Mass Casualty Respiratory Care: A Discussion of Issues of Interest

This Journal conference was the first to be held with a live audience. After the final faculty presentation, and in lieu of a conference summary from the guest editors, the conference faculty had a discussion session that addressed written questions from the audience. The moderators, Lewis Rubinson and Rich Branson, reviewed the questions and addressed them either to specific conference faculty or to the entire conference faculty group. There were too many questions to address in the allotted time, so the moderators selected the questions they thought either most pertinent or most likely to be answerable. *Key words: disaster, mass casualty, mechanical ventilation, ventilator, oxygen, emergency preparedness, resource management, disaster medicine, personal protective equipment, information technology.* [Respir Care 2008;53(2):239–248.

Rubinson: There are a lot of very thoughtful questions, which I think shows that this conference was very worthwhile. The first question is for Ray Ritz. It's from Harry Román of the respiratory therapy school of the U.S. Army Medical Department, at Fort Sam Houston in San Antonio, Texas. He asks about the EDOC [Expeditionary Deployable Oxygen Concentrator] system, which is one of the oxygen-generation systems they're using for their combat support hospitals. His question is, would that ever be considered as an element of the Strategic National Stockpile [SNS]?

Richard D Branson MSc RRT FAARC has received honoraria and research support from Cardinal Health and Coviden; he has received honoraria and has consulted for INO Therapeutics; and he has received research support from Respironics. Steven B Nelson MSc RRT FAARC is an employee of Sun Microsystems, a company that provides goods and services that could be used in a mass casualty situation. The faculty report no other conflicts of interest.

Regarding the responses of faculty who are fully (Ms Malatino) or partially (Dr Rubinson) employed by the Centers for Disease Control and Prevention, their statements are their own and do not necessarily represent the views of the Centers for Disease Control and Prevention or of the Agency for Toxic Substances and Disease Registry.

Ritz: Several different companies make such high-capacity O_2 concentrators. Their current focus of distribution is in places where they don't have liquid oxygen generating plants. They come in sizes from small to giant, and the giant ones can make something like 80,000 liters of oxygen an hour, I think. The smaller ones are more portable, and the larger ones are not portable. They might be a reasonable alternative for certain situations and conditions, with the recognized limitations of what they can produce, but they're moderately to very expensive, and some may not make 100% oxygen. That might be inconsequential if they may make 90% or greater oxygen. Some make close to 100% oxygen. I think the larger models need a compressor system that you supply, like your hospital's compressed air system. I think they aren't something you would deploy quickly, in the next 2 weeks. It requires a considerable amount of capital investment and a considerable amount of planning as to how the device would be deployed.

Malatino: Everything that goes into the SNS has to have a subject-matter expert behind it, and it's up to those experts whether an item will be included in the SNS. I think the current position is that these oxygen concentrators would not be added to the SNS. That doesn't mean the idea is off the table. Everything we put in the Stockpile has to have funding behind it, and you just mentioned the high cost. There is also the cost of storage. These oxygen concentrators would not go into the Push Packages, which we guarantee in 12 hours or less. They would go into Managed Inventory, which means anywhere from 24 to 48 hours, depending on how much it is and where it's going. So you have to wonder, how long would you want to wait to get something like this? Do you want to have it on hand or wait for it to arrive?

Ritz: If I was a state planning and developing a support infrastructure and I lived a long way from a liquid oxygen plant, I'd look into that kind of oxygen generator, because it could take a number of days for vendors to resupply your liquid oxygen system.

Rubinson: In Seattle, if an earthquake took down all of our manufacturing, the nearest places we can get liquid oxygen from are California and Salt Lake City. So having an oxygen generator would be ideal, but the question is, should we add concentrators for each vent [ventilator] at the expense of substantially reducing the number of vents. I think we all en-

dorsed a mechanism for a federal agency to be able to provide on-site oxygen, so I hope it continues to get pursued. My understanding is that FEMA [Federal Emergency Management Agency] has some oxygen-generation capability, but I think it's mostly portable devices that have relatively low capacity.

Moving on to the next question, this is for Mike Hanley. James Allen from Parkland Health and Hospital System in Dallas asks if you have an opinion on which would be a better option: individual hospitals having their own kind of Project XTREME groups or doing a regional Project XTREME group? He also asks, who would make the decision to activate it and what would be the criteria for activation?

