

# Blood Transfusions



# Overview

**Why Do We Transfuse?**

**Blood Products**

**Canine Blood Types**

**Feline Blood Types**

**Procedure**

- Blood Typing
- Set-Up
- Calculating Rate
- Monitoring

# Why Do We Transfuse?

**Anemia**

**Coagulation Issues**

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# Reasons for Transfusions

## Anemia (give pRBCs or whole blood\*)

- Anemia is a decreased RBC count
  - Blood loss
  - Hemolysis (destruction)
  - Decreased production
- Goal = replace oxygen-carrying capabilities of blood
- If we need to replenish circulatory volume, give pRBCs *and* IVF
- Transfuse when **symptomatic**, not solely based on PCV value
  - Normal PCV ranges: **Canine (35%-50%)**, **Feline (25%-45%)**
  - What are some symptoms of anemia?
    - Tachycardia, tachypnea, pulse quality, pallor, mentation
  - Chronic anemia vs. acute anemia\*
  - Goal = get PCV above 20%



# Reasons for Transfusions

## Coagulopathies (give FFP)

- Coagulation factor deficiencies (12 factors, I - XIII)\*
  - Liver produces most coagulation factors
  - PT = prothrombin time
    - Elevations indicate **extrinsic** pathway issue
  - aPTT = activated thromboplastin time
    - Elevations indicate **intrinsic** pathway issue
- Protein deficiencies
  - Hypoproteinemia
  - Hypoalbuminemia (not the best source though)
- Disseminated Intravascular Coagulation (**DIC**)
  - Deregulation of natural clotting and clot-dissolving mechanisms
    - Inappropriate and exaggerated clotting and bleeding events
  - Usually a complication of serious underlying disease/cause
    - Pancreatitis, IMHA, ITP, rattlesnake bite, heat stroke, HW, Cushing's, PLE, & others...



# Blood Products

**Whole Blood**

**pRBCs**

**Plasma (FFP)**

**Blood Banks**

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# Blood Products

## Whole Blood

- Whole blood contains all the components of blood
  - RBCs and WBCs
  - Platelets and coagulation factors
  - Plasma proteins (albumin, globulin), electrolytes
- Not common, limited lifespan
  - Ideally given within 4-6 hours after collection
  - Platelets only effective for 24 hours after collection, 2 hours if refrigerated

## pRBCs

- Packed red blood cells and anticoagulant
  - RBCs and WBCs
  - Nonviable platelets and minimal plasma (PCV = 65% - 80%!)
- **Most common**
- Can be stored/refrigerated for approximately 4 weeks
  - Use within 24 hours after spiking bag



# Blood Products

## Fresh Frozen Plasma (FFP)

- Long life-span - store frozen for 1 year
- Thaw FULLY in **warm** water bath (not hot)
- Use within 24 hours of thawing
- If thawed & re-frozen because not used, now considered **Frozen Plasma** (no longer **fresh**), but lasts 4 more years
  - Most clotting factors no longer viable
    - Vit K dependent factors ARE → good for Vit K deficient cases
  - Proteins remain functional and viable



## von Willebrand Disease

- Genetic bleeding disorder due to lack of vWB factor protein
- Several varieties (Types 1, 2, 3), each affects platelet and clotting function differently
- Treatment = manage symptoms, steroids (DDAVP), transfusions

\*Doberman Pinschers



# Blood Bank

## Blue Ridge Veterinary Blood Bank

- Virginia location, since 1993



**BLUE RIDGE  
VETERINARY  
BLOOD BANK**

## IndyVet Blood Bank

- Indiana location



## These are Volunteer Donor Programs

- Owned cats and dogs donate regularly
- Must meet pre-screening age, weight, behavioral, and health/vaccine requirements
- Benefits for donors
  - Annual wellness exams, blood screening, free blood products for emergencies
- Generally, donors are fine afterwards
  - Potential bruising at venipuncture site (jugular)
  - May receive SQF after donation

