 3

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
2	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate

Site 4

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.10-1.50	N/A	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

Site 5

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	N/A	N/A	No bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
2	>10.00	N/A	N/A	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
3	1.10-1.50	N/A	N/A	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
4	2.10-5.00	N/A	N/A	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
5	5.10-10.00	2.10-5.00	N/A	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A2	Appropriate
6	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Massive transfusion	M4	Indeterminate

## Site 6

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	N/A	N/A	Bleeding	Surgery	I3	Inappropriate

## Site 7

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
2	1.10-1.50	1.10-1.50	Within normal range	>2x upper limit of normal range	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
3	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M1	Indeterminate
4	1.60-2.00	N/A	Within normal range	N/A	Bleeding	GI Bleed	A3	Appropriate
5	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Surgery	A6	Appropriate
6	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	GI Bleed	A3	Appropriate

## Site 8

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Surgery	M5	Indeterminate
2	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
3	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
4	1.60-2.00	1.10-1.50	N/A	Within normal range	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
5	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Massive transfusion	M4	Indeterminate
6	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate

## Site 9

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
2	1.60-2.00	1.10-1.50	N/A	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
3	5.10-10.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
4	1.60-2.00	1.10-1.50	Within normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
5	2.10-5.00	1.60-2.00	N/A	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
6	2.10-5.00	N/A	N/A	N/A	Unknown	Surgery	M5	Indeterminate

## Site 10

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	N/A	1.10-1.50	N/A	1-2x upper limit of normal range	No bleeding	Surgery	M3	Indeterminate
2	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A2	Appropriate
3	1.10-1.50	1.10-1.50	>2x upper limit of normal range	Within normal range	Minor bleeding	Surgery	A6	Appropriate
4	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Surgery	A6	Appropriate
5	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Surgery	A6	Appropriate
6	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
7	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
8	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Other Bleed*	A3	Appropriate
9	1.10-1.50	N/A	Within normal range	N/A	Minor bleeding	Surgery	I3	Inappropriate

10	N/A	1.10-1.50	N/A	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
11	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Trauma- MVA	A4	Appropriate
12	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Trauma- MVA	I3	Inappropriate
13	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Surgery*- Incarcerated Hernia	A6	Appropriate
14	2.10-5.00	2.10-5.00	>2x upper limit of normal range	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
15	2.10-5.00	1.60-2.00	>2x upper limit of normal range	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
16	1.60-2.00	1.10-1.50	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Massive transfusion	A4	Inappropriate
17	1.60-2.00	1.10-1.50	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
18	1.60-2.00	0.50-1.00	>2x upper limit of normal range	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
19	1.60-2.00	0.50-1.00	>2x upper limit of normal range	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
20	1.60-2.00	0.50-1.00	>2x upper limit of normal range	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
21	N/A	0.50-1.00	N/A	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
22	N/A	0.50-1.00	N/A	>2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
23	0.50-1.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
24	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Surgery	A6	Appropriate
25	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
26	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
27	N/A	1.60-2.00	N/A	Within normal range	Minor bleeding	Surgery	A6	Appropriate
28	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
29	N/A	1.60-2.00	N/A	Within normal range	Minor bleeding	Miscellaneous*- Burn	A3	Appropriate
30	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Surgery	I3	Inappropriate

Site 11

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	N/A	Bleeding	Surgery	A6	Appropriate
2	N/A	N/A	N/A	N/A	No bleeding	Miscellaneous*- Familial TTP on regular plasma infusions	A5	Appropriate
3	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal- Warfarin	A1	Appropriate
4	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Anticoagulant Reversal- Warfarin	A1	Appropriate
5	1.10-1.50	N/A	Within normal range	N/A	Minor bleeding	Anticoagulant Reversal- Warfarin	I3	Inappropriate
6	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Unknown	Central line placement	A2	Appropriate
7	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
8	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
9	1.60-2.00	0.50-1.00	Within normal range	Within normal range	Bleeding	GI Bleed	A3	Appropriate
10	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Unknown	A3	Appropriate
11	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Liver biopsy	A3	Appropriate



## Site 12

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Unknown	Coagulopathy (liver disease, DIC, etc)	M5	Indeterminate
2	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Coagulopathy (liver disease, DIC, etc)	M5	Indeterminate
3	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Unknown	Anticoagulant Reversal-Unknown	M5	Indeterminate
4	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Surgery	A6	Appropriate
5	N/A	N/A	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
6	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
7	N/A	1.10-1.50	N/A	Within normal range	Unknown	Surgery	M2	Indeterminate
8	1.60-2.00	N/A	>2x upper limit of normal range	Within normal range	Unknown	Anticoagulant Reversal-Heparin	I4	Inappropriate
9	1.60-2.00	N/A	N/A	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate

## Site 13

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Unknown	Surgery	I3	Inappropriate
2	N/A	N/A	N/A	N/A	Unknown	Miscellaneous*- Low Platelets	M1	Indeterminate
3	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
4	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
5	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Surgery	I6	Inappropriate