Hanley: Disaster planning should be on a regional scale. Some of the ideas that you've heard about augmenting staff and other issues that we've discussed, they highlight the idea that you'll be relying on other resources within your community, and if you and another hospital are both planning on recruiting the same RT [respiratory therapist] from the same oxygen-supply company, you may find that you've lost out at the time that the disaster strikes. We should implement programs like Project XTREME regionally. Regarding who makes the decision, I think a training program like Project XTREME should only be used in an emergency officially declared by a representative of the state government, typically the governor. I'm not sure what the triggering criteria would be.

O'Laughlin: I concur that the effort, including planning and resource management, must be regional; that's necessary. If we try to all do it individually, we could waste a lot of time and money. Regarding the trigger, we do need a declared emergency, whether it's from the governor or the department of health as an agent of the governor. Generically speaking, resources would be depleted, and the information has traveled up the chain of command from the health-care-entity level up to health department officials and the request for a public health emergency declaration to authorize those measures if they're needed.

Rubinson: Though clearly there should be an obvious event and there should be some declaration, I'd be cautious about linking authority for health-system changes to a governmental declaration of emergency, especially at the state or federal level. Some declarations may be made with consideration of health-system issues, but health doesn't necessarily always drive the decision-making process.

O'Laughlin: I should clarify. In Minnesota I believe that the department of health can initiate certain activities to protect the public's health, to authorize certain things to be done. So I think you're right that it doesn't necessarily have to be a governor's declaration that's moving up to federal resources, but a governor's declaration for emergency powers would still need to be issued for certain protections to be instituted.

Rubinson: Agreed. This next question is for Rich Branson. It's from Lois Rowland of CJW [Chippenham Johnston Willis] Medical Center in Richmond, Virginia, and she asks if the Uni-Vent 754 ventilator is suited for infant ventilation with the supplied pediatric circuit? If the pediatric circuit is not acceptable for infant ventilation, can the user substitute an infant circuit?

Branson: You can ventilate a pediatric patient with the Uni-Vent 754, but of course we have to clearly state who is a pediatric patient. When you're using high-pressure air and high-pressure oxygen, the delivery of the tidal volume from 754 milliliters down to about 50 milliliters is very accurate. If you're using high-pressure oxygen and the internal compressor, the accuracy of the delivery at 50 milliliters is not as accurate. I think it's approved down to a patient size of 10 kilograms. But there are some setting changes that can help. If you hold down the manual breath and alarm silence buttons while turning the machine on, it allows you to change the trigger and the flow during the spontaneous breaths. Usually it's 60 liters a minute; you can turn it down to as low as 10 liters a minute if you're in IMV [intermittent mandatory ventilation] mode. That's one thing that I would do with pediatric patients. You can use the pressure plateau, which is really just like a mechanical pop-off [pressure-relief] valve, but then you won't have guaranteed tidal volume. I personally have never used it for infant ventilation, and I would be concerned about the dead space of the circuit with a small patient. I would have to defer to use according to its FDA [Food and Drug Administration] approval.

Branson: We have a related question from Dean Holland, also from Parkland in Dallas. He wants to know, what about using the old Bird IPPB [intermittent positive-pressure breathing] devices. If you have Mark 7s and Mark 14s and whatever else you might have around, can you adapt these and use them in the short term in a mass casualty event? And I think the answer clearly is—and this is where we want to make the distinction—there's a difference between a ventilator that you *have* that you would use and a ventilator that you would purchase to stockpile.

I would not stockpile Bird Mark-anythings. But if I happen to have some Bird Mark 14s and if it's those or nothing, obviously you would use them, but with the caveat that in a mass casualty situation where there are too many patients and too few caregivers, we shouldn't use ventilators that don't have the appropriate alarms: high-pressure, low-pressure, disconnect, apnea—those are all the things we need

to know if there's one RT running around trying to care for 20 patients with 3 Project XTREME extenders who are listening for alarms to come tell the RT that there's an alarm.

If you have these ventilators, you can use them, but I would not put those as my first priority or even in the top 10 probably for ventilators. Today's young RTs would look at a Bird Mark 14 and wonder where the button is for SIMV [synchronized intermittent mandatory ventilation]. If it doesn't have a button on it, they don't know how to use it. [Laughter] It's great for some of us old people who used to take those things apart and put them back together to talk about using them, but when you start bringing in all these young people who've never seen them, then I think that is potentially going to be a big problem.

Ritz: It's a marginal step up from manual ventilation.