# Blood Types

**Canine Blood Types**

**Feline Blood Types**

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# Canine Blood Types

## Dog Erythrocyte Antigens (DEA)

- Antigen = protein or sugar on RBC membranes
  - Antibodies against those antigens cause a dog's body to have a reaction to (reject) the blood
  - Antibodies develop after exposure/sensitization
- Dogs have 13 blood types (DEA numbers)
  - Can exist in various combinations (they are independent)
  - **DEA 1.1**
    - Most potent antigen
    - 40% - 60% of dogs are DEA 1.1 positive
  - DEA 1.2, DEA 3, DEA 5, DEA 6, DEA 7, DEA 8, and more (Dal)
  - **DEA 4**
    - All dogs have it, but dogs with ONLY this protein = universal donors



# Feline Blood Types

## A, B, and AB (and Mik)

- Antigen = carbohydrate group on RBC membranes
  - Antibodies against those antigens cause a cat's body to have a reaction to (reject) the blood
  - Antibodies are naturally occurring (without exposure)
- Cats have one of three blood types:
  - **Type A**
    - Most common
    - Dependent on region, up to 94%-99% of cats in U.S.
  - **Type B**
    - Uncommon, seen more in some purebreds
    - Rexes, Turkish, Ragdolls, British Shorthair...
  - **Type AB**
    - Extremely rare, can receive A or AB blood



# Blood Typing

**Blood Type QuickTests**

**Crossmatching**

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# Why Do We Test Blood Type?

## Prevent Sensitization

- Dogs rarely have natural antibodies to other DEA factors
- Exposure causes development of those antibodies

## Avoid Acute Reactions

- If antibodies against a blood type *are* present:
  - Hemolysis of RBCs
  - Anaphylaxis

## Optimize Compatibility for Blood Cell Survival

- If antibodies against a blood type *are* present:
  - This shortens lifespan of transfused RBCs



# Alvedia QuickTest - Blood Typing

## Species Specific

- Canine test for DEA 1.1 blood type
- Feline test for A, B, or AB blood type

## Easy Steps, Fast Results

- All components provided in kit
- Requires only a small amount of patient's blood (in LTT)
- Results in 2-5 minutes

## How does it work?

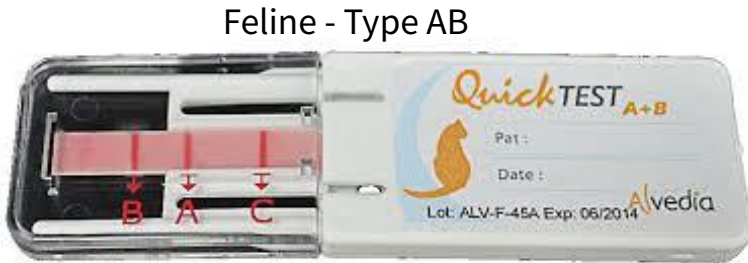
- Monoclonal antibodies specific to each antigen incorporated into strip membrane
- These antibodies react to antigens → appear as visible line
- Control line to ensure results are viable



# Alvedia QuickTest - Blood Typing Results



Feline - Type A



Feline - Type AB

Canine - DEA 1.1 Positive



(a)



(b)

Canine - DEA 1.1 Negative



# Rapid Vet-H - Blood Cross-Matching

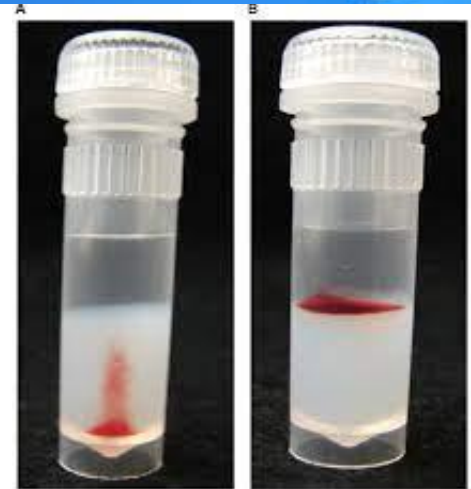
## For Feline or Canine Blood

- No species specificity
- Recommended for **all** feline transfusions
- Recommended for multiple canine transfusions
- Not a substitute for blood-typing



