

## **Rule of 20: What is Best for Critical Patients**

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### **Introduction**

Rebecca Kirby, DVM, DACVIM, DACVECC is a pioneer in veterinary medicine and many years wrote “Kirby’s Rule of 20”. The list was meant to serve as a reminder for the veterinary team to check off 20 very important items in critical patients at least once a day. Critical patients can change their state very quickly. The success of these patients often lies in noticing details, not forgetting the obvious and excellent nursing and medical care by the entire veterinary team. Years since it was first published this list continues to serve as a reminder to everyone to never overlook these 20 important things in your sick patient.

### **The Rule of 20**

1) Fluid balance: The goal of fluid therapy is to ensure adequate perfusion and hydration. How hydrated is your patient? Check the mucous membrane, skin turgor and body weight. Watch for evidence of edema or effusion. Be sure to note losses of fluids (vomit, blood, diarrhea) so that fluid adjustments can be made to keep up with the patient. When treating fluid losses, intravascular deficits should be addressed first.

2) Albumin/Oncotic pull: Colloid Osmotic Pressure is form of pressure in blood vessel induced by the proteins, mostly albumin. Albumin is the major protein that helps to keep COP in check. COP can be measured with colloid osmometry, but this is mainly reserved for specialty or university settings. Normal COP is about 20 mmHg. In pets with moderate to severe decreases in COP, natural or synthetic colloids should be considered, but natural (albumin) are preferred.

Hypoalbuminaemia can result from excessive bleeding, malnutrition, disease (sepsis, protein-losing nephropathy, proteinuria), and gastrointestinal (GI) disease (protein-losing enteropathy). When decreases in albumin are seen, colloid osmotic pressure must be monitored.

3) Glucose: Patients should maintain glucose levels between 80 and 120 mg/dL (4.4-6.6 mmol/L). At least once a day critical patients should have their blood glucose levels checked. Critical patients may not be able to regulate their blood glucose levels normally. Severe hypoglycemia can cause hypotension or neurologic dysfunction ranging from weakness to seizures. There are a variety of medical conditions that can cause hypoglycemia including: sepsis, heat stroke, cancer, or toxicities.

Administration of dextrose is necessary in any patient that is hypoglycemic. Solutions greater than 7.5% must be administered through a central line. Some animals may be hyperglycemic (DKA, HHS, Diabetes). Constant-rate infusion (CRI) of regular insulin can result in the controlled lowering of blood glucose. Patients must be closely monitored.

4) Electrolyte/acid-base balance: Potassium is the most common electrolyte to suffer an imbalance during a disease/injury process. Critical patients can suffer acid/base abnormalities due to the disease or injury they are suffering. At least once a day critical patients should have these values checked. By the time symptoms are present it may be too late. Catching changes early is key.

Hypokalemia can be a contributing factor in weakness. Hyperkalemia can be a life-threatening complication of urinary obstructed cats or those in renal failure. Hyperkalemia can result in bradycardia and must be treated quickly to save the patient’s life.

Other important electrolytes to monitor include sodium, ionized calcium, phosphorus, magnesium, and chloride. Each one is important and could cause patient mortality if left untreated.

4) 5) Oxygenation/ventilation: Even if your patient didn't present with respiratory distress it is important to remember that critical patients are at risk for aspiration pneumonia and changes in their respiratory function. Pulmonary function can be compromised in critical patients for a variety of reasons (embolism, heart disease, pneumonia). Auscultating lungs, monitoring respiratory rate and effort and pulse oximetry is important in critical patients. Early diagnostic tests like imaging and tracheal washes can help with early treatments.

Arterial blood gas measurement "gold standard" test to detect hypoxemia or hypercarbia, but it may be difficult to obtain. Pulse oximetry (SpO<sub>2</sub>) is a noninvasive way to determine the oxygen saturation of hemoglobin.

If hypoxia is unresponsive to oxygen supplementation (PaO<sub>2</sub> <60 mm Hg or SpO<sub>2</sub> <90%) or hypercarbia (hypoventilation) is present (PaCO<sub>2</sub> >60 mm Hg) then manual or mechanical ventilation should be considered. Patients requiring oxygen supplementation should be provided it the most effective, but least stressful way possible.

6) Mentation/attitude: Monitoring changes in your patient's mentation is important. A declining level of consciousness is a poor prognostic indicator. Your patient's mentation and attitude should always improve. Any decline should be investigated.

