trauma patients may differ from strategies for managing coagulopathy related to severe PPH. The use of point-of-care technologies, such as thromboelastography (TEG®) or rotational thromboelastometry (ROTEM®), have been advocated for optimizing the treatment of coagulopathy associated with severe hemorrhage.[9,17] These technologies may prove useful for goal-directing hemostatic therapy for obstetric patients experiencing obstetric hemorrhage and requiring massive transfusion. In this respect, I agree with the authors' final conclusion that more research and consensus regarding transfusion therapy for PPH are needed.

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References

1. Reitman E, Devine PC, Laifer-Narin SL, Flood P: Case scenario: Perioperative management of a multigravida at 34-week gestation diagnosed with abnormal placentation. ANESTHESIOLOGY 2011; 115: 852–7
2. Butwick AJ, Hilton G, Riley ET, Carvalho B: Non-invasive measurement of hemoglobin during cesarean hysterectomy: A case series. Int J Obstet Anesth 2011; 20:240–5
3. Lilker SJ, Meyer RA, Downey KN, Macarthur AJ: Anesthetic considerations for placenta accreta. Int J Obstet Anesth 2011; 20:288–92
4. Eller AG, Porter TF, Soisson P, Silver RM: Optimal management strategies for placenta accreta. BJOG 2009; 116:648–54
5. Stotler B, Padmanabhan A, Devine P, Wright J, Spitalnik SL, Schwartz J: Transfusion requirements in obstetric patients with placenta accreta. Transfusion 2011; 51:2627–33
6. Rossi AC, Lee RH, Chmait RH: Emergency postpartum hysterectomy for uncontrolled postpartum bleeding: A systematic review. Obstet Gynecol 2010; 115:637–44
7. Goodnough LT, Daniels K, Wong AE, Viele M, Fontaine MF, Butwick AJ: How we treat: Transfusion medicine support of obstetric services. Transfusion 2011; 51:2540–8
8. Burtelow M, Riley E, Druzin M, Fontaine M, Viele M, Goodnough LT: How we treat: Management of life-threatening primary postpartum hemorrhage with a standardized massive transfusion protocol. Transfusion 2007; 47:1564–72
9. Spahn DR, Ganter MT: Towards early individual goal-directed coagulation management in trauma patients. Br J Anaesth 2010; 105:103–5
10. Stansbury LG, Dutton RP, Stein DM, Bochicchio GV, Scalea TM, Hess JR: Controversy in trauma resuscitation: Do ratios of plasma to red blood cells matter? Transfus Med Rev 2009; 23:255–65
11. Roback JD, Caldwell S, Carson J, Davenport R, Drew MJ, Eder A, Fung M, Hamilton M, Hess JR, Luban N, Perkins JG, Sachais BS, Shander A, Silverman T, Snyder E, Tormey C, Waters J, Djulbegovic B, American Association for the Study of Liver, American Academy of Pediatrics, United States Army, American Society of Anesthesiology, American Society of Hematology: Evidence-based practice guidelines for plasma transfusion. Transfusion 2010; 50:1227–39
12. Brohi K, Cohen MJ, Ganter MT, Matthay MA, Mackersie RC, Pittet JF: Acute traumatic coagulopathy: Initiated by hypoperfusion: modulated through the protein C pathway? Ann Surg 2007; 245:812–8
13. Brohi K, Cohen MJ, Ganter MT, Schultz MJ, Levi M, Mackersie RC, Pittet JF: Acute coagulopathy of trauma: Hypoperfusion induces systemic anticoagulation and hyperfibrinolysis. J Trauma 2008; 64:1211–7
14. Huissoud C, Carrabin N, Audibert F, Levrat A, Massignon D, Berland M, Rudigoz RC: Bedside assessment of fibrinogen level in postpartum haemorrhage by thrombelastometry. BJOG 2009; 116:1097–102
15. Charbit B, Mandelbrot L, Samain E, Baron G, Haddaoui B, Keita H, Sibony O, Mahieu-Caputo D, Hurtaud-Roux MF, Huisse MG, Denninger MH, de Prost D, PPH Study Group: The decrease of fibrinogen is an early predictor of the severity of postpartum hemorrhage. J Thromb Haemost 2007; 5:266–73
16. de Lloyd L, Bovington R, Kaye A, Collis RE, Rayment R, Sanders J, Rees A, Collins PW: Standard haemostatic tests following major obstetric haemorrhage. Int J Obstet Anesth 2011; 20:135–41
17. Bolliger D, Görlinger K, Tanaka KA: Pathophysiology and treatment of coagulopathy in massive hemorrhage and hemodilution. ANESTHESIOLOGY 2010; 113:1205–19

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In Reply:

We would like to thank Butwick for his interest in our Case Scenario.[1] He raises several issues that we were not able to address in depth as the Case Scenario format does not allow for an in-depth review of all aspects of the field. To address each point in turn, we agree that an epidural is indicated when the surgery is likely to outlast the duration of a spinal block. Since this is almost always the case when abnormal placentation is expected, if neuraxial analgesia is used, an epidural with or without an intrathecal dose is advisable. The article was written about a case done with regional anesthesia, but of course hemodynamic instability is a contraindication to regional anesthesia, and in this case general anesthesia is preferred.

Blood loss at cesarean hysterectomy is variable, and we agree that one should always be prepared for extensive transfusion. In spite of the reference cited by Butwick, the average blood loss at planned cesarean hysterectomy for placenta accreta is in the range of 5 units in other published series and in our experience.[2,3] We meant to differentiate this from placenta percreta, which is more likely to require massive transfusion and, depending on the evidence for placental invasion, might cause the practitioner to favor general anesthesia from the start of the procedure.