## Straight-forward, detailed instructions

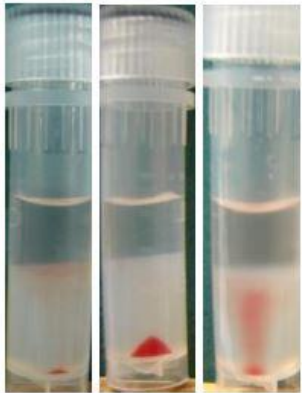
- All components provided in kit
- Requires only a small amount of **recipient patient's serum or plasma**
- Requires a small amount of **donor's blood**
- Numerous steps - read through first and take your time!
- Compare donor/recipient results to positive and negative controls



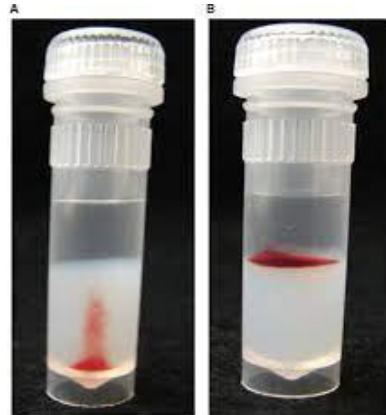
# Rapid Vet-H - Blood Cross-Matching Results

## How does it work?

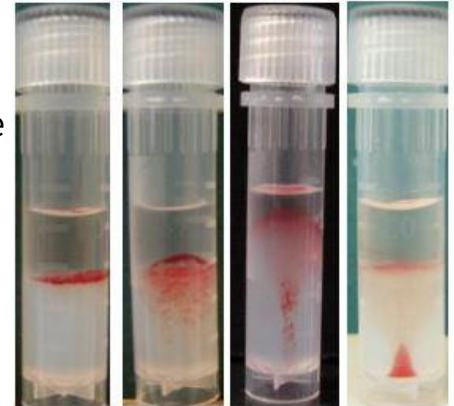
- Positive control tube - will react to antigens in donor blood
  - Blood agglutinates and remains at top of gel column after centrifuging
- Negative control tube - will not react to antigens in donor blood
  - Blood collects at bottom of gel column after centrifuging
- Reaction tube - this is your patient's serum mixed with the donor blood
  - Compare this result to the positive and negative controls to determine compatibility of donor



Negative = OK to use



Positive = do not use



# Setting Up Your Transfusion

**Pump or No Pump?**

**Logging Your Blood**

**Supplies**

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# Pump or No Pump?

## Canine Blood Study (2011)

- Gravity Delivery (no pump) = 100% chance of RBC survival to 49 days post-transfusion
- IV Pump Delivery\* = 50% chance of RBC survival to 49 days
- Syringe Pump Delivery = 0% chance of RBC survival beyond 24 hours
  - ***Much smaller*** pore size filter used

## Feline Blood Study (2014)

- No significant difference in RBC survival time up to 42 days post-transfusion between gravity delivery and syringe pump infusions despite the filter pore size difference







# Supplies

## Gather Everything for Your Transfusion

- JorVet 2000 pump or syringe pump if you are using one
- Donor blood bag - double-check for correct type
  - Did you log out the unit?!
- Administration set
  - Blood filter\* administration set
  - Appropriate syringe, extension set, heparin filter
  - Consider filter limitations\*
  - Procedure for splitting a bag\*
- Hemo-tap spike
- Animal ID label for blood bag
- Saline flush syringe
  - Size-appropriate
- Vitals monitoring supplies
  - Thermometer, stethoscope, etc.



# Calculate Rate

**On a Pump**

**Gravity/Manual Drip Rate**

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# Calculating a Pump Rate

## Be sure you have a compatible pump!

- Only the JorVet 2000 is an acceptable infusion pump
- Syringe pumps are also OK for cats

## Rate Calculation

- DVM says: Give 350ml pRBCs over 4 hours
- Like a bolus, we know our VTBI = 350ml
- **Divide** VTBI by 4 (number of hours) to get hourly rate:

$$350\text{ml} \div 4\text{hr} = 87.5\text{ml/hr}$$

**You can set your pump rate for 88ml/hr.**

It is a good idea to start the transfusion at half rate, then increase to full rate if patient is tolerating.