## Site 14

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Volume expansion	A3	Appropriate
2	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Volume expansion	A3	Appropriate
3	2.10-5.00	1.60-2.00	>2x upper limit of normal range	Within normal range	Bleeding	Anticoagulant Reversal-Unknown	A1	Appropriate
4	1.10-1.50	N/A	Within normal range	N/A	No bleeding	Paracentesis	I3	Inappropriate
5	2.10-5.00	1.60-2.00	Within normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
6	1.10-1.50	N/A	Within normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	I3	Inappropriate

## Site 15

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Surgery	I3	Inappropriate
2	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
3	2.10-5.00	1.60-2.00	Within normal range	Within normal range	Unknown	Anticoagulant Reversal-Coumadin	I1	Inappropriate
4	1.60-2.00	1.10-1.50	N/A	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
5	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
6	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	>2x upper limit of normal range	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
7	1.10-1.50	1.10-1.50	N/A	N/A	Unknown	Anticoagulant Reversal-Coumadin	I3	Inappropriate
8	2.10-5.00	N/A	N/A	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
9	2.10-5.00	N/A	N/A	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate

## Site 16

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
11	N/A	1.10-1.50	N/A	N/A	Unknown	Anticoagulant Reversal-Coumadin	M1	Indeterminate
12	5.10-10.00	N/A	N/A	N/A	Unknown	Anticoagulant Reversal-Warfarin	M5	Indeterminate
21	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I3	Inappropriate
22	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Warfarin	A3	Appropriate
41	0.50-1.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Other Bleed*- Vag Bleed in Pregnancy	A3	Appropriate
51	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
52	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

## Site 17

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	N/A	N/A	N/A	Minor bleeding	Anticoagulant Reversal-Unknown	A3	Appropriate
2	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Anticoagulant Reversal-Unknown	A2	Appropriate
3	2.10-5.00	N/A	N/A	N/A	No bleeding	Anticoagulant Reversal-Unknown	I6	Inappropriate
4	1.60-2.00	N/A	N/A	N/A	Bleeding	Other Bleed*- Patient bled 3 units of RBCs given in 24 hours	A3	Appropriate
5	N/A	N/A	N/A	N/A	Bleeding	Massive transfusion	M4	Indeterminate
6	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
7	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
8	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A2	Appropriate
9	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Surgery	A2	Appropriate
10	2.10-5.00	1.60-2.00	N/A	N/A	No bleeding	Anticoagulant Reversal-Unknown	I6	Inappropriate

## Site 18

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
900	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Unknown	M3	Indeterminate
901	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
902	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
903	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Bleeding		A3	Appropriate
904	N/A	1.60-2.00	N/A	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
905	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
906	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
907	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
908	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Central line placement	A2	Appropriate
909	1.10-1.50	1.10-1.50	>2x upper limit of normal range	Within normal range	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A2	Appropriate
910	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
911	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
912	1.10-1.50	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate

913	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
914	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A2	Appropriate
915	1.60-2.00	N/A	Within normal range	N/A	No bleeding	Central line placement	A1	Appropriate
916	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
917	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Image guided therapy	A2	Appropriate
918	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery*- CABG/Valve Replacement	A3	Appropriate
919	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
920	1.60-2.00	1.10-1.50	Within normal range	>2x upper limit of normal range	No bleeding	Cardiac catheterization	A2	Appropriate
921	2.10-5.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate

Site 19

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	N/A	Bleeding	Surgery	A6	Appropriate
2	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Miscellaneous*- Alcohol Withdrawal	I3	Inappropriate
3	2.10-5.00	1.10-1.50	>2x upper limit of normal range	>2x upper limit of normal range	Unknown	Sepsis	M5	Indeterminate
4	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
5	1.60-2.00	1.10-1.50	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
6	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate

Site 20

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
2	2.10-5.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
3	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
4	1.60-2.00	N/A	Within normal range	N/A	Unknown	Coagulopathy (liver disease, DIC, etc)	M5	Indeterminate
5	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
6	N/A	N/A	N/A	N/A	Unknown	Plasma protein deficiency- TTP	A5	Appropriate
7	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
8	N/A	1.10-1.50	N/A	1-2x upper limit of normal range	Unknown	Surgery*- Appendectomy	A6	Appropriate
9	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Sepsis*- Replacement factors, Sepsis, Renal Failure	A3	Appropriate
10	5.10-10.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)*	A3	Appropriate
11	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	GI Bleed	A3	Appropriate
12	5.10-10.00	1.60-2.00	1-2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)*	A3	Appropriate
13	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate

Site 21

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	N/A	N/A	N/A	N/A	Minor bleeding	Surgery*- Post-op C-Section	M1	Indeterminate