Level of consciousness is often monitored by observing the patient and utilizing coma scales. One of the most used coma scales in veterinary medicine is the Modified Glasgow Coma Scale. The MGCS involves three separate categories, including level of consciousness, motor activity, and brainstem reflexes. Critically ill patients should have their mentation/level of consciousness serially monitored as part of routine patient parameters every 1-4 hours to assess changes early.

Elevating the head 15° and avoiding procedures that may increase venous pressure and subsequently intracranial pressure is essential (pressure on neck). Maintaining normal oxygenation/ventilation, blood pressure, glucose level, and serum osmolality is essential for animals with head trauma/disease.

7) Blood pressure: Check how your patient's pulses feel and check your patient's blood pressure. Remember that how pulses feel does not always correlate with blood pressure. Blood pressure should be monitored via direct (arterial invasive monitoring) or indirect methods (doppler/oscillimetric). The minimum goal is to maintain organ perfusion by maintaining a mean arterial blood pressure >60 mmHg (systolic >90 mmHg).

There are a variety of reasons patients may experience hypotension or hypertension. Hypotension is more common in critical patients. The need for cardiovascular support with positive inotropes or vasopressors should be considered when fluid therapy fails to support blood pressure.

Hypertension can lead to retinal detachment or to neurologic derangements from intracranial hemorrhage. Moderate to severe hypertension can be treated with antihypertensive agents such as calcium channel blockers (amlodipine) or topicals like nitroprusside.

8) Heart rate, rhythm and contractility: Listen to the heart with the stethoscope. Don't just rely on feeling pulses. Perform a spot-check ECG to truly get an assessment of what the heart is doing. It takes just a few minutes to perform and tells you a lot about the heart. There are six perfusion parameters used to measure cardiac function. These include mentation, heart rate, pulse rate, mucous membrane color, capillary refill time, and body temperature.

Arrhythmias can occur for a variety of reasons (GDV, electrolyte abnormalities, sepsis).. Oxygen, fluids, and pain medication are considered first-line agents to treat underlying conditions. If arrhythmias are persistent then cardiac medications need to be considered.

9) Temperature: Be sure to take your patient's temperature throughout the day. Hyperthermic causes can include heat stroke, infectious (sepsis), cancer or inflammatory (tick borne). Hypothermia is most commonly associated with chronic diseases (kidney, liver disease).

Temperature is a vital parameter to monitor. Appropriate treatment options should be performed when warranted. Therapeutic hypothermia may have some benefit in preventing I/R injury, but more studies need to be performed.

10) Coagulation/clotting ability: Look for petechiae and ecchymosis. Is your patient bleeding more after a venipuncture stick? These are early signs of disseminated intravascular coagulation. Most critical patients are at risk for developing DIC.

Disseminated intravascular coagulation (DIC) can develop in any animal that has undergone a major disruption in the intravascular system. Usually this causes exposure of capillary endothelial cells which results in circulating inflammatory mediators. The goal is to detect DIC in the early stages and to slow or prevent its progression.

The most common hypercoagulable states in veterinary patients are aortic and pulmonary thromboemboli. Whenever there is a major change in the respiratory state of a patient, emboli should be considered. Antithrombotics are warranted in these cases. (aspirin, clopidogrel, heparin (low molecular weight or unfractionated), rivaroxaban, or warfarin). Common diseases that result in hypocoagulability states include rodenticide toxicity, snake envenomation, ITP and other thrombocytopenic states. Therapies should include plasma products.

11) Red Blood Cell and hemoglobin concentration: Check a PCV and TS at least once a day in a critical patient. Hemoglobin which is found to RBCs carries oxygen. It's important to maintain a high RBC count and hemoglobin concentration. When the patient is anemic, they may show clinical signs such as tachycardia, increased respiratory rate, altered mentation, severe lethargy/weakness, and hypotension. Treatment of anemia includes blood products, or if available hemoglobin-based oxygen carriers (HBOCs). The appropriate Hgb level has not been determined in pets. In people the Hgb goal is 7 g/dl with a minimum of 20% PCV.

Some disease states may result in altered hemoglobin (methemoglobinemia) or altered oxygen-carrying capacity (carboxyhemoglobinemia) which usually cause mucous membrane color to be a muddy or brick-red color respectively. Hemoglobin concentrations will be normal while oxygen cannot be delivered to tissues. Oxygen supplementation is necessary along with treatment of the underlying disease.

12) Renal Function: Is your patient producing enough urine? Most critical patients are at risk for organ dysfunction. The kidneys are very sensitive to major changes in the body and may stop producing adequate amounts of urine. Measuring and quantifying urine amounts in critical patients is important. Don't forget to record urine production.