# Calculating a Manual Drip Rate

## Check the packaging of your drip set

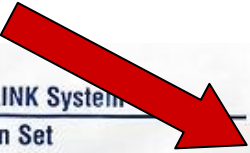
- The number in the corner = how many **drops per ml (10)**

## Rate Calculation

- DVM says: Give 350ml pRBCs over 4 hours

Determine your rate:	$350 \text{ mL} \div 4 \text{ hr} = 87.5 \text{ mL/hr}$ (88 mL / hr)
Find drops/hr	$88 \text{ mL} \times 10 \text{ drops/ml} = 880 \text{ drops/hr}$
Find drops/min	$880 \text{ drops/hr} \div 60 \text{ min} = 14.6 \text{ drops/min}$
Find drip rate	$60 \text{ seconds} \div 14.6 \text{ drops/min} = 4.09 \text{ sec}$

You should have a flow rate of **1 drop of blood about every 4 sec.**



**INTERLINK System**  
**Solution Set**  
76" (1.9 m)  
Injection Site, Lever Lock Cannula,  
Male Luer Lock Adapter with  
Retractable Collar

**2C6401 s**  
**10**  
10 drops/mL  
Approx.

Fluid path is sterile, nonpyrogenic.  
Cautions: Do not use if tip protectors (1) are not in place.  
Do not place on sterile field.

Indications for Use: For the administration of fluids from a container to the patient through a vascular access device. The INTERLINK Lever Lock Cannula is indicated to function exclusively with the INTERLINK Injection Site as a fluid path injection device.

Directions: Use aseptic technique.  
Close regulating clamp (5). Insert spike (2) into solution container. Fill drip chamber (3) to fill line. Open regulating clamp (5). Prime set, purge air. Close regulating clamp (5) until roller meets bottom of frame. Attach cannula (8) to Luer lock adapter (7) and prime. Squeeze levers, insert cannula (8) into INTERLINK injection site (identified by a colored ring), release to lock. Swab septum of injection site (6) with antiseptic prior to access. Access INTERLINK injection site (5) (identified by a colored ring) with INTERLINK cannula. See cannula directions.



To properly set flow, always close regulating clamp (5) until roller meets bottom of frame, then reopen to establish flow rate. Repeat procedure if adjusting clamp from fully open position.

Cautions: Do not allow air to be trapped in set. Puncturing set components may cause air embolism. If needle must be used, insert small gauge needle into perimeter of septum (6). Do not use cannula (8) if its package is opened or damaged. Do not disconnect set, syringe or other component from cannula (8) while cannula is still connected to INTERLINK injection site (5). Rx Only. Single use only. Do not resterilize.

Notes: This product is not made with natural rubber latex. This product contains DEHR. To stop flow without disturbing regulating device (5), close slide clamp (4). Cannula (8) internal diameter equals a 15 gauge regular wall needle, length 3/8". Cannula (8) is not compatible with conventional injection sites. If set is to be used without cannula, attach male Luer adapter (7) to vascular access device, using a firm push and twist motion, and then engage the Luer lock collar to prevent accidental disconnection. When used in gravity mode, replace per CDC guidelines. When used with Baxter pumps or SIGMA Spectrum infusion system, replace per directions in respective pump labeling. When used with FLO-GARD pumps, replace after 24 hours. Lengths are approximate. For Product Information 1-800-933-0303

**Baxter**  
Manufactured by an affiliate of  
Baxter Healthcare Corporation  
Deerfield, IL 60015 USA  
Made in Singapore  
07-34-75-866 Rev 2016-05-01

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# Monitoring Your Transfusion

**Documentation**

**Tracking Vitals**

**Potential Reactions**

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# Tracking Vitals

## Use Vitals Section of Transfusion Sheet

- Get pre-transfusion baseline vitals
- Temp, HR, RR/RE, MM/CRT, mentation, notes

## Frequency of Vitals

- Hour 1 - Vitals every 15 minutes
- Hour 2 - Vitals every 30 minutes
- Hours 3 & 4 - Vitals every 60 minutes
- **If** patient has a reaction, return to q15min vitals
- Get post-transfusion vitals for completion
- Use notes section to document any additional information