Newer protocols for massive transfusion with higher ratios of plasma have emerged from the trauma literature. However, as we stated in our manuscript, "Additional clinical trials are needed to establish the cost-benefit and risk-benefit profiles for procoagulant drugs and to establish standards for treatment of massive bleeding in pregnancy."[1] The use of more plasma in obstetrical hemorrhage seems reasonable in massive obstetrical hemorrhage, as fibrinogen levels are often found to be low and may be associated with continued oozing even when surgical bleeding is controlled. On the other hand, pregnancy is associated with enhanced procoagulant risk, making the hematologic situation more complex. The use of thromboelastography and rotational thromboelastometry may have been advocated for management of

transfusion, but outcome data supporting their use in cardiothoracic surgery has been difficult to come by[4] and is not available for surgery in pregnancy. Finally, it should be remembered that a single unit of plasma is preserved with more EDTA than one unit of packed erythrocytes. As such, hypocalcemia may occur more rapidly with newer transfusion protocols than traditional protocols. Large clinical trials of transfusion practices in pregnancy are important but will be difficult to conduct because bleeding is often unexpected and occurs after hours. Careful retrospective analysis of outcomes after change to a new protocol may be helpful while we wait for more definitive guidance.

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References

1. Reitman E, Devine PC, Laifer-Narin SL, Flood P: Perioperative management of a multigravida at 34-week gestation diagnosed with abnormal placentation. Anesthesiology 2011; 115:852–7
2. Chestnut DH, Dewan DM, Redick LF, Caton D, Spielman FJ: Anesthetic management for obstetric hysterectomy: A multiinstitutional study. Anesthesiology 1989; 70:607–10
3. Wright JD, Pri-Paz S, Herzog TJ, Shah M, Bonanno C, Lewin SN, Simpson LL, Gaddipati S, Sun X, D'Alton ME, Devine P: Predictors of massive blood loss in women with placenta accreta. Am J Obstet Gynecol 2011; 205:38.e1–6
4. Wikkelsoe AJ, Afshari A, Wetterslev J, Brok J, Moeller AM: Monitoring patients at risk of massive transfusion with Thrombelastography or Thromboelastometry: A systematic review. Acta Anaesthesiol Scand 2011; 55:1174–89

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Current and Emerging Approaches to Address Failure-to-Rescue

To the Editor:

We read with interest the review by Taenzer *et al.*,[1] in which a conceptual framework for a successful patient surveillance system is clearly described.

We agree that overcoming the problem of nuisance alarms, which can be exacerbated by continuous surveillance, is important in all surveillance systems. The authors recommend that alarm thresholds based on the distributions of continuously acquired datasets of physiologic variables in representative general patient populations not in the intensive care unit are combined with notification delay to help achieve the required alarm accuracy rate of at least 90%.

The authors kindly include our work in their review.[2] Our alarm model was developed using continuously acquired data on representative general medical and surgical patient populations not in the intensive care unit, uses an alarm threshold based on the underlying distributions of five vital signs, requires an abnormality to persist for 4 min out of 5 before an alarm is generated (a form of notification delay), and had a "true alarm" rate of 94.5%, meeting many of the criteria described by Taenzer *et al.* But our randomized controlled trial did not assess the effects of a multi-parameter patient status model on patient outcome, as they suggest. Rather, our trial compared mandated five-channel continuous monitoring with standard care, and showed that extra monitoring had no effect on adverse event rates or mortality. The performance of the multi-parameter patient status model (Biosign, now Visensia™; OBS Medical, Abingdon, Oxon, United Kingdom) was retrospectively assessed using the five-channel monitoring data. More recently the introduction of this model to a 24-bed step-down unit in Pittsburgh has been associated with reduced periods of cardiorespiratory instability in step-down unit patients.[3]

From their own work, the authors suggest that heart rate and oxygen saturation distributions may vary little across patient groups. Our recently published distributions from 64,622 h of vital-sign data, acquired from 863 acutely ill in-hospital patients, add to this observation, showing largely similar distributions for systolic blood pressure and respiratory rate (as well as heart rate and oxygen saturation) in medical and surgical patients, studied both in the United Kingdom and the United States. As they suggest, we proposed alert thresholds based on these distributions.[4]

The authors review their promising results from a before-and-after study using the Patient SafetyNet™ system (Masimo Corporation, Irvine, CA).[5] However, the alerting criterion for oxygen saturation of 80% used in the "after" phase in this study would alert for 0.67% of patient observations (as compared with 6.25% for an oxygen saturation of 90%) in populations with the distribution of oxygen saturations seen in our study.[4] Although this might explain the reduction in medical emergency team activations that occurred after the Patient SafetyNet™ system was introduced, we suggest it may also demonstrate the difficulties of highlighting deteriorating patients without creating an unmanageable number of "nuisance alarms" rightly discussed by the authors.

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References

1. Taenzer AH, Pyke JB, McGrath SP: A review of current and emerging approaches to address failure-to-rescue. Anesthesiology 2011; 115:421–31
2. Watkinson PJ, Barber VS, Price JD, Hann A, Tarassenko L, Young JD: A randomised controlled trial of the effect of continuous electronic physiological monitoring on the adverse event rate in high risk medical and surgical patients. Anaesthesia 2006; 61:1031–9
3. Hravnak M, Devita MA, Clontz A, Edwards L, Valenta C, Pinsky MR: Cardiorespiratory instability before and after implement-

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