Rubinson: This is a question for Mike, from William R Solly a Master's candidate in disaster medicine and management at the University of Pennsylvania Health System. Would it be feasible and perhaps safer for facilities to dedicate all of their RTs to vent management and to assign other traditional respiratory care roles such as nebulizer therapy, O_2 therapy, and other things they get on the general wards, to other health care providers rather than cross-training people to do the more complicated competencies?

Hanley: That certainly is one approach. You have to look at the Project XTREME training DVD [digital video disc] and our program and think about how it best applies to your hospital and clinical situation. In our training program we do not train the extenders in nebulized medication therapy, so you won't be able to use our program to do that, but it does emphasize the key idea that there are basic RT tasks that extenders could take over.

In my MICU [medical intensive care unit] at any one time there are 2 types of critically ill patients: stable and unstable. We had 3 patients in our ICU when I left on Friday who have been ventilated for 2 months, who have acute lung injury and are on 60 to 70% oxygen, and every few hours a therapist comes by and records the various settings and the results of patient monitoring. Once a day they assess the patient for weaning potential. You get the idea: a very stable patient. This patient is somebody that I think an extender could easily assist with the care of. They could obviously assist in the care of patients who are on the floor and free up your RTs to perform more sophisticated tasks.

So how you use the extenders is something that you have to decide about ahead of time. The question was about using nurses and other health care professionals to do these simpler tasks, but you have to consider where your resources are coming from and who might be available. If they're floor nurses they will already be busy. If you have extenders available, they may be able to do those tasks for you.

Branson: We teach parents to perform suctioning on pediatric home-care ventilated patients, so why can't we teach somebody to do it in the hospital? Well, clearly there is a difference between suctioning the home-care patient who's on room air and suctioning the patient with acute lung injury who's on 18 cm H_2O PEEP [positive end-expiratory pressure] and 80% oxygen with a closed-circuit system. You have to know how that system affects the ventilator performance, what alarms might go off, and how to examine the changes in hemodynamics.

People have criticized Project XTREME for that, but that's where we have to show leadership. The RT doesn't give the extender responsibility for suctioning that patient. You give them responsibilities with stable patients of the sort Mike described. Of course Project XTREME has lots of limitations, and I think Mike acknowledged all of them in his presentation. It's never been tested for a long period, and we don't know how long the training lasts. It's similar to what we've learned from CPR [cardiopulmonary resuscitation]. But we do know that there are some duties that can be performed, and it's our job to use extenders appropriately.

Rubinson: This question is for Ray. Sandra Barnes, from the Olive Harvey College Respiratory Care Program in Chicago, asks, are you aware of any grants that would cover acquisition of oxygen cylinders?

Ritz: In short, no. That idea was recently proposed to me by several vendors, who said, "You give me this amount of money and I will guarantee I will have available for you ventilators, or oxygen cylinders, or whatever." I am not aware of any grant money. I looked at this at the same that I looked at a vendor's proposal that I pay for a maintenance contract for my ventilators. In all likelihood the maintenance contract is going to cost me more money than just doing the repairs and required preventative maintenance. Those programs usually are more expensive than just taking care of the repairs as they come along. I don't think there is any grant money available for these types of programs.

Rubinson: Although they are different monies, in Seattle for public health we use about 5 different sources of money to pay for our preparedness effort, and they all have different restrictions. With certain money sources the equipment needs to be on the Department of Homeland Security list of equipment. With the ASPR [Assistant Secretary for Preparedness and Response] (which is the old HRSA [Health Resources and Services Administration]) noncompetitive grant money, you can use it for equipment procurement if it goes through the state

and the state passes it down to your region and your region decides that is a priority, and then the state approves that procurement. These grants are not specific for oxygen cylinders, but general equipment money is available. My guess is that the competitive grants would not award money just for buying oxygen cylinders. A proposal probably needs to be more comprehensive to win funding.

The next question is from Sunita Mehta, from Good Samaritan Hospital in San Jose, California, and she asks Eileen, is there any variation or difference in ventilator allocation going to a public versus a private hospital?

Malatino: The SNS does not have any responsibility for doing the allocations unless it happens to be pandemic flu or something where the problem is going to be nationwide. Then it might come from a higher authority such as Health and Human Services. Once we get the message that stuff has to go out, if it's a Push Package, it will go to a predetermined warehouse; that may be the same for Managed Inventory as well. There may be an instance with Managed Inventory, say with the ventilators, where they would arrive in an airport and then the state would pick them up, or the area of the region would pick them up and then *they* distribute them.