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	No bleeding	Other Bleed*- Acute Hydrocephalus Thalamic Bleed	A3	Appropriate
2	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	No bleeding	Other Bleed*- Acute Hydrocephalus Thalamic Bleed- Angio	A3	Appropriate
3	1.10-1.50		Within normal range		Bleeding	Miscellaneous*- Renal Failure- Spinal Tap	I3	Inappropriate
4	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
5	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
6	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
7	N/A	N/A	N/A	N/A	Unknown	Surgery*- Biliary Obstruction- TIPS revision	M1	Indeterminate
8	2.10-5.00	1.60-2.00	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Drain/Line Insertion*- arterial line & adb tap for ascites	A2	Appropriate
9	1.60-2.00	2.10-5.00	Within normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
10	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
11	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	No bleeding	Other Bleed*- SAH- Procedure LP	A2	Appropriate
12	N/A	N/A	N/A	N/A	Minor bleeding	Drain/Line Insertion*- Liver failure	M1	Indeterminate
13	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Sepsis	A3	Appropriate
14	1.60-2.00	1.10-1.50	Within normal range	Within normal range	No bleeding	Surgery	A6	Appropriate
15	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy*- Liver Failure	A3	Appropriate
16	1.60-2.00	1.60-2.00	Within normal range	Within normal range	Minor bleeding	Drain/Line Insertion*- Acute Biliary Colic- percutaneous drain line insertion	A2	Appropriate
17	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Drain/Line Insertion*- Removal of percutaneous abscess drain	A2	Appropriate
18	1.10-1.50	N/A	Within normal range	N/A	Minor bleeding	Drain/Line Insertion*- Removal of percutaneous abscess drain	I3	Inappropriate
19	1.60-2.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
20	2.10-5.00	2.10-5.00	Within normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
21	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M1	Indeterminate
22	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	GI Bleed*- Sepsis	A3	Appropriate
23	1.10-1.50	1.10-1.50	>2x upper limit of normal range	Within normal range	Bleeding	Surgery*- Post cardiovascular surgery <24 hrs	A3	Appropriate
24	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Miscellaneous*- Heart failure- Trach	A3	Appropriate
25	2.10-5.00	N/A	Within normal range	N/A	No bleeding	Drain/Line Insertion*- Pacemaker problem- lead repositioning	A2	Appropriate
26	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Surgery*- Post Wipple- drain insertion	I3	Inappropriate
27	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Miscellaneous*- mitral insufficiency	A3	Appropriate
28	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Other Bleed*- ACS & CHF (cranial bleed)	I3	Inappropriate
29	1.10-1.50	1.60-2.00	N/A	Within normal range	Bleeding	Surgery	A6	Appropriate
30	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
31	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
32	5.10-10.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	Bleeding	GI Bleed	A3	Appropriate

33	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
34	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery*- Post surgery <24 hrs	A6	Appropriate
35	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery*- returning to surgery	A6	Appropriate

Site 23

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	0.50-1.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I2	Inappropriate
2	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
3	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	GI Bleed*- Perforated bowel	A3	Appropriate
4	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	GI Bleed*	A3	Appropriate
5	N/A	1.60-2.00	N/A	Within normal range	Bleeding	GI Bleed*	A3	Appropriate
6	1.60-2.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Surgery*- Perforated bowel post-op	A6	Appropriate
7	2.10-5.00	2.10-5.00	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Drain/Line Insertion*- Query Pulmonary Edema- line insertion	A2	Appropriate
8	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
9	2.10-5.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Drain/Line Insertion*- Percutaneous line insertion	A2	Appropriate
10	1.10-1.50	N/A	Within normal range	N/A	No bleeding	Drain/Line Insertion*- Post procutaneous line insertion	I3	Inappropriate
11	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
12	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
13	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery*- Post surgery <24 hrs	A6	Appropriate
14	1.10-1.50	N/A	Within normal range	N/A	Unknown	Thoracentesis*- Pericardial centesis	I3	Inappropriate
15	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
16	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Surgery*- Diverticulitis colectomy	A6	Appropriate
17	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
18	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
19	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal- Warfarin	I1	Inappropriate
20	1.60-2.00	1.10-1.50	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
21	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Surgery*- Post surgery <24 hrs	A6	Appropriate
22	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Drain/Line Insertion*- Acute Renal Failure- catheter insertion	A2	Appropriate
23	2.10-5.00	2.10-5.00	>2x upper limit of normal range	>2x upper limit of normal range	Bleeding	GI Bleed*	A3	Appropriate
24	2.10-5.00	N/A	>2x upper limit of normal range	N/A	Bleeding	GI Bleed*	A3	Appropriate

Site 24

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Other Bleed*- presumed varicele bleeding	A3	Appropriate

## Site 25

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	2.10-5.00	Within normal range	1-2x upper limit of normal range	Unknown	Surgery*- Ruptured Spleen	A3	Appropriate
2	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
3	2.10-5.00	N/A	Within normal range	N/A	Bleeding	Other Bleed*- Subdural Hematoma	A3	Appropriate
4	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	GI Bleed*	A3	Appropriate
5	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Miscellaneous*- Pain in Mid Back	I6	Inappropriate

