SIMULATIONS AND DRILLS
Leslie Casper, MD, San Diego Medical Center, Southern California Permanente Medical Group

BACKGROUND AND LITERATURE REVIEW
Medical simulation drills of obstetrical hemorrhage cases can assess system weaknesses and strengths, test policies and procedures for coping with hemorrhage and improve teamwork and communication skills of staff members. Drills that include all disciplines (obstetrics, anesthesia, pediatrics and nursing) can be especially effective in improving communication and coordination among team members.

Drills are practice sessions of relatively uncommon but critical events, such as antenatal or postpartum hemorrhage and amniotic fluid embolism. Critical Event Training simulations for all physicians, midwives, anesthesiologists and nurses may improve neonatal outcomes. (1) Implementing a rapid response team and addressing systems issues for management of obstetrical hemorrhage has been shown to decrease maternal mortality and improve outcomes. (2) The Joint Commission recommends team training in their 2005 Executive Summary of Strategies to Improve the Medical Liability System and Prevent Patient Injury. (3)

Human factors training can improve communications and teamwork. Such training includes briefings, handoffs, time-outs and situational awareness for the team, which is a shared understanding of what is happening now and what happens next. Explicit communication skills to be taught include: addressing team members by name, making eye contact, repeating back orders and confirming that you are responding to an order, and not speaking to the room and assuming that you were heard. In addition, the concept of “Just Culture” or a similar environment should be implemented in all health care settings so that all team members feel respected and comfortable with asserting observations, suggestions and opinions. Improving team communications skills is one of the Joint Commission 2009 National Patient Safety Goals.

Scenarios for simulation should be designed for the needs of the learners (nurses, physicians, residents, respiratory therapy, etc.) and tailored to available resources. Interdisciplinary training should include all disciplines involved in the care of obstetric patients. Simulation can be low tech—using live models—or high tech, using complex computerized simulators or a combination of both. The objective of simulation is to create situations that are as similar to “real life” as possible. Simulation in situ may improve ability to address systems issues and provides practice in one’s own hospital setting with familiar resources. Simulation in a computerized simulation center offers high technology in an environment similar to real life, but without the distractions of the hospital. The choice of high or low fidelity simulation is institution dependent; both can work well for hemorrhage scenarios. For practicing complex events requiring a maternal cardiorespiratory arrest, high fidelity may be a better choice since chest compressions cannot be performed on a
live model, for example. Some institutions use a combination of both types. Debriefing is appropriate both for simulation drills and for live events.

Video taken during simulation serves as a realistic debriefing tool to explore what went well and what needs improvement after a scenario is performed. Evaluation tools such as checklists for expectations of each participant in their role and for team and individual performances can provide an objective approach to debriefing. Similarly, follow-up evaluation ensures that specific goals and objectives for each level of participant are met. The Ottawa Crisis Resource Management Global Rating Scale and Mayo High Performance Teamwork Scale are examples. (4, 5)

**RECOMMENDATION**
All hospitals adopt regularly scheduled simulation drills for practicing response to obstetric hemorrhage. The choice of high or low fidelity drills is institution dependent; both can work well for hemorrhage scenarios.

**EDUCATIONAL TOOLS**
1. Obstetric Hemorrhage Sample Scenario 1: Drill for Abruptio Placentae (attached)
2. Obstetric Hemorrhage Sample Scenario 2; Drill for Placenta Previa (attached)
3. Obstetric Hemorrhage Sample Scenario 3: Hemorrhage and Hypotension (attached)
4. Obstetric Hemorrhage Sample Scenario 4: Atonic Uterus (attached)
5. Kaiser Evaluation Form for Drills; Debriefing Tool: “Labor and Delivery/Family Centered Care, Mock Obstetrical Hemorrhage, Roles and Responsibilities of Staff Skills Validation” (attached)
6. Dreyfus Model of Skill Acquisition (attached) (6)
7. Ottawa Crisis Resource Management Global Rating Scale (4)
8. Mayo High Performance Team Work Scale (5)

**EVIDENCE GRADING**
Level of Evidence: B. Recommendations based on limited or inconsistent evidence.
SIMULATIONS AND DRILLS: EDUCATIONAL TOOL #1.
SAMPLE SCENARIO #1: ABRUPTIO PLACENTAE
Leslie Casper, MD

