**Pharmaceutical Failure Mode and Effects Analysis**

**Doxil® (doxorubicin hydrochloride (HCL) liposome injection)**

**Step 1:**

Describe how the intended product will be procured and used, from acquisition through administration.

- Who will prescribe the drug and for what type of patient?
  Oncology physicians will prescribe Doxil for refactory ovarian cancer patients.

- Where will the drug be stored?
  It will be stored in the pharmacy storeroom refrigerator at 2º-8ºC (36º-46ºF). Diluted Doxil is stable for 24 hours in the refrigerator or at room temperature.

- Who will prepare and dispense it?
  It will be prepared by a certified pharmacy technician and be double checked by an IV room pharmacist.

- How will it be administered?
  It is administered by IV infusion by a chemotherapy certified nurse.

**Step 2:**

Identify potential failure modes (how and where systems and processes may fail) while considering how the product will be used.

- Could the drug be mistaken for another similarly packaged product?
  It is supplied as a 10-mL or 30-mL single-use vial

- Does the label clearly express the strength or concentration?
  Yes

- Does the name sound or look like another drug on the formulary?
  Yes-Adriamycin RDF® (doxorubicin HCl), Cerubidine® (doxorubicin HCl)

- Are dosing parameters complex?
  Yes-50 mg/m² IV every 4 weeks. Dose modifications are needed for drug toxicities [infusion-related reactions, palmer plantar erythrodyesthesia (hand-foot syndrome), hematological toxicity, stomatitis, and hepatic impairment]

- Is the administration process error prone?
  Yes-Doxil is incompatible with heparin flushes and should be flushed with 5-10 mL of D₅W solution; Doxil should be administered at an initial rate of 1 mg/min
· **Step 3:**

Once failure modes have been identified, determine the likelihood of making a mistake and the potential consequences of an error.

What would happen to the patient if the drug were given in the wrong dose, at the wrong time, to the wrong patient, by the wrong route, at the wrong rate?
Overdose, wrong rate: higher incidence and severity of side effects

· **Step 4:**

Identify any preexisting processes in place that could help detect the error before it reaches the patient, and evaluate their effectiveness based upon knowledge of human factors.

There is a double check between the physician and the pharmacy and again between the pharmacy and nursing. There is a double check procedure with the IV room between the technician who prepares the medication and the pharmacist who checks the medication. All prepared chemotherapy drugs are labeled with a yellow auxiliary sticker and placed in a distinct chemotherapy bag for delivery. Nurses follow a two patient identifier policy prior to administration. The chemotherapy order entry process includes a second pharmacist check and verification of a nursing checklist.

· **Step 5:**

If failure modes could cause errors with significant consequences, what actions could be taken to prevent the error, detect it before it reaches the patient, or minimize its consequences? (A few examples include: using an alternative product; preparing the drug in the pharmacy; standardizing drug concentrations, order communication and dosing methods; using auxiliary warning labels or computer alerts; and requiring entry of specific data into computer systems before processing orders).

Do not store regular doxorubicin HCl and Doxil side by side in the pharmacy storeroom.

**Administration Information:**

What are the most common side effects that Nursing should be aware of to ensure proper monitoring?

Common side effects in patients with recurrent ovarian cancer that were treated with Doxil included hand-foot syndrome, nausea, mouth sores (stomatitis), fatigue, abdominal pain, vomiting, constipation, rash, fever, reduced red blood cell count (anemia), reduced white blood cell count (neutropenia), weakness, hair loss, appetite loss and diarrhea.
Myocardial damage may lead to congestive heart failure and may be encountered as the total cumulative dose of doxorubicin HCl approaches 550 mg/m². The use of Doxil may lead to cardiac toxicity. Prior use of other anthracyclines or anthracenediones should be included in calculation of total cumulative dosage. Cardiac toxicity may also occur at lower cumulative doses in patients with prior mediastinal irradiation or who are receiving concurrent cyclophosphamide therapy. Doxil should be administered to patients with a history of cardiovascular disease only when the potential benefit outweighs the risk.

Acute infusion-related reactions have occurred in up to 10% of patients treated with Doxil. Serious and sometimes life-threatening or fatal allergic/anaphylactoid-like infusion reactions have been reported. Medications to treat such reactions, as well as emergency equipment, should be available for immediate use.

Is there any associated laboratory monitoring that Nursing should be aware of to ensure proper patient care?
CBC with diff, Chemistry including Liver Panel, Patients should have cardiac function carefully monitored.