## Site 26

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
2	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Surgery	A6	Appropriate
3	0.50-1.00	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Surgery	I2	Inappropriate
4	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Sepsis*- AML, Septic Shock	A3	Appropriate
5	2.10-5.00	1.60-2.00	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery*- Acute hemorrhagic shock secondary to cephalohematoma	A3	Appropriate

## Site 27

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
2	N/A	N/A	N/A	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	M1	Indeterminate
3	1.10-1.50	1.10-1.50	Within normal range	Within normal range	No bleeding	Volume expansion	I5	Inappropriate
4	2.10-5.00	1.10-1.50	N/A	N/A	Bleeding	Massive transfusion	A4	Appropriate
5	0.50-1.00	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	I2	Inappropriate
6	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
7	1.10-1.50	1.60-2.00	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
8	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
9	1.60-2.00	2.10-5.00	Within normal range	1-2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
10	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	N/A	Bleeding	Surgery	A6	Appropriate
11		1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
12	1.10-1.50	N/A	N/A	N/A	Bleeding	Surgery	I3	Inappropriate
13	5.10-10.00	N/A	>2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
14	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

## Site 28

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
2	2.10-5.00	N/A	Within normal range	N/A	Bleeding	Fine Needle aspirate	A2	Appropriate
3	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
4	1.10-1.50	N/A	>2x upper limit of normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
5	>10.00	1.10-1.50	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
6	2.10-5.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Surgery*- Repeat C-Section	A6	Appropriate

## Site 29

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
2	2.10-5.00	N/A	Within normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
3	5.10-10.00	N/A	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
4	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
5	1.10-1.50	1.10-1.50	Within normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
6	1.60-2.00	N/A	Within normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate
7	1.60-2.00	N/A	N/A	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate
8	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate
9	1.60-2.00	N/A	N/A	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate
10	1.60-2.00	1.60-2.00	Within normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate

## Site 30

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	N/A	>2x upper limit of normal range	N/A	No bleeding	Miscellaneous*- Subacute bowel obstruction	I6	Inappropriate
2	2.10-5.00	1.60-2.00	N/A	N/A	Minor bleeding	GI Bleed*- Perforated viscous/Ruptured diverticuli/ Bloody stool	A3	Appropriate
3	2.10-5.00	N/A	N/A	N/A	No bleeding	Miscellaneous*- Pancreatitis/Cholecystitis	I6	Inappropriate

## Site 31

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
2	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery*- Radical Prostatectomy	M2	Indeterminate
3	1.10-1.50	1.10-1.50	N/A	Within normal range	No bleeding	Anticoagulant Reversal-Coumadin	I3	Inappropriate
4	>10.00	2.10-5.00	N/A	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
5	N/A	1.10-1.50	N/A	Within normal range	Unknown	Paracentesis	M2	Indeterminate
6	2.10-5.00	N/A	Within normal range	N/A	Unknown	Coagulopathy (liver disease, DIC, etc)	M5	Indeterminate

## Site 32

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Anticoagulant Reversal-Warfarin	M5	Indeterminate
2	1.10-1.50	N/A	N/A	N/A	Unknown	Image guided therapy	I3	Inappropriate
3	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
4	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Unknown	Anticoagulant Reversal-Warfarin	M5	Indeterminate
5	2.10-5.00	2.10-5.00	Within normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate

## Site 33

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Surgery*- Bowel Resection	A2	Appropriate
2	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Unknown	Leukemia*- Leukemia receiving alternative treatment	M5	Indeterminate
3	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery*- Surgical complications	A6	Appropriate
4	1.10-1.50	N/A	N/A	N/A	Unknown	Unknown*- Not indicated	I3	Inappropriate

## Site 34

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
2	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
3	1.60-2.00	1.60-2.00	Within normal range	N/A	No bleeding	Thoracentesis	A2	Appropriate
4	1.60-2.00	N/A	N/A	N/A	No bleeding	Thoracentesis	A2	Appropriate
5	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
6	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
7	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
8	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Surgery	I3	Inappropriate
9	1.60-2.00	N/A	N/A	N/A	No bleeding	GI Bleed*- Endoscopy (upper UGIB)	A2	Appropriate
10	2.10-5.00	N/A	Within normal range	N/A	Bleeding	Other Bleed*- Rt. Parietal bleed	A3	Appropriate
11	N/A	N/A	N/A	N/A	Bleeding	Miscellaneous*- 1 unit requested to replace 1 unit in case 010 where only 10 ml given as bag was leaking	M1	Indeterminate
12	1.60-2.00	1.10-1.50	Within normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate
13	N/A	N/A	N/A	N/A	Unknown	Surgery	M1	Indeterminate
14	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
15	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
16	1.10-1.50	1.10-1.50	Within normal range	Within normal range	No bleeding	Sepsis*- Ruptured gallbladder	I3	Inappropriate
17	1.10-1.50	1.10-1.50	Within normal range	Within normal range	No bleeding	Leukemia*- Acute Leukemia	I3	Inappropriate
18	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Sepsis*- Ruptured gallbladder	I3	Inappropriate
19	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
20	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Other Bleed*	A3	Appropriate
21	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Other Bleed*	I3	Inappropriate