Transfusion Vital Sign Chart						
Date: _____						
Patient Name: _____						
Transfusion/Infusion Type: _____ Total Volume: _____ Rate: _____						
Blood Product Bag #: _____ Blood Product Donor #: _____						
Blood Product Bag Size (without additives): _____						
Start Time: _____			End Time: _____			
Time	Temp	Pulse	Resp	MM	CRT	Comments
1:00p	100.3	150	40 / n	pale	—	baseline
1:02p						Start pRBC
1:15p	100.4	148	40 / n	pale	—	
1:30p	100.3	152	40 / n	pale	—	P = QAR
1:45p	100.6	144	36 / n	pale	—	
2:00p	100.7	140	36 / n	pale	—	
2:30p	100.4	136	36 / n	pale	—	sleeping
3:00p	100.8	128	32 / n	pale pk	2s	
3:30p	101.6	120	32 / n	pale pk	1.5s	
4:00p	102.1	124	72 / pant	pale pk	1.5s	QAR, pant
4:30p	102.4	120	76 / pant	pale pk	1.5s	Benadryl
5:00p	101.9	116	40 / n	pale pk	1.5s	
5:10p						Flush
5:40p	101.7	120	32 / n	lt pk	1.5s	Complete

# Potential Reactions

## Immune Reactions

- Hemolysis
- Allergic Reactions, Graft-vs-Host Reactions
  - **Facial swelling, urticaria**
  - **Hyperthermia**
  - **Tachycardia, tachypnea**
  - **Hypotension**
  - **Nausea, vomiting, agitation, weakness**
  - **Muscle tremors**
  - **Anaphylaxis**

## Non-Immune Reactions

- Hemolysis → low PCV
- Bacterial contamination of blood product
  - Improper handling, infected donor
- Hypocalcemia (from citrate toxicity)
  - Muscle tremors, shaking, weakness
- **Hypothermia**
- Hyperammonemia (concurrent liver disease)
- **Fluid volume overload**

\*\*Reactions to blood/plasma transfusions can occur even when only a small volume (a couple of mls) of has been administered.

\*\*Reactions can occur within the first hour, or up to 48 hours after the transfusion!



# Solutions for Reactions

## Set Yourself Up for Success

- Handle blood products correctly to reduce lysing damage
  - Blood does **not** usually need to be warmed
  - Use appropriate pumps or gravity infusions
  - Avoid using small-gauge needles when possible
  - Check blood type and expiration date **before** use

## If Your Patient DOES Have a Reaction

- Notify the DVM if you note a reaction!
  - Give Diphenhydramine
  - Slow transfusion down (half-rate or slower)
  - Stop transfusion
- Based on case
  - Give other medications: steroids, epinephrine (anaphylaxis), furosemide (fluid overload)
  - IVF may be needed



# Post-Transfusion Monitoring

## Be Observant!

- Hemolysis
  - Can be noted by urine color changes
- Delayed reactions can occur hours/days/weeks later!
- Monitor patient's PCV
  - Check it 2 hours post-transfusion
  - May need to check at additional intervals



## Patient May Need Additional Transfusions

- Follow DVM instructions and cross-match when giving more than one transfusion

# Special Scenarios

**Autotransfusion**

**Xenotransfusion**

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# What is an autotransfusion?

## Auto = self

- **Autologous** = from the same individual (referring to tissue or cells)
- Using a patient's own blood to transfuse
  - Hemothorax - chest is a pretty sterile environment
  - Traumatic hemoabdomen
- Only perform when no evidence of contamination from:
  - Urine (uroabdomen)
  - Bile (bile peritonitis)
  - Bacteria (septic peritonitis)
  - Neoplastic cells (hemangiosarcoma)



## Benefits

- Blood is readily available
  - Has already undergone **fibrinolysis**, so no need to add anticoagulants
- No transfusion reaction - guaranteed compatibility
  - This is the patient's own blood, so no antibodies against it
- Collect sterilely in syringes and deliver or use satellite donation collection bag
- Should still use a filter when administering to patient

# How to give an autotransfusion



# What is a xenotransfusion?

## Xeno = foreign, strange

- A type of **xenotransplantation** = transfer of blood from the one species into the veins of another
- Using canine blood to transfuse a feline

