

## 17. Patient Transport

Figure 17-1 shows some of the options for transporting a patient to a cryonics facility from the location where death has been pronounced. We are assuming that blood washout and, optionally, neuroseparation and neurocryoprotection will be done either in a mortuary or a suitably equipped ground vehicle. Other possibilities exist but are not shown, as they are less commonly used. The chart also omits cases that originate overseas.

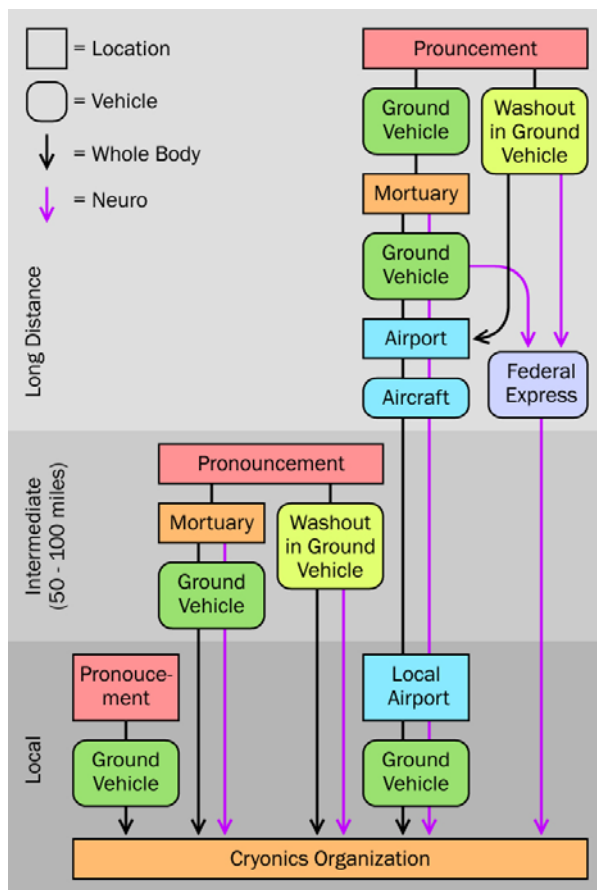


Figure 17-1. The most commonly used transport options for patients originating inside the United States. Note that blood washout may also be done at the Mortuary.

For local cases, the ground vehicle is usually owned by a cryonics organization. During a remote standby, a vehicle that has been equipped for cryonics procedures may not be available if the distance is too great or there is insufficient time for deployment. Team members may rent a van locally, or may depend on a collection service associated with a mortuary.

Intermediate-distance cases are arbitrarily defined here as 50 to 500 miles, such as those that originate in Southern California (where a large number of cryonicists are located) and terminate at the Alcor facility in Scottsdale, Arizona. Chartered aircraft have been used in such cases, but rarely.

Federal Express is an option reserved for neuro cases shipped on dry ice, after neuroseparation has been performed in a remote location.

Air transport may be by scheduled airline or chartered jet, depending on the funding that is available for the case and the location of the patient.

Sometimes more than one option will be available, and choosing between them may be difficult, always bearing in mind that rapid transport and rapid cooling are the primary considerations. Suppose that a patient is pronounced at a location four or five hours from the cryonics facility via ground vehicle. Can the cryonics organization deploy a vehicle to the area before death is pronounced? If so, can blood washout be performed in the vehicle by a suitably qualified person, or should the patient be moved to a mortuary, even though this will add some extra time? Suppose the patient prefers whole-body preservation but has signed an option for neuro conversion if this will optimize the case. Should neuroseparation be done at a mortuary, followed by transport on dry ice, or should whole-body washout be done, followed by transport on water ice? Such decisions have to be made on a case-by-case basis.

## **Local Ground Transport**

We may hope that a local case will originate in a home, hospital, or hospice where the cryonics organization has secured cooperation and has been able to station an ice bath and supplies near the patient. After pronouncement, the patient is placed in the ice bath, a pump circulates ice-cold water over the head

and body, CPS begins, medications are administered, and these activities should continue with minimal interruptions while the ice bath is wheeled to the transport vehicle and driven to the cryonics facility.

Local transport will typically take less than an hour, but preparations for cryoprotection at the cryonics organization may take longer. To minimize the risk of the facility being unprepared when the patient arrives, active communication is essential. Staff at the facility should be given frequent updates about the condition of the patient prior to legal death, and must be informed immediately when death has been pronounced and the transport has begun.

A wheeled ice bath that has legs to raise it above floor level is useful for ground transport in a vehicle dedicated for cryonics cases. The vehicle must have an easily operated clamp to restrain the ice bath during transport, as the weight of the ice bath, with its patient and a full load of ice and water, will be hazardous to personnel if it can roll around.

A discussion of appropriate vehicles that can be customized for transport of cryonics patients will be found in the addendum to this section, illustrated by three examples.

## **Ground Transport to Mortuary**

The term “mortuary” in this subject heading includes any environment where surgery and blood washout may be possible, in a location that is remote from the cryonics organization.

When team members fly to a remote standby, if a vehicle adapted for cryonics procedures is not available, renting a van near the airport is the next-best option. A passenger van or minivan will not be appropriate, as they have seats and windows. A cargo van is preferred, although rental offices for this type of vehicle may be at a different location from automobile rentals. Making a phone call to check availability of cargo vans at the actual renting office is a worthwhile precaution. Google search results, and staff at 800-number call centers, are not necessarily reliable.

Ideally, the decision to rent a van should be made before deployment. Staff at the cryonics facility can make the reservation and verify the van’s

location while team members are in flight. If there are at least three team members, they can divide the tasks among them when they reach the destination airport. Person A stays at the airport to wait for baggage to come off the carousel; Person B takes a taxi to the patient's location to make personal contact with medical staff and any friends or relatives; Person C takes a taxi to rent the van, then drives it back to the airport to collect Person A and all of the equipment. If the patient's death seems imminent, equipment can be divided between the patient's location and the mortuary. Another scenario is when an active local cryonics group draws upon its local resources and secures a suitable van for the arriving team.

When choosing a van, bear in mind that while high-roofed vehicles are easier to work in, they are usually too tall for multistory parking garages. Also consider that while a longer vehicle is more convenient on the inside, it is more difficult to park on the street, and may require more driving skill.

Because a standby is always unpredictable, renting a van for a longer period than seems necessary is a sensible precaution. A vehicle can usually be returned early for a refund, but extending a short rental may not be possible.