22	1.10-1.50	1.10-1.50	Within normal range	Within normal range	No bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
23	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Anticoagulant Reversal-Warfarin	A1	Appropriate

Site 35

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
2	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Surgery	A6	Appropriate
3	1.60-2.00	1.10-1.50	Within normal range	N/A	No bleeding	Surgery*- Removal massive lymph nodes	A2	Appropriate
4	1.10-1.50	1.10-1.50	Within normal range	1-2x upper limit of normal range	Bleeding	Massive transfusion	A4	Appropriate
5	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
6	1.60-2.00	1.10-1.50	Within normal range	Within normal range	No bleeding	Sepsis	I6	Inappropriate
7	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
8	1.10-1.50	N/A	Within normal range	N/A	Unknown	Surgery*- pre-surgery	I3	Inappropriate
9	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Massive transfusion	M4	Indeterminate
10	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Massive transfusion	M4	Indeterminate
11	1.60-2.00	1.10-1.50	Within normal range	Within normal range	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate

Site 36

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
2	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
3	1.10-1.50	1.10-1.50	N/A	N/A	No bleeding	Surgery*- CA pancreas/liver	I3	Inappropriate
4	5.10-10.00	2.10-5.00	N/A	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate
5	2.10-5.00	1.60-2.00	N/A	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate

Site 37

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	N/A	N/A	N/A	Unknown	Surgery	A6	Appropriate
2	1.60-2.00	N/A	N/A	N/A	Unknown	Surgery	A6	Appropriate
3	1.60-2.00	N/A	N/A	N/A	Unknown	Sepsis	M6	Indeterminate
4	1.60-2.00	N/A	N/A	N/A	Unknown	Sepsis	M5	Indeterminate
5	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	GI Bleed	A3	Appropriate
6	N/A	N/A	N/A	N/A	Minor bleeding	GI Bleed	M1	Indeterminate
7	>10.00	1.60-2.00	>2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Unknown	A1	Appropriate
8	2.10-5.00	N/A	N/A	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
9	1.10-1.50	N/A	N/A	N/A	Minor bleeding	Sepsis	I3	Inappropriate
10	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate

## Site 38

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
2	2.10-5.00	1.10-1.50	>2x upper limit of normal range	Within normal range	Minor bleeding	Paracentesis	A2	Appropriate
3	>10.00	2.10-5.00	>2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
4	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	>2x upper limit of normal range	Minor bleeding	Paracentesis	A2	Appropriate
5	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
6	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Warfarin	A1	Appropriate
7	1.60-2.00	1.10-1.50	N/A	N/A	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
8	1.10-1.50	N/A	>2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
9	2.10-5.00	N/A	N/A	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate

## Site 39

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	N/A	N/A	No bleeding	Surgery	A2	Appropriate
2	1.60-2.00	N/A	N/A	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	I6	Inappropriate
3	1.60-2.00	1.10-1.50	N/A	N/A	No bleeding	Surgery	A2	Appropriate
4	>10.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
5	1.10-1.50	N/A	N/A	N/A	Bleeding	Massive transfusion	M4	Indeterminate
6	1.60-2.00	1.10-1.50	Within normal range	Within normal range	No bleeding	Surgery	A2	Appropriate

## Site 40

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	>10.00	2.10-5.00	N/A	N/A	Minor bleeding	Image guided therapy	A2	Appropriate
2	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	Bleeding	Image guided therapy	A2	Appropriate
3	>10.00	2.10-5.00	1-2x upper limit of normal range	N/A	Bleeding	Image guided therapy	A2	Appropriate
4	0.50-1.00	N/A	Within normal range	N/A	Minor bleeding	Image guided therapy	I2	Inappropriate
5	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Unknown	Miscellaneous*- Stroke	M5	Indeterminate
6	5.10-10.00	1.60-2.00	N/A	Within normal range	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

## Site 41

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	N/A	Within normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate
2	1.60-2.00	1.60-2.00	Within normal range	N/A	Bleeding	Massive transfusion	A4	Appropriate

## Site 42

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Other Bleed*- Hematuria	A3	Appropriate
2	5.10-10.00	N/A	N/A	N/A	Minor bleeding	Other Bleed*- Wound Bleeding	A3	Appropriate
3	5.10-10.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate
4	>10.00	2.10-5.00	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate
5	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Surgery	A2	Appropriate
6	>10.00	N/A	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate
7	>10.00	N/A	>2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Unknown	A1	Appropriate