## Benefits

- Canine blood is more readily available than feline blood
- Canine blood is a less expensive alternative
- No need to blood type the patient
- Avoids transmission of feline specific diseases (i.e., FeLV, FIV)

## Risks

- Causes sensitization to antigens on canine blood
- Band-Aid, not cure
  - Only provides viable blood for ~4 days
  - Versus allogenic, or cat-to-cat transfusion = 30 day blood viability
- Rare and not terribly well-studied (few studies, small sample sizes)



# Xenotransfusion Studies

## Some Study Stats

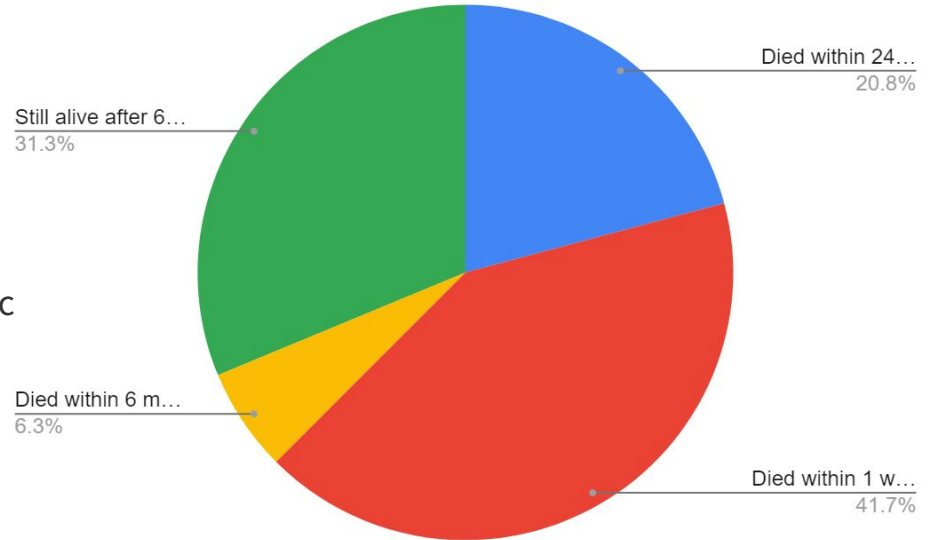
- This is still pretty rare with limited data!
  - Only 61 cases in 4 publications back in the 1960s
  - No publications from 1968 until 2014 - thought to be an outdated practice
  - Only 17 more documented cases between 2014 and 2019
  - 2020 study of 49 cases
- Observations and Safety Considerations
  - Must be virgin transfusion - in a study, no major reactions seen in any of the cats, only minor crossmatch positives
    - Clinical reactions = tachypnea, hyperthermia
  - Second transfusion (if needed) is given **within** 4 days
    - (13 of 13 cats did ok, no positive crossmatch results)
  - Second transfusion (if needed) is given **after** 4-6 days
    - (18 of 18 cats experienced anaphylaxis, and 66% died)



# Xenotransfusion Studies

## More Study Stats

- Another study (2016-2018)
  - 49 cats from 2 hospitals
  - Causes of anemia
    - Surgical blood loss, IMHA, neoplasia
  - Median PCV pre-transfusion = 10%
  - Reactions = minor, 6 of 49 were febrile
  - Median PCV 12 hours post-transfusion = 25%
  - 10 cats died/were euthanized within 24 hours
  - 25 of remaining 39 cats had delayed hemolytic reaction (~2 days after)
    - Icteric (15 cats)
    - Hemolytic serum (19 cats)
  - 18 cats alive 1 week after discharge
  - 15 cats still alive at a median of 173 days after transfusion



# Is a Xenotransfusion Worth It?

## Rationale and Limitations for Xenotransfusions

- So when is this a viable option?
  - No other options/no blood bank or donor available
  - Rare blood type (B or AB cat)
  - Patient is critically anemic and death is imminent if not given blood
    - Includes potential hypoxic death if no blood received
  - Short-term effect is enough to save patient (can get compatible blood or treat underlying cause to allow regeneration)
  - Virgin recipient so that there is no sensitization
  - Owner is informed of risks and gives consent



# Thanks!