At an Alcor standby in Texas, a van was rented for four weeks (the maximum allowed) and was parked in a multistory garage adjacent to the hospital where the patient was located. Basic standby equipment (excluding medications and valuable items) was left in the vehicle. When the patient made an unexpected partial recovery, team members abandoned the standby and returned to Arizona but left the vehicle in its parking spot. Three weeks later, when nurses called to warn Alcor that the patient's condition was deteriorating, the team returned and resumed the standby. The cost of the long van rental, plus the parking charges, was comparable to the cost of flying equipment to and from Arizona. The decision to leave some equipment in Texas was made bearing in mind that Alcor had more than one full set of standby-transport equipment at that time.

## **Equipping a Rented Vehicle**

Interior lighting is the most important consideration if any procedures will be attempted in a windowless rented van. The default lighting in a van will be

meager at best. Large LED flashlights can be duct-taped into position around the load area. Their battery life should be sufficient for even a prolonged standby, but extra batteries are always a good precaution.

A DC-AC inverter that plugs into a cigarette-lighter socket is useful. If one is not included in the standby kit, it can be bought at any local auto-parts store or Home Depot. A splitter for the lighter socket is useful, so that two or three devices can share it.

The rear doors on a typical van are not tall enough to allow an ice bath on legs to be loaded, and lifting an ice bath on legs into the vehicle is hazardous, especially while CPS is being administered by a chest-compression device. Any ice bath used in conjunction with a rented vehicle should have detachable legs, or no legs at all.

If a team doing a remote standby prefers not to rent a vehicle, a mortuary will either have its own vehicle to collect patients who have been pronounced or will retain an independent collection service. These options for transport are not ideal, as they may not allow continuation of stabilization procedures during transport. Also, collection services cannot be expected to share any sense of urgency.

## **Preparation for Air Transport**

It is not commonly realized that scheduled airlines frequently transport people who are legally dead. After the body has been embalmed, a mortician places it in a utilitarian container known as a Ziegler box, fabricated from thin galvanized steel. The box is strapped to a plywood shipping tray, and a corrugated cardboard cover is added for cosmetic purposes. To be discreet, morticians and airlines often use the name Jim Wilson to mean a deceased person, and the shipping tray is often referred to as a Jim Wilson tray.

In a cryonics case, as early as possible (preferably before deployment begins) the cryonics organization, cryonics standby/stabilization contractor, or local group should establish the precise location of a cooperating mortuary relative to the current location of the patient and location of the nearest airport, bearing in mind typical highway conditions, especially during rush-hour

periods. The organization must establish which airlines are used by the mortician, and must compile a list of flight departure times.

A mortician will have a pre-existing arrangement to ship cargo via at least one airline, will know where the cargo section of the airport is located, and will know all the regulatory requirements that must be fulfilled before the airline will accept the cargo. A mortician will also know what legal requirements must be satisfied to move a deceased person out-of-state (see the section below titled Legal Considerations). Attempting to transport a cryonics patient on a scheduled airline without using the services of a mortician is not recommended.

When airline schedules are compared, any route involving a change of aircraft is undesirable, as it greatly increases the risk of delays. Note that a “direct” flight may entail one or more stops along the route, but the same aircraft will be used from start to finish.

The transport team should be fully informed about flights before they reach the mortuary. In a worst-case scenario, a team member can obtain flight information while blood washout is in progress. It is not acceptable for the team to start thinking about flight options after washout is complete. In an ideal situation, local Alcor groups maintain and update this kind of information for potential cases.

Because the cooperation of a mortician is so important, a cryonics organization or standby team should avoid hard bargaining over a mortician’s fee, and should consider offering a bonus for handling a case ahead of other obligations. This should be effective to obtain rapid response. Most mortuaries are not high-profit businesses, and they appreciate receiving more money than they expected.

## **Preparation for Whole-Body Transport in Water Ice**

While the patient is on bypass for blood washout at a mortuary, the team can assemble the necessary items for air shipment on water ice.

A Ziegler box is usually provided by the mortuary. While most mortuaries keep at least one Ziegler box in stock, an unusually large patient may require an oversize box. If the cryonics organization is aware that a

patient is significantly larger than average, it should notify the mortuary in advance. The mortuary may have an oversize box in stock, or may have to order one. The box must be large enough to allow room for ice to be packed around the patient.

In an unlikely situation where a mortuary does not have a Ziegler box, a bare-minimum casket can be used, but will add substantially to the cost.

The team will need 40 kg of water ice (more, for a large patient) and sufficient 1-gallon ziploc bags to contain it. Ice cannot be placed loose around the patient. A Ziegler box is not watertight, and any leakage of fluid can be grounds for an airline to refuse a shipment, even if the fluid is only water. Ice must be bagged securely. Double bagging in ZipLoc bags is preferred if time permits. The minimum amount of ice will depend on the weight of the patient, as discussed below.

It is important that water ice used to ship cryonics patients be visibly wet. Wet ice is ice that has started melting at a temperature of 0 degrees Celsius. This is the desired shipment temperature. Ice that was stored in a freezer will initially be at the subzero temperature of the freezer. Ice that is not visibly wet or appears covered in frost is still at subzero temperature. If ice at subzero temperature is placed in contact with a cryonics patient, it may cause tissues of the cryonics patient to freeze. Subzero temperature ice can be warmed by either waiting or pouring small quantities of water on the ice until it stays visibly wet and/or all frost on the ice or ice bags disappears.

Sealed freezer packs may be used instead of water ice. To avoid freezing the patient, it is important that the packs have a melting temperature of 0 degrees Celsius, and that the packs be warmed enough to melt any white frost covering the packs. Freezer packs with white frost on the surface can freeze cryonics patients. A disadvantage of freezer packs compared to bagged ice is that it may not be possible to tell how much of the interior material of freezer packs has melted. For this reason, freezer packs should ideally be obtained at a temperature such that they still have frost on them and the frost observed to melt shortly before packing the patient.

If because of any emergency situation a patient must ever be shipped with less ice than covers them completely, or under circumstances in which

endurance of the ice during shipping may be in doubt, a priority should be placed on covering the head of the patient with ice.

For maximum security, the patient should be double-bagged to minimize the risk of leakage of body fluids. A 3-mil body bag of the type used by mortuaries should be enclosed in a 20-mil body bag of the type used in forensic work. Although the mortuary is likely to have 3-mil bags in stock, it is unlikely to have the heavier type of bag. This should be included in the remote standby kit.

Thermal insulation of the Ziegler box is essential, especially in summer weather. Hugh Hixon at Alcor is a believer in using fiberglass insulation, which is always available locally from big-box hardware stores. However, it can cause a skin rash and may require eye protection and a dust mask. Some mortuaries may be unhappy about a team cutting fiberglass insulation on their premises.

We recommend polyisocyanurate foam board as an alternative, as it is very easy to work with. It should be at least half-an-inch thick, and foil-coated on one side, with an R value of at least 3.0. Rmax is a brand that we have tested.