We do not decide where they go; that is a state or region or local decision. We do have consultants who work with the states, and they determine at what site they want something delivered if it's coming from Managed Inventory. Usually a Push Package goes to a predetermined facility, unless that facility is in a hot zone, or they've all been destroyed, and then there would be a decision at that time where they would be taken.

Rubinson: The next question is from Sharon at Mt Clemens Regional Medical Center, Mt Clemens, Michigan, who asks Lee Daugherty about fit-testing of N95 masks. She says that the Michigan OSHA [Occupational Safety and Health Administration] and, she thinks, the CDC [Centers for Disease Control and Prevention] require annual fit-testing for N95 masks, but she thinks that the semi-quantitative and the qualitative testing (the saccharine testing) is lame. Would there be any benefit to switching to a quantitative test? Would that be adequate for people who had changes such as weight gain, weight loss, facial, or oral changes? Does quantitative testing play any role, and for whom, and is it sufficient?

Daugherty: First, it is important to underscore the fact that although some states require quantitative testing, both qualitative and quantitative fit-testing meet OSHA standards. One concern in this debate is that with the qualitative test it is possible to "fake it," but quantitative testing allows objective fit confirmation. However, a major problem with quantitative testing is that the testing equipment is quite expensive and not always readily available. In a mass casualty situation, such as a pandemic, qualitative testing will be more practical and will still meet OSHA standards. Regarding re-testing, OSHA standards require re-testing annually, and changes in body weight, dental changes, and other changes can affect fit.

Malatino: We do have a medical surveillance program for our deployable people. The Technical Advisory Response Unit (TARU) goes out before the Push Package to receive it when it arrives. We also have full-time equivalents who are CDC employees, and we also have contractors. And we have occupational health at CDC, and we have a contract agency that does our contractors. They get fit-tested every year, and we are required by occupational health to do that.

Daugherty: Is that just within the Stockpile?

Malatino: Any deployable person from CDC who is required to have specialized equipment such as an N95 mask has to go through the same process.

Rubinson: This question is from George Steer at UTMB [University of Texas Medical Branch] in Galveston, and it is for Dan. Where do the NICU [neonatal intensive care unit] patients, especially those on ventilators, fit into the scheme of allocation of scarce resources?

O'Laughlin: There is a pediatrics subgroup in Minnesota that is working on that. Some of that equipment is so subspecialized that it doesn't apply to the rest of the pediatric population. Obviously, NICU patients are very sick. However, it also goes back to the question of the amount of resources allocated to a patient. Could those pediatric subspecialty NICU nursing staff, RTs, et cetera, be better utilized in another pediatric capacity? This issue comes up not infrequently about ECMO [extracorporeal membrane oxygenation]. How long is an infant going to be on ECMO? And are they to be taken off ECMO if somebody else who has a higher likelihood for survival comes in?[1] Usually these NICU locations are in pediatric specialty hospitals or large institutions, and those institutions will have to look at those policies and identify how high their resource ceiling is going to be for that patient population.

1. Truog RD, Triage in the ICU. Hastings Cent Rep 1992;22(3):13-17.

Talmor: The data are imperfect because we don't have a lot of experience with avian influenza, but until now the mortality in children with avian influenza has been close to 100%. As a triage factor we may find ourselves using age in the opposite direction of what we discussed earlier, so that is something for pediatric intensivists to think about.

Rubinson: When we've approached this with several groups, we've used PICU [pediatric intensive care unit] experts, but we haven't addressed the NICU. The question was basically set aside because it was too complex; it needs to be dealt with. When we originally started thinking about it, we thought the NICU would be less impacted, at least in terms of disease process, unless there is a lot of vertical disease transmission, because you don't see a whole bunch of neonates going out in the community at high risk. But if the equipment is the same, and some of it does overlap, I think it's a fair question and a subject that's right for our neonatal experts to try to give some guidance on.

The next question is from Gordy Gunderson from Sanford USD Medical Center in Sioux Falls, South Dakota. Are there any specific software tools, such as Emergency Preparedness Resource Inventory, that would help institutions track crucial resources during a mass casualty event?

Nelson: I don't know of any automated tools. Most of what's being done is on a contract basis, where some high-priced consultant writes you a report that tells you what you pretty much already knew and that's out of date by the time it's printed. I've worked with several different industries—education, state and local government, telecommunications, and health care, and they all fall under the same category. There just isn't a good product available, as far as I know.

O'Laughlin: There are some Web-based tools, but as far as looking at a specific facility and high-level detail, I cannot comment. When you look at broader regional application, there are some resources out there. New York uses HERDS [Health Emergency Response Data System] to track a lot of things, including some of their equipment.