## Site 43

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
2	2.10-5.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
3	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Surgery	I3	Inappropriate
4	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
5	>10.00	2.10-5.00	N/A	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
6	1.10-1.50	N/A	Within normal range	N/A	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
7	1.10-1.50	1.10-1.50	Within normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
8	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate

## Site 44

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	N/A	N/A	N/A	N/A	No bleeding	Surgery*- Pre-op Splenectomy order	M1	Indeterminate
2	1.60-2.00	N/A	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
3	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
4	5.10-10.00	N/A	>2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
5	>10.00	1.60-2.00	>2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Anticoagulant Reversal-Warfarin	A1	Appropriate
6	1.60-2.00	1.10-1.50	N/A	1-2x upper limit of normal range	No bleeding	Surgery	A2	Appropriate

## Site 45

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
2	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
3	5.10-10.00	N/A	>2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
4	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
5	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
6	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
7	5.10-10.00	N/A	Within normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

## Site 46

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Surgery	I3	Inappropriate
2	N/A	N/A	N/A	N/A	Bleeding	Surgery	M1	Indeterminate
3	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Surgery*- Pre-operative lung surgery	I3	Inappropriate
4	2.10-5.00	0.50-1.00	N/A	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
5	1.60-2.00	1.10-1.50	Within normal range	Within normal range	No bleeding	Surgery*- Pre-operative for extensive surgery for necrotizing fasciitis/sepsis	A2	Appropriate
6	0.50-1.00	N/A	N/A	N/A	No bleeding	Apheresis*- Patient has TTP and to be transferred downtown to UHN for possible Plasmapheresis	A5	Appropriate
7	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery*- Pre-operative for laparotomy with hemoglobin of 51	I3	Inappropriate

## Site 47

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	>10.00	1.60-2.00	N/A	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
2	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Miscellaneous*- Bowel perforation	A3	Appropriate
3	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Other Bleed*- Bleeding into right knee	A3	Appropriate
4	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
5	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
6	5.10-10.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Other Bleed*- Bleeding into right knee	A3	Appropriate
7	2.10-5.00	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Miscellaneous*- Asthma Exacerbation	A3	Appropriate
8	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
9	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	GI Bleed	A3	Appropriate

## Site 48

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	N/A	Unknown	Miscellaneous*- Prematurity	M5	Indeterminate

## Site 49

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	0.50-1.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Massive transfusion	M4	Indeterminate
2	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Surgery	I3	Inappropriate
3	1.10-1.50	N/A	Within normal range	N/A	Minor bleeding	Other Bleed*- Subdural Hematoma	I3	Inappropriate

## Site 50

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Anticoagulant Reversal-Warfarin	A1	Appropriate
2	5.10-10.00	2.10-5.00	>2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
3	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	No bleeding	Surgery*- Pre-op Transurethral resection of prostate	I3	Inappropriate
4	2.10-5.00	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

## Site 51

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Other Bleed*- Epistaxis	A3	Appropriate
2	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Unknown	Surgery	I3	Inappropriate
3	2.10-5.00	1.60-2.00	Within normal range	Within normal range	Unknown	Coagulopathy (liver disease, DIC, etc)	M5	Indeterminate
4	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Miscellaneous*- Coma/ Altered LOC	I3	Inappropriate

## Site 52

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
2	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
3	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
4	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
5	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
6	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
7	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
8	5.10-10.00	1.60-2.00	1-2x upper limit of normal range	Within normal range	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
9	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
10	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
11	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
12	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
13	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Surgery	I3	Inappropriate
14	5.10-10.00	1.10-1.50	>2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
15	5.10-10.00	1.10-1.50	>2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
16	5.10-10.00	1.10-1.50	>2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
17	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	I3	Inappropriate
18	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Surgery	I3	Inappropriate
19	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Surgery	I3	Inappropriate
20	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
21	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
22	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
23	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
24	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Massive transfusion	M4	Indeterminate
25	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Massive transfusion	A4	Appropriate
26	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate
27	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
28	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate

29	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
30	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate

Site 53

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Other Bleed*- Acute intra-abdominal hemorrhage with myeloproliferative disorder	I3	Inappropriate
2	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Other Bleed*- Massive intra-abdominal hemorrhage with myeloproliferative disorder	I3	Inappropriate

Site 54

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
2	>10.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
3	N/A	1.60-2.00	N/A	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
4	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
5	2.10-5.00	N/A	N/A	N/A	No bleeding	Liver biopsy	A2	Appropriate
6	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery*- Left radical nephrectomy; repair renal vein	I3	Inappropriate
7	1.10-1.50	N/A	>2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Heparin	I4	Inappropriate
8	1.60-2.00	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	A6	Appropriate
9	1.10-1.50	N/A	N/A	N/A	Bleeding	Surgery	I3	Inappropriate