In areas of the country where very high or very low temperatures are rare, this foam board may be unavailable. Therefore, we recommend including precut sections of foam board in a standby kit. Suspended Animation developed sections that were taped together so that they could be zig-zag folded. Figure 17-2 shows the unfolding and application of these sections around a Ziegler box. At top left, the folded sections are shown. At top right, the sections that go under the box have been unfolded. At bottom left, the box has been placed on the unfolded foam board. At bottom right, the remaining sections are taped around it.





Figure 17-2. Unfolding and taping pre-cut foam board around a Ziegler box.

Duct tape is necessary to attach the foam board. It should be a standard item in the remote standby kit.

If a standby team will need to buy foam board locally, phone calls should be made before deployment to find a source that stocks it. Thermal insulation is an important issue, as it is crucial for transport on water ice.

## **Minimum Weight of Water Ice**

At Suspension Animation, tests were performed in 2005 to determine the minimum weight of ice for transporting a hypothetical patient. Inside a Ziegler box, a styrofoam dummy was wrapped in one 3-mil lightweight body bag plus one 20-mil heavyweight body bag, and was then packed in 45 kilos of bagged water ice (approximately 100 lbs). A thermocouple measured temperature at the surface of the dummy's "head."

The experiment was done three times. In the first trial, no insulation was used around the Ziegler box. In the second trial, half-inch Rmax board with an R value of 3.2 was used. In the third trial, generic unbranded bare 2-inch large-cell styrofoam board was used.

Insulation in the second and third trials was cut roughly to size and taped around the exterior of the Ziegler box after it was screwed shut. The board was applied without much attention to detail, simulating the haste of a standby team working under time pressure.

In all three trials, the Ziegler box was lowered into a plywood shell containing two thermostatically controlled hair dryers that maintained a temperature ranging between 24 and 25.5 degrees. Thus, the environment of the Ziegler box was kept at a nearly constant temperature. Each experiment ran until the internal thermocouple probe showed the temperature of the "patient" rising above 8 degrees Celsius. Data is shown in the curves in Figure 17-3.

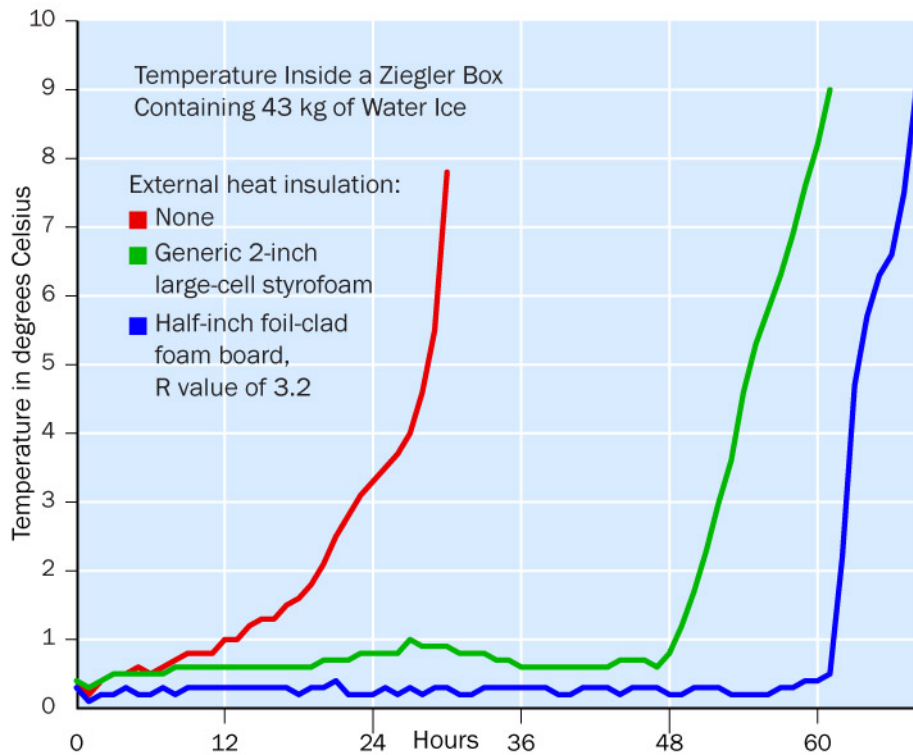


Figure 17-3. Time taken for ice to melt, using three options for insulation.

Because the styrofoam dummy patient had almost zero thermal mass, this experiment demonstrated the time taken for ice to melt if a patient contributes no heat to the process. In reality, a patient will begin the procedure at a temperature above the melting point of ice, and will contribute heat as a function of body weight and body temperature.

We may assume that the initial body temperature will range from around 10 degrees Celsius or lower (if blood washout has been done), up to 20 degrees Celsius (if there was CPS without blood washout), and even up to 37 degrees Celsius (if there was no CPS and prompt transport after legal death). The specific heat of a human body is comparable to that of water (i.e. 1 calorie per gram). Bearing in mind that the latent heat of fusion of water is 80 calories per gram, a patient weighing 80 kilograms, with a temperature of 10 degrees Celsius, will have sufficient heat capacity to melt 10 kg of ice, excluding other factors. The same patient with a temperature of 15 degrees will melt 15 kg of ice, and so on.

A good rule-of-thumb to remember is that a patient will melt a minimum of half their own weight of water ice while cooling from normal body temperature to 0 degrees Celsius. This is especially important to remember if a warm patient that didn't receive initial stabilization and cooling is packaged for transport while still warm. It's tempting to think that twice the amount of ice packed with a patient for transport will last twice as long. That's only true for whatever extra ice is left over after all the ice that melts due to body heat of the patient while the patient is still cooling toward 0 degrees Celsius.

Bearing these factors in mind, a nomogram to assist in determining the weight of ice that will be melted by the patient's body heat is shown in Figure 17-4. Place a straight edge between the weight of the patient and the temperature of the patient (in Celsius degrees), and you will find the approximate weight of ice. This nomogram works for either pounds or kilograms as long as the same weight unit is used for both the patient weight and ice weight.