Serial measurement of serum BUN, creatinine, electrolytes, and phosphorus will detect changes and help guide treatment plans. Urinalyses can be used to detect glucosuria, proteinuria, or renal tubular casts help evaluate acute renal injury. Pets can be staged by using the International Renal Interest Society staging system which monitors serum creatinine, BUN, blood pressure, and proteinuria.

13) Immune status/antibiotic dosage: Critical patients have a decreased immune function. Remember to wear gloves when working with them. Strict aseptic technique should be observed when examining or treating animals that are neutropenic or receiving immunosuppressive drugs. Minimize risk to your immune compromised patient by keeping it away from other sick patients. Think about using antibiotics when appropriate.

Antibiotic selection should be based on the results of culture and susceptibility testing. Empiric treatment should occur, but based on data of common bacteria for that particular illness/injury. Repeat culture and susceptibility testing in pets not responding or if prolonged antibiotic therapy is anticipated.

14) Gastrointestinal motility and mucosal integrity: Critically ill patients are at risk for gastric ulcers, ileus, gastritis and other GI disturbances. Is your patient eating? Any vomiting or diarrhea? All of these indicate the health of the GI tract in a critical patient.

Antiemetics should be used in pets that continue to vomit frequently despite treatment options. Consider a placement of a nasogastric tube which allows for removing air and stomach acid/juices which may reduce nausea.

15) Drug dosages and metabolism: Critical patients usually receive a lot of medications. Appropriate documentation, treatment sheets and a list of drugs that do not interact with each other should be kept. Record what you give and when you gave it. Drugs should be constantly monitored for compatibility with other drugs. Remember the Five Rs: Right Dose, Right Drug, Right Patient, Right Route, Right Time.

16) Nutrition: It used to be thought to withhold food to allow the body to heal. This has been proven incorrect. The earlier nutrition is introduced the faster the body heals. Start thinking about nutrition as soon as you get the patient admitted. It should be introduced as soon as possible.

Enteral feeding is best, but when patients are not intaking enough calories feeding tubes should be considered. Nutrition and GI integrity go hand in hand. Short-term options include syringe or forced feeding, which is no longer recommended due to complications and food aversion. Easy to place and well-tolerated, short-term feeding tubes that allow trickle feeding include nasogastric and nasoesophageal. Nasogastric tubes also allow gastric suctioning to monitor GI function and may help to limit continued vomiting.

Long-term feeding tubes include esophagostomy, pharyngostomy, gastrostomy, or jejunostomy tubes. Each of these tubes are well tolerated by most animals, and all require anesthesia to place. Esophagostomy tubes are the easiest to place with most cats readily accepting these tubes. Consider appetite stimulating drugs if really struggling to get adequate nutrition into a patient.

17) Pain control: Advocate for your patient since they cannot speak. Almost all critical patients need some type of pain management. Be sure to use multimodal pain medication. NSAIDs should not be used in critically ill animals because of their negative effects on the GI tract, kidney, and liver. Other oral classes of medication that are well tolerated for mild to moderate pain include tramadol, amantidine, and gabapentin. Studies varies on how much relief is provided for these drugs. Codeine has been used for years in other countries and used to be a primary pain reliver in dogs in the 1990s in the United States. It is making a comeback and should be considered for pets where oral medications are an option.

18) Wound care and bandage change: Any wounds or bandages must be cared for appropriately. Keeping them clean and changing them appropriately is important to ensuring they heal quickly. Patient factors that play a role in the overall healing of a wound include: age, underlying disease processes, foreign material, infection, blood supply, and severity of initial injury.

19) Nursing care: Providing nursing care to critically ill animals requires a skilled, knowledgeable, attentive, and highly trained nursing staff. Veterinary technicians and assistants play an equal role in the patient's care. They are the patient's advocate and are responsible for recommending treatment and therapy that may have been omitted by a veterinarian.

Critical patients require extensive nursing care. Turning patients, passive range of motion, keeping the patient free of urine scald and bed sores, bathing and cleaning are important in helping the patient recover. Having an extensive knowledge of caring for pets with tubes and drains, ventilator patients and critical disease knowledge is key to patient's successful recovery.

20) Tender Loving Care: Don't dismiss kindness and love. Allow owners to visit for long periods of time. So often hospitals restrict visitation times to 15 minutes or certain times of the day. Recognize that

mental health of your patient plays a direct role in their recovery. Happiness helps with healing. Allow owners of critical patients to be the exception to the hospital rule. You should spend time with your patient truly caring for them. Remember that caring for pets is why you went in to this field. Pet them, talk to them and give them the love they so need at a very critical time.