SCENARIO: A 22 year old gravida 4 para 3303 Caucasian woman carrying a singleton pregnancy at 35 weeks estimated gestational age presents to the emergency room with vaginal bleeding. She has had limited prenatal care and she reports that she is approximately 36 weeks estimated gestational age by dates. Her records indicate she is carrying a singleton pregnancy in the vertex presentation. Her past medical history is uncomplicated, she has no allergies, and she takes no medications other than prenatal vitamins. She admits to smoking one-half pack of cigarettes per day. Her prenatal labs are not available. She states that her pregnancy has been uncomplicated with the exception of occasional spotting in the last trimester. She is uncertain if she has experienced rupture of membranes. An external fetal monitor is in place.

Physical examination reveals:

- Vital signs: heart rate = 132 beats per minute, blood pressure 135/80 mm Hg
- Uterus: longitudinal fetal lie, vertex presentation
- Cervix: dilatation 2 cm, effacement 40%, station -2, small amounts of bright red blood per vagina are noted

Fetal Monitor Output:

Fetal Heart Rate
- Baseline: 140 beats per minute
- Deviations from baseline: accelerations seen initially, then vanishing; variable decelerations evolving into persistent late decelerations

Fetal Heart Rate Variability
- Short-term: normal becoming decreased
- Long-term: normal becoming decreased

Maternal Uterine Activity
- Frequency of contractions: normal progression with increased frequency progressing to hypertonus near time of delivery
- Duration of contractions: gradually increasing to 80 seconds intensity of contractions: gradually increasing to 120mm Hg

CASE SUMMARY: Abruptio placentae or placental abruption is the premature detachment of a normally implanted placenta from the uterus. The incidence is approximately 0.5-1%. (7) The majority of cases actually occur prior to the initiation of labor. The combination of uterine bleeding, increased frequency of uterine contractions or hypertonus, and a non-reassuring fetal heart rate tracing is highly suspicious for placental abruption. As functional placental surface area decreases with evolving abruption, placental gas exchange becomes increasingly impaired resulting in fetal
hypoxemia and acidosis. A retroplacental clot is often found upon inspection of the placenta after delivery.

Abruptio placentae is classified as follows: (8)

- Grade 1: mild vaginal bleeding and uterine irritability
- Grade 2: moderate bleeding with increased uterine irritability or tetany; maternal supine hypotension and tachycardia; evidence of fetal distress on fetal monitor tracings
- Grade 3: severe bleeding; uterine tetany; maternal hypotension and coagulopathy

Ultrasound will help to differentiate placental abruption from placenta previa.

Placental abruption has been associated with maternal hypertension, chorioamnionitis, advanced maternal age, advanced parity, maternal trauma, and ingestion of cocaine or tobacco. (8, 9) Although the incidence of placental abruption is <1%, it accounts for a significant percentage of perinatal mortality. (9, 10)

Management of abruptio placentae can be difficult. While a grade 1 abruption in a woman carrying a full term fetus mandates close monitoring and active management of labor, more advanced degrees of abruption may require emergent operative delivery due to significant risk to both mother and fetus.
SAMPLE SCENARIO #2: PLACENTA PREVIA
Leslie Casper, MD

SCENARIO: a 21 year old gravida 2 para 1100 Caucasian woman presents at 37 weeks estimated gestational age to Labor and Delivery in early labor with the onset of contractions approximately one hour ago. She has had intermittent prenatal care starting at 12 weeks estimated gestational age. Her records indicate she is carrying a singleton pregnancy in the vertex presentation. Her past medical history is uncomplicated, she has no allergies, and she takes no medications other than prenatal vitamins. She admits to smoking less than one-half pack per day of cigarettes. Her prenatal labs are negative and her pregnancy has been uncomplicated except for intermittent spotting in the last six weeks. An external fetal monitor is in place.