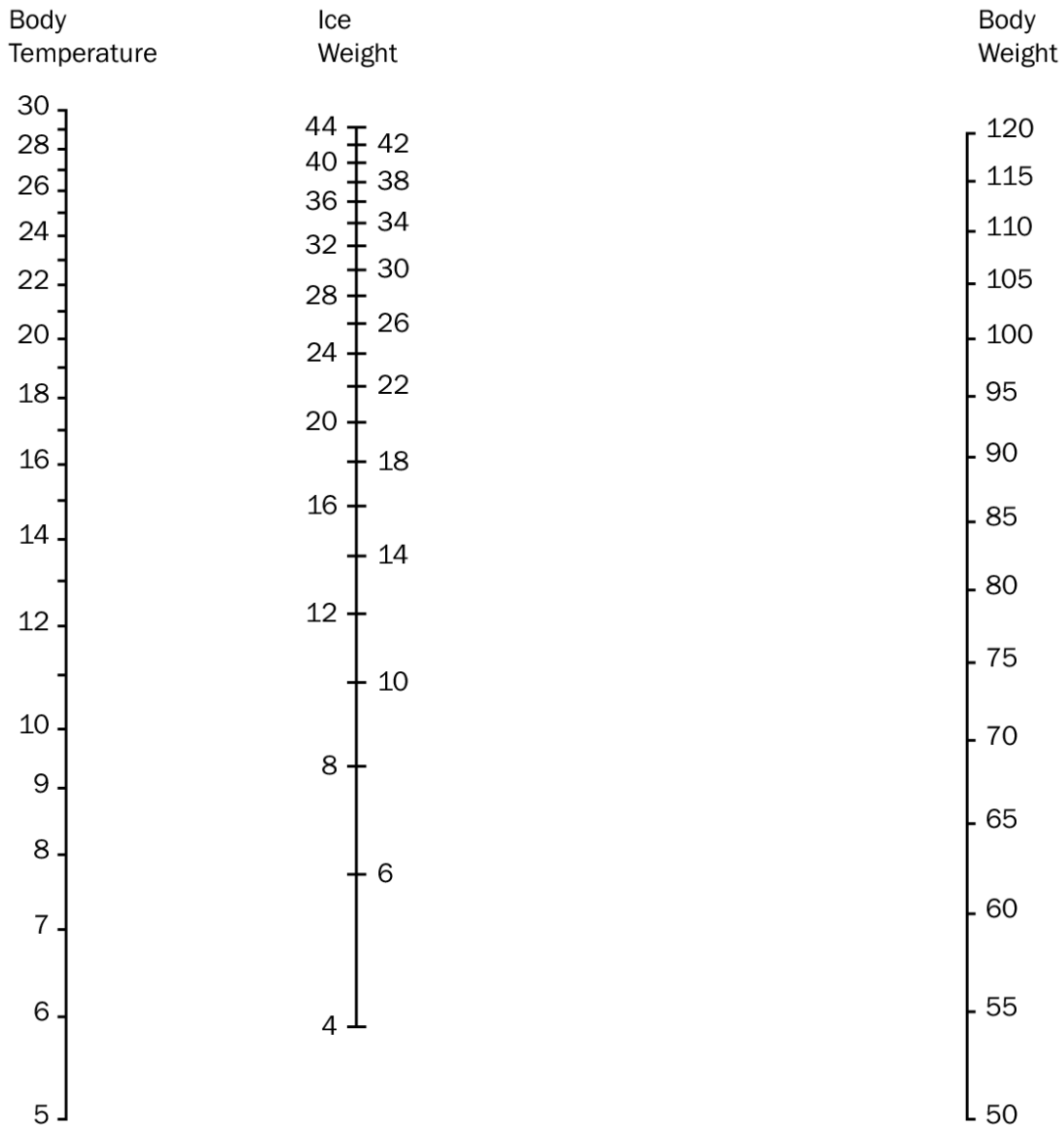


Figure 17-4. Nomogram to determine how much ice will be melted by body heat from a patient at the body temperature in degrees Celsius on the left side who has the body weight on the right side. Lay a ruler between the left and right scales to find the amount of ice that will melt. This nomogram works for either pounds or kilograms as long as the same weight unit is used for both the patient weight and ice weight. For shipping in a box with R3 insulation, add 50 pounds or 20 kilograms of extra ice to the ice weight to account for heat incursion from outside the box during transport.

Now you must factor in the penetration of heat from outside the box. For a hypothetical 24-hour transport, a minimum of 50 pounds or 20 kg of extra ice should be added to the value from the nomogram.

These numbers for extra ice to add are only valid if foam-board insulation of R3 value or higher is used around the Ziegler box. As Figure 17-3 indicates, the type of insulation is crucial. Without insulation, more ice will melt per hour of transport time, and there will be greater risk of moisture condensation forming and leaking outside the transport container, especially in humid climates.

## **What Can Go Wrong**

Any list of problems relating to transport is inevitably incomplete, but here are some examples derived from actual cases.

- The team doesn't buy enough ice.
- The team doesn't have enough bags for the ice.
- The team doesn't buy enough insulation, or can't find it, or can only obtain it from a location that requires a long drive from the mortuary, causing a delay.
- The patient may be too large to fit into the available Ziegler box with sufficient ice.
- The mortician may not have a pre-existing arrangement with an airline that has the best available flight.
- The team may encounter heavy traffic or other factors causing them to miss the flight.
- The flight may be delayed.
- Paperwork that the airline requires may be incomplete.

- If transport requires a connection between two flights, the patient may miss the connection.
- Delays in offloading the patient at the receiving end may occur.

To guard against unexpected eventualities, the patient should be packed in sufficient ice for a trip lasting at least twice as long as the expected duration. In case a patient is transported on dry ice, an even more stricter protocol need to be adhered to.

## **Transport by Chartered Aircraft**

If the patient is sufficiently well funded, a chartered aircraft is an attractive option. However, the charter company must be notified that a Ziegler box will be loaded into the aircraft. Some Lear jets have a wide door suitable for medical teams to load and unload stretchers, and should be capable of accommodating a Ziegler box. An aircraft with a standard-sized (narrow) door will not be suitable.

The team should maintain contact with the charter company while the patient is being moved to the mortuary, and while perfusion is in progress.

A chartered aircraft offers three major advantages. First, the aircraft will wait for the patient to reach the airport, and will then take off immediately. Second, minimal paperwork will be required, as freight on the chartered aircraft does not have to go through the certification process required for scheduled airlines by the TSA. Third, if the chartered aircraft lands at a private FBO instead of a public airport terminal, a cryonics transport vehicle may be allowed to drive onto the tarmac for direct transfer of the patient from the plane. The current headquarters of the Alcor Life Extension Foundation are situated beside an airport where this is possible.

Note that although chartered aircraft may seem a more reliable option, in at least one cryonics case the aircraft turned out to be unavailable when needed. The standby team should have contact information for more than one charter service.

## **Neuro Transport in Dry Ice**

Because dry ice is less reliably and widely available than water ice, phone calls should be made to sources of supply as early as possible in the standby operation—preferably before the team is deployed. Better even is for Alcor, SST (standby/stabilization/transport) contractors, or a local group to maintain a list of locations and their opening hours. In one case, dry ice was completely out of stock in almost all locations because the case occurred at the beginning of November, and a lot of people had bought dry ice to create clouds of vapor in conjunction with Halloween.