Site 55

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Surgery	I3	Inappropriate

Site 56

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
2	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate
3	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	No bleeding	Surgery	A2	Appropriate
4	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Warfarin	I1	Inappropriate
5	2.10-5.00	1.60-2.00	Within normal range	N/A	Minor bleeding	Surgery	A6	Appropriate
6	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Surgery	I3	Inappropriate
7	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
8	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Coagulopathy (liver disease, DIC, etc)	M3	Indeterminate

Site 57

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	N/A	>2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate

## Site 58

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
2	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
3	1.10-1.50	N/A	Within normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	I3	Inappropriate
4	2.10-5.00	1.10-1.50	>2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Anticoagulant Reversal-Coumadin	I1	Inappropriate
6	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Coagulopathy (liver disease, DIC, etc)	A3	Appropriate
10	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate
12	1.10-1.50	N/A	N/A	N/A	No bleeding	Miscellaneous*- Obstructive jaundice, Atrial fibrillation history	I3	Inappropriate
13	>10.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

## Site 59

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	>10.00	N/A	>2x upper limit of normal range	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate
2	1.60-2.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
3	N/A	N/A	>2x upper limit of normal range	N/A	Bleeding	Surgery	M1	Indeterminate
4	1.60-2.00	1.60-2.00	N/A	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
5	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery*- Post cardiac surgery bleeding	A3	Appropriate
6	1.10-1.50	1.10-1.50	N/A	Within normal range	Minor bleeding	Pleural effusion	I3	Inappropriate
7	>10.00	1.60-2.00	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
8	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Minor bleeding	Surgery	A6	Appropriate
9	N/A	1.60-2.00	N/A	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
10	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
11	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
12	1.60-2.00	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Other Bleed*- Post arrest; bleed?	A3	Appropriate
13	1.10-1.50	N/A	1-2x upper limit of normal range	N/A	Minor bleeding	Surgery*- Abdominal aortic aneurysm	I3	Inappropriate
14	N/A	1.10-1.50	N/A	1-2x upper limit of normal range	Bleeding	Surgery	M2	Indeterminate
15	2.10-5.00	1.10-1.50	N/A	Within normal range	Bleeding	GI Bleed	A3	Appropriate
16	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Minor bleeding	Surgery*- Post cardiac surgery	I3	Inappropriate
17	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	GI Bleed	I3	Inappropriate
18	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Minor bleeding	GI Bleed	I3	Inappropriate
19	1.10-1.50	N/A	N/A	N/A	Minor bleeding	GI Bleed	I3	Inappropriate
20	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	N/A	Unknown	Unknown	I3	Inappropriate
21	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Minor bleeding	Surgery*- Post cardiac surgery	A3	Appropriate
22	1.10-1.50	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Other Bleed*- hemorrhage during delivery	I3	Inappropriate
23	1.60-2.00	1.60-2.00	N/A	Within normal range	No bleeding	Sepsis	M3	Indeterminate
24	2.10-5.00	1.10-1.50	1-2x upper limit of normal range	N/A	Minor bleeding	Other Bleed*- Subdural Hematoma	A3	Appropriate

25	N/A	1.10-1.50	N/A	Within normal range	Minor bleeding	Surgery*- Post cardiac surgery	M2	Indeterminate
26	N/A	N/A	N/A	N/A	Unknown	Miscellaneous*- Intestinal metaplasia	M1	Indeterminate
27	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Minor bleeding	GI Bleed	I3	Inappropriate
28	0.50-1.00	N/A	Within normal range	N/A	Minor bleeding	GI Bleed	I2	Inappropriate

Site 60

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	N/A	N/A	N/A	N/A	No bleeding	Leukemia*- ALL	M1	Indeterminate
2	N/A	N/A	N/A	N/A	No bleeding	Leukemia*- ALL	M1	Indeterminate
3	N/A	N/A	N/A	N/A	No bleeding	Leukemia*- ALL	M1	Indeterminate
4	N/A	N/A	N/A	N/A	No bleeding	Leukemia*- ALL	M1	Indeterminate
5	N/A	N/A	N/A	N/A	No bleeding	Unknown	M1	Indeterminate

Site 61

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	N/A	N/A	N/A	N/A	Unknown	Thoracentesis	M1	Indeterminate
2	N/A	1.60-2.00	N/A	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
3	1.10-1.50	N/A	Within normal range	N/A	Unknown	Leukemia*- Refractory AML	I3	Inappropriate
4	2.10-5.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Liver Transplant	A3	Appropriate
5	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	N/A	Unknown	Surgery*- Possible cardiac bypass	A2	Appropriate
6	2.10-5.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
7	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	Bleeding	Liver Transplant	A3	Appropriate
8	0.50-1.00	N/A	Within normal range	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
9	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
10	N/A	1.10-1.50	N/A	1-2x upper limit of normal range	Bleeding	Liver Transplant	M2	Indeterminate
11	N/A	N/A	N/A	N/A	Bleeding	Liver Transplant	M1	Indeterminate
12	2.10-5.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
13	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Unknown	Unknown	M5	Indeterminate
14	N/A	1.60-2.00	N/A	Within normal range	Bleeding	Surgery	A6	Appropriate
15	0.50-1.00	N/A	Within normal range	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
16	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Unknown	A3	Appropriate
17	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
18	N/A	1.60-2.00	N/A	1-2x upper limit of normal range	Bleeding	Liver Transplant	A3	Appropriate
19	1.60-2.00	2.10-5.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Liver Transplant	A3	Appropriate
20	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
21	N/A	N/A	N/A	N/A	Unknown	Unknown	M1	Indeterminate
22	0.50-1.00	1.60-2.00	Within normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
23	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate



24	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
25	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Miscellaneous*- End stage renal disease	M2	Indeterminate
26	1.60-2.00	1.10-1.50	Within normal range	Within normal range	Bleeding	Liver Transplant	A3	Appropriate
27	1.60-2.00	1.60-2.00	>2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
28	1.60-2.00	0.50-1.00	Within normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
29	2.10-5.00	1.60-2.00	Within normal range	1-2x upper limit of normal range	Bleeding	GI Bleed	A3	Appropriate
30	N/A	1.60-2.00	N/A	1-2x upper limit of normal range	Bleeding	Other Transplant*- Double lung transplant	A3	Appropriate
31	2.10-5.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	No bleeding	Thoracentesis	A2	Appropriate
32	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery*- Post cardiovascular surgery	A3	Appropriate
33	2.10-5.00	N/A	1-2x upper limit of normal range	N/A	No bleeding	Miscellaneous*- Oesophagogastroduodenoscopy	A2	Appropriate
34	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
35	0.50-1.00	1.10-1.50	Within normal range	1-2x upper limit of normal range	Bleeding	Surgery*- Abdominal aortic aneurysm	I2	Inappropriate
36	N/A	N/A	N/A	N/A	Bleeding	Liver Transplant	M1	Indeterminate
37	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
38	2.10-5.00	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	A6	Appropriate
39	2.10-5.00	1.60-2.00	>2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
40	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
41	N/A	N/A	N/A	N/A	No bleeding	Plasma exchange (therapeutic apheresis)	A5	Appropriate
42	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Other Transplant*- Double lung transplant	A3	Appropriate
43	N/A	1.10-1.50	N/A	1-2x upper limit of normal range	Bleeding	Surgery	M2	Indeterminate
44	2.10-5.00	1.60-2.00	Within normal range	N/A	No bleeding	Unknown	M3	Indeterminate

Site 62

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	Within normal range	Bleeding	Surgery	A6	Appropriate
2	1.10-1.50	N/A	N/A	N/A	Unknown	Surgery	I3	Inappropriate
3	1.60-2.00	0.50-1.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
4	1.60-2.00	1.60-2.00	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
5	1.60-2.00	1.10-1.50	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
6	1.60-2.00	N/A	1-2x upper limit of normal range	1-2x upper limit of normal range	Bleeding	Surgery	A6	Appropriate
7	N/A	1.10-1.50	N/A	Within normal range	Bleeding	Surgery	M2	Indeterminate
8	5.10-10.00	N/A	N/A	N/A	Unknown	Pleural effusion	M5	Indeterminate
9	1.10-1.50	1.10-1.50	Within normal range	Within normal range	Bleeding	Surgery	I3	Inappropriate

Site 63

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	0.50-1.00	N/A	Within normal range	N/A	Bleeding	GI Bleed	I2	Inappropriate

Site 64

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	5.10-10.00	N/A	N/A	N/A	No bleeding	Anticoagulant Reversal-Unknown	I1	Inappropriate
2	5.10-10.00	N/A	>2x upper limit of normal range	N/A	Unknown	Anticoagulant Reversal-Coumadin	M5	Indeterminate
3	2.10-5.00	N/A	>2x upper limit of normal range	N/A	Bleeding	Anticoagulant Reversal-Coumadin	A1	Appropriate

Site 65

#	Pre-INR	Post-INR	Pre-aPTT	Post-aPTT	Indication	Procedure Indication	Code	Result
1	2.10-5.00	N/A	N/A	N/A	Unknown		M5	Indeterminate
2	N/A	N/A	N/A	N/A	Unknown		M1	Indeterminate
3	N/A	N/A	N/A	N/A	Minor bleeding	Surgery	M1	Indeterminate
4	1.10-1.50	N/A	Within normal range	N/A	Unknown		I3	Inappropriate
5	N/A	N/A	Within normal range	N/A	Unknown	Surgery	M1	Indeterminate
6	1.60-2.00	1.10-1.50	N/A	N/A	Unknown		M5	Indeterminate
7	1.10-1.50	N/A	N/A	N/A	Unknown		I3	Inappropriate

\* Denotes Procedure/Indication Re-classified

Site 66-76- Reported no plasma orders during the audit period.

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