Physical examination reveals:

- Normal vital signs
- Uterus: longitudinal fetal lie, vertex presentation
- Cervix: dilatation 2 cm, effacement 10%, station -3, intact membranes

Fetal Monitor Output:

Fetal Heart Rate
- Baseline: 140 beats per minute
- Deviations from baseline: frequent accelerations throughout labor; bradycardia and late decelerations occur late in labor, simultaneously with frank hemorrhage

Fetal Heart Rate Variability
- Short-term: normal initially, demises as vaginal bleeding worsens
- Long-term: normal initially, demises as vaginal bleeding worsens

Maternal Uterine Activity
- Frequency: gradually increases to a rate of one contraction every two minutes
- Duration: gradually increases to 60 seconds
- Intensity: gradually increasing to 100 mm Hg

CASE SUMMARY: Placenta previa is defined as a placenta that develops in the lower uterine segment adjoining or covering the internal os. Three forms have been described. (8) In marginal placenta previa the edge of the placenta is in contact with the margin of the cervical os but does not cover it. Partial placenta previa incompletely covers the cervical os. Total placenta previa completely covers the os. Varying degrees of bleeding occur during the third trimester as the lower uterine segment matures in preparation for labor.
The incidence of placenta previa is approximately 0.4%. Risk factors include previous cesarean section and tobacco use. (9, 11) The management of a pregnancy complicated by placenta previa is dependent on first recognition of the presence of the abnormally located placenta; this is usually done by ultrasound (digital examination may inadvertently lead to severe hemorrhage). A history of prior cesarean section or total placenta previa likely mandates operative delivery. In patients with marginal or partial placenta previa, as in this case, vaginal delivery may be attempted, provided an emergency cesarean section can be performed should uncontrollable hemorrhage result. The descending fetal head often places pressure on the edge of the placenta and may act to limit bleeding.

In this case fetal bradycardia and late decelerations ensue after frank hemorrhage develops late in labor.
SIMULATIONS AND DRILLS: EDUCATIONAL TOOL #3.

SAMPLE DRILL SCENARIO #3: HEMORRHAGE, HYPOTENSION AFTER DELIVERY

HEMORRHAGE VERSUS ANAPHYLAXIS

Used with permission of Paul Preston, MD

This scenario employs NOELLE Maternal & Neonatal Birthing Simulators


Teaching Objectives
Recognition of abruption. Decision not to activate epidural with hypotension. Differential, bleeding vs. allergy. Management of massive bleeding, including other resources (IR, tamponade balloons). Communication with neonatology, and neonatal team management of severe abruption with meconium. Need to give type specific or O- blood in certain situations.

Potential System Issues Explored
Communication, especially when things aren’t clear-cut. Overall preparation of unit, hospital for massive bleeding and c/hyst. Preparation of neonatal team for really sick kid, needing drugs/CPR/volume. Relations with blood blank in demanding and unusual situations.

Equipment, Settings, Rooms:

a) Noelle: Single IV, pitocin and Magnesium running at usual rates. Epidural catheter, infusing at usual rate.

b) Fetalsim: Abruption pattern, PPSP 2, programmed and allowed to run for a while.

c) Baby: Loaded on sim-man* in uterus. Mouth and body covered in pea soup and blood. Blood loaded in UA reservoir, fake umbilicus in place. If using device driver, set to HR of 60 and 50% saturation. (*Note: Noelle is used in a labor room, then transported to the OR and left outside of the OR; then sim-man becomes the patient as he is already in the OR and set up as Noelle would coming from the room).

d) Sim-Man: Single IV, pitocin and Magnesium running (unless these would be discontinued for transport. Epidural catheter, infusing at usual rate. Program HR to 138, BP to 85/40, O2 sat to 97%. Breath sounds, airway all normal.

e) Other: Prepare suction full of fake blood, multiple bloody pads, and hide under towel in OR. Take off towel right after delivery, call attention to this finding.

Confederates and Briefings:

a) Patient voice: having pain, worse than before. Feeling exhausted, sick of mag. Legs still very heavy, at least T8 level to testing (if performed). In OR, still pain and now feeling weak, nauseated. If epidural dosed, profound weakness (along with LOW BP) and eventual unresponsiveness.
b) Partner: (optional) Nervous, wants to accompany patient, but reasonable—will stay behind if given good explanation.

**Briefing for team**
Mrs. Jones is a wonderful lady—it’s painful to see her having such an awful labor. 38YO, G2P1, induced for moderate pre-eclampsia. On mag and pit. Prior section for breech, really wants vag delivery. Slow labor all night, minimal sleep. CBC, labs—compatible with moderate pre-eclampsia, not HELLP. Finally got epidural 2 hours ago, now calling RN for something. If asked, no other major illness or known allergy, normal height and weight, last BP was 150/82, last HR 110, last cervical check 4 cm.