For cases originating overseas, dry ice may be less easily available than in the United States.

Alcor's neuro shipper is shown in Figure 17-5. It consists of a styrofoam box with a layer of silvered mylar bubble-wrap around it, packed in a Pelican transport case in which the hygroscopic element in the pressure-relief valve has been removed, leaving a simple air vent. The case allows room for a data logger that will record temperatures during the transport.





*Figure 17-5. Dry-ice shipping container for an isolated cephalon, at Alcor Foundation.*

After placing thermocouples in the cephalon, it is lowered into the styrofoam box, and as many pieces as possible of dry ice are stacked around it. The box is closed and moved to a location where cooling progress can be monitored. When core temperature of the cephalon is close to -79 degrees Celsius the dry ice is replenished again. After the dry ice is replenished the dry ice shipper with cephalon needs to be tested for at least the duration of

transport before authorizing transport. After this protocol is followed, it is transported to the Alcor facility by airline or Federal Express. Generally speaking, Federal Express is considered more reliable than an airline. The contents of the Pelican case are declared as cryopreserved tissue samples.

## **Whole-Body Transport in Dry Ice**

Because of the length of time that may be involved in whole-body shipment from overseas, dry ice is preferable to water ice in all cases.

In Figure 17-6, a Ziegler box is visible inside an insulated whole-body dry-ice transport container built by Alan Sinclair in the UK. This container has been used for one whole-body patient originating in a country outside of the United States. Almost all the dry ice had vaporized by the time the patient reached Alcor, leading to the conclusion that an ideal whole-body shipping container does not yet exist. To avoid such scenarios in the future, dry ice transport of whole body patients needs to follow the same rigorous protocol as for neuro patients. After cooling the patient to dry ice temperature, the dry ice is replenished and the shipper is tested for its ability to maintain dry ice temperature for at least the duration of the trip (but preferably much longer) before any shipping can commence. Under no circumstances should a patient be shipping on dry ice before the patient has reached dry ice temperature and the box is validated for at least the expected duration of the trip (using conservative assumptions).



*Figure 17-6. A whole-body dry-ice shipping container designed and built by Alan Sinclair in the UK. A Ziegler box is visible inside it. This particular photograph shows gaps in the foam insulation surrounding the Ziegler case. It should be noted that this is highly undesirable for insulating efficiency because even small air gaps between insulating panels will support heat transport by passive convection. This can be ameliorated by interleaving small gaps between two or more panel layers so that there are no gaps directly connecting the shipping container interior and exterior.*

In overseas cases, a mortician with wide experience of international shipment is essential.

## **Intermediate-Distance Ground Transport on Water Ice**

When transport is done on water ice, minimizing the duration is essential. The patient should be exposed to cold ischemia for as brief a period as possible.

Suppose a patient has received whole-body blood washout at a mortuary 500 miles from a cryonics organization. Is ground or air transport the

preferred option? Bear in mind, a rented vehicle can be used for ground transport if the organization's own vehicle has not been deployed.

What if the distance is 1,000 miles? What is the distance threshold beyond which air shipment is always the preferred option, and what is the threshold below which ground transport should be used?

These questions entail balancing the advantage of rapid air transport against the risks associated with losing control of the patient. After a Ziegler box has been received by airline personnel, the situation is almost totally outside the control of the cryonics organization. By comparison, if the standby team drives the patient back to the facility, there is a much higher probability of arriving on time, and the team can provide frequent updates while they are on the road.

Suppose the patient is in a mortuary 500 miles from the cryonics organization. The standby team has determined that a flight will leave 2 hours after blood washout is complete, and the airport is only a few miles away. Suppose the flight time is 1.5 hours, and the patient will be unloaded and ready for pickup 1 hour after the aircraft lands. Suppose the arrival airport is 0.5 hours from the cryonics facility, and no traffic delays are expected. Under these circumstances, the total transport time, from when the patient leaves the mortuary to when the patient arrives at the facility, will be 5 hours. This scenario does not include any unexpected delays. In a less-favorable scenario, the transport time could be 10 hours.

By comparison, if transport is done by ground from the mortuary to the cryonics organization at an average speed of 60 miles per hour, the total transport time will be a little over 8 hours.

We tend to feel that for distances up to 500 miles, ground transport is the better option, assuming a vehicle is available. Above 500 miles, it can be a difficult judgment call.

This is a major reason why neuro-cryoprotection followed by dry-ice shipment can seem desirable. When the patient's temperature has been lowered to -79 degrees Celsius, transport time is much less critical.

## **Legal Issues**

So long as a human body does not cross a state line after legal death, legal issues are minor. If the body is transported from one state to another, a death certificate and/or a transit permit may be required.

Each state has its own laws regarding the removal of human remains, and each county may have additional regulations. State laws vary widely; for example, in Florida, shipment can be done without a death certificate or a transit permit, so long as a mortician is confident that this was not a case of unnatural death, and documentation will follow. In California, a death certificate and a transit permit are mandatory before shipment can be done legally, and obtaining these documents can be a time-consuming process, especially on evenings or weekends.

However, Alcor received legal advice in 2010 which we interpret to confirm that a cephalon may be considered an anatomical donation, enabling it to be transported across state lines without a transit permit while the body, as human remains, waits for any permits that are required, or may be conventionally interred or cremated in the state where death was pronounced. Therefore if neuroseparation can be performed in the state where legal death occurs, and if it is consistent with the patient's wishes, this can be a major advantage in completing a transport as quickly as possible.

## **Addendum**

### **Choosing and Equipping a Transport Vehicle**

#### **Buying a Vehicle for Alcor**

For many years, Alcor used a refurbished ambulance for local ground transport (see Figure 17-7). This continued until November, 2002 when it was deployed for transport of a patient from a suburban home to the Alcor facility just three miles away. When the patient was pronounced, the ambulance refused to start.



*Figure 17-7. This refurbished ambulance was used at Alcor until the end of 2002.*

A quick decision was made to move the patient to Alcor in a different vehicle, even though cooling would not be available during the journey. Getting the patient to the facility as rapidly as possible was seen as being more important than trying to make other arrangements, especially as the operating room at Alcor was ready and waiting.

Alcor had to replace the ambulance as quickly as possible, and in the interests of reliability, the vehicle would be new, not second-hand. Because this was a significant expenditure and would affect cases for years to come, many people participated in the decision.

A new ambulance was prohibitively expensive, and was not entirely compatible with the needs of cryonics cases anyway. The space inside an ambulance tends to be limited, and there are features that a cryonics organization doesn't need, such as a large steel compartment for an H-sized cylinder of oxygen.

Alcor staff investigated the option of a step van. This type of vehicle has a sliding driver's door and is often seen making deliveries for United Parcel Service. However, the step-van design does not seem to have improved for many decades, and would require a lot of upgrades to make it comfortable for significant distances.