**How Scenario Runs**

a) RN arrives, patient feels pain. Strip looks progressively more ominous, but without catastrophic decel. Maternal BP starts at 110/50, HR of 122, progressive deterioration. Good sensory level to epidural. On cervical exam, still 4 cm, thick mec with blood. Advance the Fetalsim appropriately to make sure we go to OR.

b) In OR, low BP noted and strip keeps looking worse. Class 2 airway if examined. If epidural activated, profound hypotension/near cardiac arrest. If GA induced, reward light doses of anesthetic. Airway not a problem. Does discussion of probably shock, uterine rupture, choice of anesthetic, advance planning for bleeding occur?

c) Baby delivered---does peds get briefed about blood and mec and probable abruption? How well are they able to do this resuscitation? NALS instructor—don’t let them get baby back until they actually cannulate cord and give volume.

d) After delivery, while Kefzol being given, really drop the BP—70/30, add some PVCs. Show bloody suction, rags to team. Uterus is totally boggy, tone is terrible. Give some credit for pressors and lighter anesthesia, but not enough to feel safe—push them to order blood--her color looks very pale. Stat crit---14, if ordered. How well prepared is OR team to do a C/hyst? Start more IV access and give blood? Blood bank is reluctant to release blood (“Can you just give us another 30 minutes to work on this antibody?”) Requires clear communication to release uncrossmatched blood.

**Key Times to be Alert**

a) Recognition of rupture, communication, decision to go to CS.

b) Briefings in OR-situation, shock, baby, choice of anesthesia?

c) Management of bleeding

d) Management of baby

**Why This Scenario?**
Bleeding is commonly seen. Many of our facilities report systems issues in handling this problem, often related to blood bank. Overall, a good discussion of system strengths and weaknesses results. New information on uterine tamponade balloons, best practices for blood storage (coolers work if no fridge), clear planning for requesting emergency blood will often result.
SIMULATIONS AND DRILLS: EDUCATIONAL TOOL #4.

SAMPLE SCENARIO #4: ATONIC UTERUS AND POSTPARTUM HEMORRHAGE (12)

Used with permission from Martin P. Eason, MD, JD

Participants: OB residents, FM residents.

Learning Objectives
At the end of the session the participants will be able to:

1) recognize the signs of uterine atony
2) appropriately treat uterine atony and hemorrhage
   a. use correct medications
   b. order appropriate labs
   c. ensure resuscitation measures are instituted
   d. make decision to treat surgically

Simulation Overview
This case involves the condition of uterine atony. It is the most common cause of significant obstetric bleeding. It may be associated with placenta previa, placental abruption, retained placenta, or occur alone. Factors associated with uterine atony include multiple gestation, macrosomia, polyhydramnios, high parity, prolonged labor, excessive use of oxytocin, and chorioamnionitis. An atonic uterus may contain up to 1L of blood. Although rarely life threatening, uterine atony can cause severe postpartum hemorrhage and hypotension. The problem should be recognized and treated quickly. Treatment should include administration of appropriate medication to stimulate uterine contractions (oxytocin, Hemabate---prostglandin F2 alpha, ergonivine) and management of hypovolemic shock. Postpartum hemorrhage should be treated as follows:

1. Initiate appropriate general resuscitation principals (ABC’s)
2. Ask for assistance
3. Place large bore intravenous lines
4. Order blood tests and blood products
5. Begin volume replacement with crystalloid and/or colloid solutions
6. Consider invasive monitoring
7. Treat bleeding disorders if present
8. Monitor urine output
9. Consider use of vasopressors

Patient History
Patient is a 32 year old G4P3 female with no prenatal care who presents in labor. She is crowning and ready for delivery. She is a stat transfer from the ED.
Patient History, continued

PMH: Asthma
PSH: None
Meds: albuterol 2 puffs BID prn
All: bee stings
SHx: married; husband is rushing from work. Smokes ½ pack per day; no ETOH; she wants more children
FHx: none

ROS: labor started about 2 hours ago. Water broke 45 minutes ago; clear

Physical examination (provided only if asked)

Cardiac: tachycardic otherwise normal
Lungs: clear bilaterally
Neck: supple

Labs:
None initially available
If ordered: CBC Hct 35% Platelets 235; WBC 8.2
Chem 7 WNL
PT/PTT 9.5/26 seconds