The Alcor staff decided that a typical cargo van would not be large enough. In the end, they chose a 16-foot box truck. This type of vehicle is manufactured as a cab and bare chassis, after which a conversion company mounts a box-shaped cargo section on the back. The cargo section typically has a wooden floor and wooden interior frame. The vehicle that Alcor acquired is shown on the dealer's lot in Figure 17-8, and its interior is shown in Figure 17-9.



Figure 17-8. A box truck purchased for Alcor. It became a cryonics transport vehicle that is still currently in use.



Figure 17-9. The interior of Alcor's vehicle, before conversion began.



Many box trucks do not have any communicating door between the load area and the cab. This feature is referred to as a “cutaway” and was considered essential, so that team members could take turns in the roles of driver, passenger, and patient supervisor with minimal inconvenience.

Any person with a driving license may drive a box truck. A heavy-vehicle license is not required.

Advantages of a box truck include:

- Relatively low cost.
- Relatively easy to maintain and repair.
- Unobtrusive (the default color of a new truck is white).
- Interior typically allows everyone to stand instead of having to stoop.
- Sufficient ground clearance to install accessories under the floor, such as a large generator and batteries.

Disadvantages of a box truck include:

- Difficult to park.
- People who lack experience with large vehicles may find it difficult to drive.
- Usually too tall for a parking garage.
- Relatively noisy for long journeys.
- Not a very smooth ride.
- Air conditioning for the box section is a high-cost aftermarket option.
- Heat insulation must be added in the box section.

The box truck was converted at Alcor, but the conversion was not considered entirely satisfactory. It was stripped out and replaced in 2010 by

Steve Graber, Alcor's Technical & Readiness Coordinator. Photographs of his work are shown in figures 17-10, 17-11, and 17-12.



*Figure 17-10. Interior of the Alcor patient transport vehicle with one seat folded up to allow the ice bath to be loaded.*



*Figure 17-11. Storage at the rear of the Alcor patient transport vehicle.*



*Figure 17-12. The ice bath loaded into the Alcor vehicle, and the seats folded down.*

## **Buying a Vehicle for Suspended Animation**

Suspended Animation addressed the need to acquire a vehicle for patient transport after a change of management in 2004. Mindful of the negative attributes of a box truck, employees tried to think of other options.

The Dodge Sprinter had recently been introduced, and its specification looked promising. It was taller-than-average cargo van, and was available in a long version that might provide enough space for a transport kit, consumables, and an ice bath, with possibly enough room to perform procedures. The Sprinter (which is actually a Mercedes, behind the Dodge nameplate) was quieter and much easier to drive than a box truck, with a softer ride.

A second option was a shuttle bus of the type that typically picks people up from an airport terminal and drives them to a parking garage or car-rental agency. An example is shown in Figure 17-13. Shuttle buses are easy to drive, have a gentle ride, and are easy to access, because they have a relatively low ground clearance. A company was located that would equip a bus with any configuration that a customer wants. The company reduced its usual charge

when Suspended Animation specified a vehicle with no windows, no seats, no front steps and folding door, and no custom exterior paint (just plain white).



*Figure 17-13. A shuttle bus in a typical configuration.*

The choice between a Sprinter van or shuttle bus was presented to Bill Faloon of Life Extension Foundation, which was underwriting Suspended Animation. After a brief assessment, Faloon approved purchase of both.

Suspended Animation went ahead and acquired both vehicles. The shuttle bus is shown on its day of delivery in Figure 17-4.



*Figure 17-14. The shuttle bus delivered to Suspended Animation*

## **Converting a Vehicle After Acquisition**

Specifics of vehicle conversion turned out to be a cause of lengthy disagreements, both at Alcor and at Suspended Animation. The details would take too much space here, but some salient points can be summarized.

### *The Ice Machine*

Local availability of cubed ice is one of the few requirements that has never been a problem in any standby in the United States. Ice is ubiquitous, cheap, and plentiful. Nevertheless, when Alcor addressed the challenge of outfitting its box truck, a senior employee at Alcor wanted to install a full-size, commercial-grade ice machine.

Ice machines are designed for installation in bars and restaurants where size, weight, and power consumption are not sensitive issues. Ice machines also consume water on a constant basis, and emit a lot of waste heat. Still, the initial conversion of the Alcor vehicle did include an ice machine, together with a very large generator, a very large water tank, and some huge battery packs.

After the employee moved on, new management at Alcor decided that the ice machine should be removed.

### *Side Door or Rear Door*

A major advantage of a side door is that it opens directly onto the sidewalk from a parked vehicle. Many vans include side doors for this reason.

If a fully loaded ice bath has to be loaded into the rear door, the ice bath must be moved down off the curb and onto the street, then up onto the platform of a lift gate. This will require at least two people, and preferably three.

Rear access also requires ample space behind the vehicle—hence the “keep back” signs on ambulances. If personnel leave a cronics transport vehicle to collect a patient from inside a hospice, and if someone parks behind their vehicle while they are away, they will be unable to load the patient when they return.

At Suspended Animation, both vehicles initially were configured using their side doors. This in turn required the use of ramps, because lift gates cannot be installed on side doors.

### *Ramp or Lift Gate*

Professional movers typically like to use a ramp when loading or unloading a truck, because it's quicker to use than a lift gate, does not run down the battery, and in some respects can be safer. However, for a box truck, the load bed is so high off the ground, a ramp must extend outward a long way—otherwise, its gradient will be too steep. Consequently lift gates are often found on box trucks, and the substantial extra weight is well within the design limits of this kind of vehicle. For cryonics cases, the only concern is that the lift gate should be large enough for an ice bath, and rated to lift the substantial weight of the ice bath with ice, water, and patient.

Alcor's box-truck transport vehicle uses a lift gate.

At Suspended Animation, a ramp was custom-built in-house and installed on the Sprinter, as shown in Figure 17-15. (This photograph also shows a small door near the rear of the vehicle, which was being installed to allow access to two 1,000-watt Honda generators.) To assist with the challenge of pushing a fully loaded ice bath up a ramp, a winch was also installed. To allay concerns about water splashing out of a tilted ice bath, a leveling device was used, consisting of two wheels on an axle, a vertical handle, and a bar that extended horizontally at the bottom. The bar was engaged in the bottom of the ice bath, and someone pulled back on the handle, much like a delivery person using a hand truck. The leveler was suggested by a staff member with experience moving heavy objects in industrial environments.



*Figure 17-15. Custom-built aluminum ramp extended from the side door of the Sprinter van acquired by Suspended Animation.*

Using this equipment, two people could load the vehicle fairly easily. There was some concern about the winch motor, which showed sparking around its armature, but the fire risk was eliminated when Suspended Animation replaced its oxygen-driven Thumpers with the electrically-powered Autopulse.