Simulation Parameters

Initial Parameters
BP: 135/78
Hr: 96
RR: 20
Sat: 98%
Heart Sounds: Normal
Lung sounds: clear

Scenario Run
The patient will present with the fetal head crowning; she will be wanted to push. The baby will be delivered OA without complications. Immediately after the placenta is removed, blood will come from the vaginal opening. If palpated the uterus will soft. It will remain so despite medications. The blood pressure will drop from the initial readings over the next 10 minutes to 70/40. Oxytocics will not cause uterine contraction. If Hemabate is given, the patient will complain of shortness of breath and her sats will drop to 80%. If the lungs are auscultated, wheezing will be evident. Rise in blood pressure will depend on replacement of volume. If large bore IVs are placed rapidly and put on pressure bags, the pressure will initially improve to 80/45 but will slowly (over five minutes)
decrease back to the 70’s. Decision to take patient to OR for operative intervention will end case. If not, patient will expire.

Materials needed
- **Platform:** Laerdal® or METI® monitor; Noelle birthing simulator modified with external tubing attached to “blood” bag for bleeding

- **Diagnostic studies:** CBC, coagulation studies

- **Props:** L and D delivery drapes
  - Fetal monitor
  - IV equipment
  - Drugs

- **Personnel:** one “L and D nurse”
  - Patient Voice

**Expected actions by participants (checklist)**

- _____ Take appropriate history from patient
- _____ Order IV access
- _____ Order placement of fetal monitors
- _____ Order placement of maternal monitor (BP, sat)
- _____ Successfully deliver baby
- _____ Recognize post-partum hemorrhage
- _____ Assess uterine tone
- _____ Order fundal massage
- _____ Order labs to include CBC, type and screen, clotting studies
- _____ Order placement of secondary IV access (large bore) with rapid fluid replacement
- _____ Call for help
- _____ Order vasopressors (correct drug in correct amount)
- _____ Order blood to be administered
- _____ Order oxytocin in appropriate dose
- _____ Consider Hemabate® but hold its administration
- _____ Order ergonovine in appropriate dose and route
- _____ Makes decision to go to OR for surgical intervention
- _____ Order surgical team to be called in
- _____ Discusses the need for potential hysterectomy with patient and gets consent
**CRITICAL ELEMENTS** | **MET** | **NOT MET** | **COMMENTS**
--- | --- | --- | ---
A. Primary Surgeon, MD or CNMp
• Recognizes the need to activate the hemorrhage protocol and ensures its immediate activation
• Updates nursing team and the team leader of blood products needed.
• Cancels the hemorrhage protocol as indicated

B. Charge Nurse or designated team Leader
• Assesses the patient, source of bleeding, color, amount
• Cont. monitor VS
• Stays with the patient at all times
• Performs all nursing interventions
• Call MD using SBAR format
• Initiates the hemorrhage protocol per MD order
• Ensures IV access patent
• Ensures collection of a Blood Bank specimen and its immediate transport to the blood bank
• Assigns a person who will communicate with the Blood Bank for the duration (Communicator)
• Maintains communication with the physician, surgeon or designee, using SBAR
• Explains all procedures to patient
• Obtains transfusion consent
• Arranges transportation to L&D
• Ensures cancellation of the protocol, as directed per policy and prompt return of unused blood products to the Blood Bank
### CRITICAL ELEMENTS

**C. Designated team leader or staff**

- Calls the Blood Bank stat @ extension [XXXX]
- Tells the Blood Bank technician "Hemorrhage protocol is in effect for patient (state patient's name), medical record # (give patient’s MRN), in room # (give patient’s location/unit)
- Gives telephone extension for return calls and further communication
- Immediately transports the blood specimen and lab slip directly to the Blood Bank via transporter
- Initiates electronic or manual orders for all Blood products as they are requested by the attending MD/CNM
- Relays to the blood bank any information and or instructions from the MD

**D. The communicator (person assigned to communicate with the Blood Bank), usually the Ward Clerk or Transporter**

- Transports blood bank specimen to the Blood Bank immediately if transporter is unavailable
- Completes orders for blood products (electronic or manual) and *Blood Release Verification* forms for pick up of products.
- Receives blood products from the Blood Bank and delivers to patient location immediately if transporter is unavailable
- Maintains close communication with the Blood Bank
- Waits for additional instructions from the Charge Nurse or team leader
- Notify the Blood Bank if hemorrhage Protocol is cancelled by the MD/CNM