Access through the side door sacrificed some storage space, but it was regained by blocking off the rear doors so that equipment could be stacked there. The snug space inside the Sprinter when a portable ice bath has been wheeled into it is shown in Figure 17-16.



*Figure 17-16. The interior of the Sprinter van after its initial conversion at Suspended Animation. The walls have been panelled with washable plastic, and LED lighting has been installed. An aftermarket air conditioner is visible in the roof.*

The side door of the shuttle bus presented more of a challenge, as the bus was higher off the ground than the Sprinter. The ramp was steeper, and a more elaborate leveler was required, as shown in Figure 17-17. This did allow the vehicle to be loaded by just one person using a remote control for the winch, but looked unsafe to anyone who had not used it.





*Figure 17-17. With a remote-controlled winch and a levelling linkage, the Suspended Animation vehicle could be loaded by one person through its side door, but the arrangement was not popular.*

Disagreements regarding doors and ramps continued until Catherine Baldwin became the general manager of Suspended Animation. At that point, lift gates were installed on both vehicles, even though the Sprinter was not really designed for so much weight behind the rear wheels.

In Europe, many ambulances are equipped with ramps. An example was bought by Alan Sinclair as part of his equipment for Alcor UK.

Because the rear suspension of the ambulance is designed so that it can be lowered, the ramp can be very short. However, the interior of this type of vehicle allows very limited space.

Figure 17-18 shows the ambulance with its rear suspension lowered, Figure 17-19 shows the interior viewed through the rear door, and Figure 17-20 shows the very small ramp unfolded so that a wheeled stretcher can be rolled right in.



*Figure 17-18. The ambulance converted by Alan Sinclair in the UK, shown with its rear suspension in the lowered position.*



*Figure 17-19. Interior of the ambulance converted by Alan Sinclair.*



*Figure 17-20. The ramp folded down in Alan Sinclair’s ambulance.*

### *Suspended Animation Experience*

In 2014, Catherine Baldwin shared the experience she had acquired with the vehicles at Suspended Animation since she took over in 2007. She wrote: “In 2009-2010 the E450 [shuttle bus] vehicle in FL was stripped to the frame, updated and refurbished—floors, walls, ceiling, electrical, plumbing, seating, general lighting, cameras, A/C. In 2011 the Sprinter in CA was stripped to the frame, redesigned and refurbished—floors, walls, ceiling, electrical, ambient and surgical lighting, cameras, ice bath mounts, storage cabinets, rear lift gate. Both vehicles now provide stand-alone support for stabilization, including femoral or thoracic access surgery, perfusion and neuroseparation.”

She noted that re-renovating the vehicles had been preceded by trials using swine cadavers to simulate patient procedures.

“Medical professionals are impressed by our equipment,” she continued. “Giving them a quick tour before a case has helped our credibility on cases.

We have also had requests to build vehicles for coroners and disaster response teams.”

As of January, 2014 Baldwin reported that the shuttle bus had been used for five cryonics cases involving surgery and blood washout, and 26 regular practice sessions with swine cadavers. The Sprinter had not been equipped for surgery and perfusion until the end of 2011, and had been used for surgery and washout in one case by 2014.

When asked which vehicle she preferred, she seemed to have difficulty choosing between the nimble handling of the Sprinter and the extra interior space on the shuttle bus.

The ideal cryonics transport vehicle may not yet exist, but experience has certainly shown that conversion can end up costing considerably more than anyone initially expects.

### *Conversion Decisions*

Some of the fundamental issues that have to be resolved when planning a transport vehicle include:

**Air conditioning.** Should it run from a separate compressor added to the engine? This is typical on box trucks, but may not be possible or appropriate on smaller vehicles. On the Suspended Animation Sprinter, two small Honda generators were installed in conjunction with an aftermarket air conditioner on the roof. In the shuttle bus, air conditioning sufficient for the entire vehicle was a standard item installed during the conversion.

**Heat insulation.** The load area of a truck or van is not normally insulated, but has to be, for cryonics transport. Figure 17-21 shows the Sprinter being insulated with foil-coated foam board.



*Figure 17-21. Installing insulation during initial conversion of the Suspended Animation Sprinter van.*

**Ventilation.** Fans may be necessary in the load area.

**Air filtration.** A HEPA unit may be advisable, bearing in mind the possible risk of transporting patients who have died of communicable diseases.

**Plumbing.** A sink will be necessary, with a pump, a water tank, and a waste-water tank. Should a chemical toilet be installed? Should a mini-shower be added?

**Folding seats for long journeys.** The staff in the rear of the vehicle cannot stand up all the time.

**Lighting.** Must be sufficient not only for emergency procedures, but for surgery. Should it run off 12VDC or 110VAC?

**Refrigeration.** Some medical supplies must be kept cool. A few must be kept frozen. Refrigeration should be minimized, as it will create waste heat. Should a propane-powered refrigerator be used?

**Power.** If a generator is installed, it must run quietly to avoid attracting unwanted attention. Some generators are so quiet, they are certified as suitable

for use in national parks. A separate battery supply may be considered necessary, with a large inverter.

When considering these issues, experienced advice will be extremely helpful, and a good starting point may be one of the many conventions or fairs that are held for owners of recreational vehicles. Every conceivable type of vehicle has been adapted and modified by enthusiasts in the RV community, and they are generally eager to share their knowledge.

As always in cryonics, it is wise to avoid reinventing the wheel.



# Remotely Assembled Dry Ice Shipment Packaging

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Tuesday, March 31, 2009

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## Required Materials

The dry ice shipper requires the following materials to assemble:



### Ziegler Case

Standard shipping component.



### Air Tray

Standard shipping assembly.



### R-19 Insulation

Standard R-19 fiberglass insulation. 6.25" (16cm) thick and 15" (38cm) wide. This project requires about 62 feet (18.9 meters) of insulation material. Gloves are recommended, but not required for handling this material.





### Duct Tape

Used for internal packaging. Packaging tape or other strong tape may work.



### Dry Ice

Keeps the core temperature of the patient down. Dry ice in pellet, rice, powder, or other particle form is preferable, as blocks will need to be broken up.



### Gloves

Suggested to reduce contact with the fiberglass insulation material, which may be irritating to the skin.



## Plastic Drop cloth

A plastic sheeting to help hold everything in place. .7 MIL is recommended, minimum 9 feet (2.75 m) x 12 feet (3.7 m).

## (2x) Support Piece

Small sections of support for the bottom of the Ziegler case. Wooden 2x2's are recommended, but any similar material should work. Each piece should be between 1 and 2 feet (30 to 60 cm) long. They serve to prevent the Ziegler case from flattening the insulation below it.



## Packaging the body

The body is packaged with the dry ice inside the Ziegler case for shipping. The mortician should handle most if not all of this part.

The first step is to lay down a base layer of dry ice. The patient is then laid onto the base layer of ice, and then the container can be filled with ice. If limited by weight, the container can be left partially full, but for ideal shipment, the case should be filled to the top.

Once the patient is placed in the case, on dry ice, some time should be allotted for the temperature of the patient to lower to the required temperature for shipment. After placing the patient in the case, close, but do not seal it. Allow 24-48 hours (48 hours being ideal) for the patient to cool down to the temperature of the dry ice (-78°C). Once this time has passed, re-fill the case with dry ice and seal for shipment.

The maximum shipment time is given by the total amount of dry ice initially placed into the shipping container at the start of the shipment.



## Shipping Assembly

Once the body has been packed in the Ziegler case for shipping, the shipping container can be assembled.



### Step 1: Unpack the Air Tray

Remove the packaging from the air tray. Set the cardboard sleeve and cardboard top aside for later use. The wooden baseboard of the air tray should now be on the ground, the straps on the sides for refastening.

### Step 2: Apply the Base Insulation Layer

Lay the plastic sheet into the wooden component of the Air Tray. Cut two strips of insulation the length of the tray, and lay them down side by side forming the base layer of insulation. Place the two supports equidistant from the in the center of this insulation, preventing the case from flattening the insulation below.



### Step 3: Add the Surrounding Insulation

Place the Ziegler case onto the insulation layer, on top of the two supports. Wrap insulation material all around it. Tape the ends together to hold it on. The material should extend upwards from the top.



#### Step 4: Apply the Siding

Pull the plastic sheeting up over the sides of the insulation, wrapping the insulation in plastic. Slide the cardboard sleeve onto the top of this, over the outside of the plastic. Assure that the cardboard passes inside the lip of the wooden base.



#### Step 5: Cover the Case with Insulation

Add a strip of insulation about the length of the Ziegler case to the top of the case.



#### Step 6: Add the Final Layer of Insulation

Apply two additional strips of insulation to the top of the case, mirroring the bottom layer.





### Step 7: Close the plastic wrap

Wrap the plastic over the top of the insulation and tape it closed.

### Step 8: Close the case

Add the cardboard top to the case, then attach the straps, sealing the case.



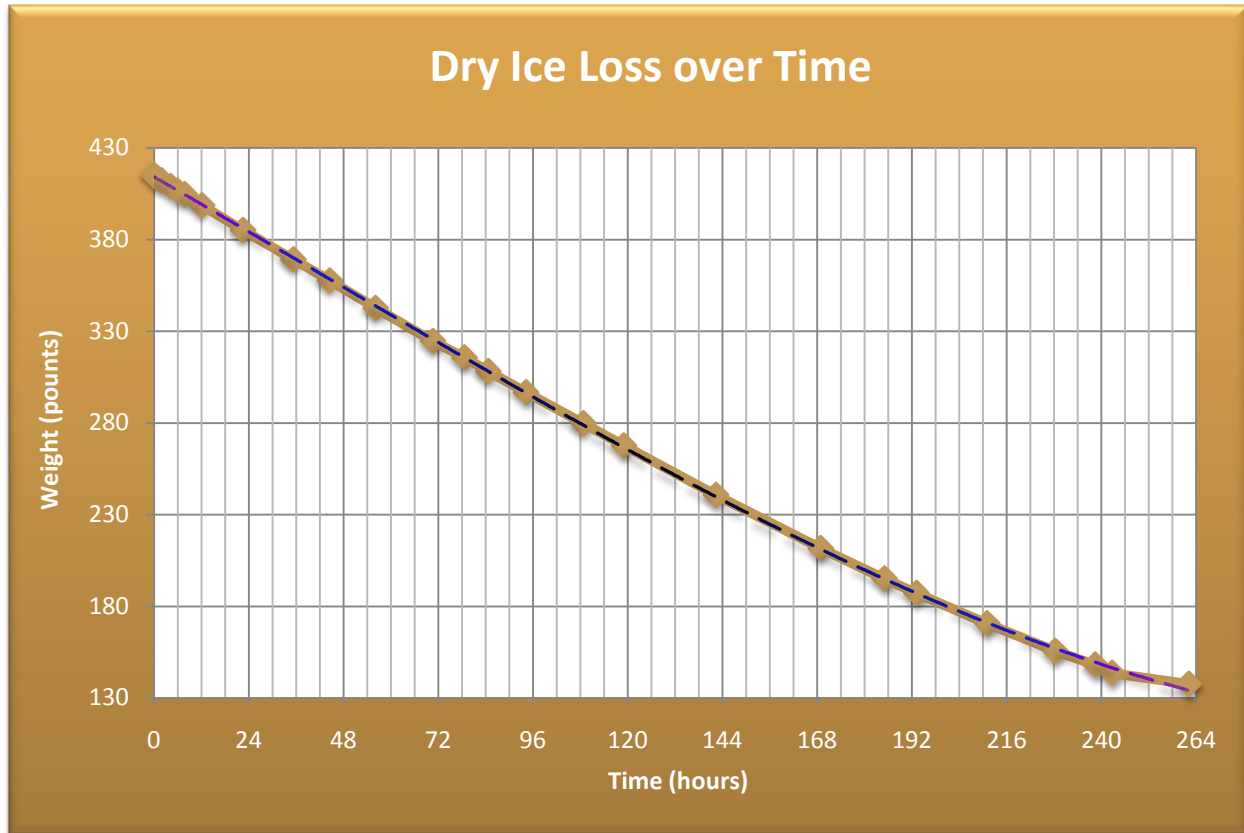
# Physical Dimensions

Weight Empty	135.5 pounds (32.37 kg)
Weight Capacity (recommended)	500 pounds (226.80 kg)
Weight Capacity (maximum)	1000 pounds (453.59 kg)
Length	88" (223.5 cm)
Width	30.5" (77.5 cm)
Height	20.5" (52 cm)





## Shipping Times and Dry Ice loss over Time



The patient should arrive with at least 30 – 50 pounds (13.6 to 22.7 kg) of dry ice remaining to assure ideal temperature is maintained. Dry ice is lost at an approximate weight of 30 pounds per day. Therefore, the absolute maximum transit time is calculated by the formula  $\text{Time}_{(\text{days})} = (\text{Weight}_{(\text{pounds})} / 30)$ . This should assure the patient maintains optimum temperature during transit. In all cases, where possible, the transit time should be reduced to as short as possible, and the amount of dry ice included in the Ziegler case should be as great as possible, thus allowing for unforeseen delays or extenuating circumstances.