**E. The Transporter (if available) will:**

- Bring the blood specimen (a red top Corvac) and the complete release form to the Blood Bank
- Pick up 4 units O negative (blood type of patient) PRBC or
- Pick up additional blood products as ordered
### F. The Blood Bank Technologist (CLS):

- Prepares 4 units of uncrossmatched O negative RBC for immediate issue
- Completes uncrossmatched Waiver for MD’s signature
- Immediately calls the telephone extension of the unit given for pick-up of the blood product and the waiver
- Notifies a lab supervisor as needed
- If requested, begin to thaw at least 2 units of type specific frozen plasma. If ABO/Rh is not known at this time thaw AB plasma
- Immediately performs type and screen
- Verifies ABO/Rh result with previous record otherwise have another technologist verify ABO/Rh
- While antibody screen is incubating, immediately spins crossmatch 4 units of type specific RBC
- Checks blood inventory and orders, additional blood products for immediate delivery
- Processes requested blood products as soon as telephone orders received
- Sets aside the labeled donor unit segments of issued blood products for later recording and/or maintenance
- Compare pertinent paperwork
- Standby for additional instructions
- When protocol is cleared/cancelled: complete paperwork and update patient’s computer record
- Restores unused blood products in the computer and the refrigerator

### G. Scrub Tech/RN:
- Scrubbed and in OR within 1-2 minutes
- Sets up equipment in OR/DR
- Prepares D&C/Hysterectomy tray

### H. Other RN:
- Assists with patient transfer to OR
- May be 3rd nurse to assist anesthesiology or scrub tech prn
**SIMULATIONS AND DRILLS: EDUCATIONAL TOOL #6.**

**DREYFUS MODEL OF SKILL ACQUISITION (6, 13)**

<table>
<thead>
<tr>
<th>Level 1</th>
<th><strong>Novice</strong></th>
<th><strong>Observer</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rigid adherence to taught rules or plans</td>
<td>Observes the procedure performed by a colleague</td>
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<tr>
<td></td>
<td>Little situational perception</td>
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<td></td>
<td>No discretionary judgment</td>
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<table>
<thead>
<tr>
<th>Level 2</th>
<th><strong>Advanced Beginner</strong></th>
<th><strong>Assistant</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guidelines for action based on attributes or aspects</td>
<td>Assists a colleague in performing the procedure</td>
</tr>
<tr>
<td></td>
<td>Situational perception still limited</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All attributes and aspects are treated separately and given equal importance</td>
<td></td>
</tr>
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<table>
<thead>
<tr>
<th>Level 3</th>
<th><strong>Competent</strong></th>
<th><strong>Directly supervised</strong></th>
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<tbody>
<tr>
<td></td>
<td>Coping with crowdedness</td>
<td>Performs the entire procedure under direct senior supervision</td>
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<tr>
<td></td>
<td>Now sees actions at least partially in terms of longer-term goals</td>
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<tr>
<td></td>
<td>Conscious deliberate planning</td>
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<thead>
<tr>
<th>Level 4</th>
<th><strong>Proficient</strong></th>
<th><strong>Indirectly supervised</strong></th>
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<tbody>
<tr>
<td></td>
<td>See situations holistically rather than in terms of aspects</td>
<td>Performs the entire procedure with indirect senior supervision</td>
</tr>
<tr>
<td></td>
<td>See what is most important in a situation</td>
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<td></td>
<td>Perceives deviations from the normal pattern</td>
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<td></td>
<td>Decision-making less laboured</td>
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<td></td>
<td>Uses maxims for guidance, whose meaning varies according to the situation</td>
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<thead>
<tr>
<th>Level 5</th>
<th><strong>Expert</strong></th>
<th><strong>Independent</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No longer relies on rules, guidelines, or maxims</td>
<td>Performs the entire activity without the need for supervision</td>
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<tr>
<td></td>
<td>Intuitive grasp of situations based on deep tacit understanding</td>
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<tr>
<td></td>
<td>Analytic approaches used only in novel situation or when problems occur</td>
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</tr>
<tr>
<td></td>
<td>Vision of what is possible</td>
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**REFERENCES**