In Minnesota we use a system that Seattle just picked up as well, designed by ImageTrend. It is a Web-based system that was initially designed for EMS [emergency medical services] diversion communication. The product is also being developed for us as an online command and control resource. That has not been fully released, so I can't provide any feedback yet.

Rubinson: The crucial element of regional collaboration is situation-awareness and knowing what's out there and getting the information in time and getting it to where it will be used. Though there are software systems that are clearly giving us a better picture than we had before, I am not aware of any one that does automated dumps of flat files or delimited files that speak with all the different data systems that it needs to. It needs to communicate with pharmacy and materials management and all these different groups that currently we request give us manual data.

Currently, without automated systems it's very hard to even get people to count once every 3 to 6 months, let alone to get information immediately. So there are mechanisms to have kind of a gestalt, but I'm not aware of anyone who is able to interface across all of the data systems to get a more detailed view.

Dan, you guys have just under 30 hospitals; we have 20-some hospitals, and we have all the ambulatory care community, and I don't know of anyone whose software is affordable for a region to be able to work across everyone's different data systems and that doesn't quadruple work at each of those institutions, because there is no money to support people's time at institutions to keep entering data.

O'Laughlin: How many people here could give an *accurate* count of the ventilators you have in your region? I see very few hands going up. And those that put your hands up have done a great deal of work and probably double- and triple-checked those numbers to see if they're accurate, and that was all by hand, I assume. So even with a number we should be able to gather easily, we have difficulty doing so. To ask us, with current technologies and systems, to get the finer numbers and quantities of multiple items across departments and facilities is, shall we say, challenging.

Rubinson: Keep in mind that if you do a lot of pushing region-purchased equipment out to institutions, rather than centrally stockpiling, you need to try to track where they are in the individual institutions so you can retrieve them quickly if necessary. This is an important logistical barrier to distributing equipment and expecting it to be returned and redistributed during disasters.

The next question is from Regina Reale from Multicare in Tacoma, Washington, who asks Eileen, have you spoken with the manufacturer of the Uni-Vent 754 to see if there is an easier way to recharge its batteries?

Malatino: It would mean retrofitting these cases and making the case a little bit bigger, so it would be an added expense. Our biomedical technicians, who open the cases and charge the batteries periodically, also rotate all the ventilators back through the manufacturer so they can take out the batteries and make sure they're still OK or replace them if necessary. They go through a process when they go back to the vendors as well. New ventilators that come into the Stockpile are going to be fitted so that we can just flip a switch, as opposed to having to take all of these out. But right now it would probably be more of an expense then it would be worth.

Rubinson: Regina also has a question for Mike, about getting the Project XTREME DVD. What is the Web address?

Hanley: It's http://www.ahrq.gov/prep/projxtreme. Or call them at (800)358-9295.

Rubinson: This is a question from Dennis Archer from Harborview Medical Center in Seattle. Will disaster preparation be incorporated into a specialty section in the AARC [American Association for Respiratory Care]?

Branson: I don't know. There's a movement for it, but we don't know if it is actually going to happen. There aren't that many specialty sections, and a lot of it depends on membership. We'll see.

Rubinson: I can see someone from the audience suggesting that if you all write e-mails to the AARC, it probably would happen faster.

Dennis also has a question for Lee. Did Toronto stop their aggressive PPE [personal protection equipment] and environmental controls too soon and trigger SARS 2 [severe acute respiratory syndrome]? He says that a news article suggested that precautions were lifted for political rather than scientific reasons.

Daugherty: In their final report the SARS Commission concluded that there was no evidence to suggest that political pressure resulted in a premature declaration of the end of the SARS outbreak. They concluded that the decision to lift precautions at the end of SARS 1 was made "in good faith on the best medical advice available."[1] Perhaps the most important lesson is that consistent PPE use on an ongoing basis, regardless of heightened concern, is incredibly important. It's very easy for us to breathe a sigh of relief when we perceive a lower infectious risk and then become less vigilant about using precautions. SARS taught us that it behooves us to be very consistent on an ongoing basis.

1. Campbell A. Spring of fear: volume one: the SARS Commission executive summary. 2006. http://www.sarscommission.ca/report/v1-pdf/volume1.pdf. *Accessed October 30, 2007.*

Rubinson: Michael McGee from Saint Francis Medical Center in Peoria, Illinois, asks, do you see a role for respiratory therapists [RTs] in hazardous materials and/or hospital decontamination teams outside of the emergency department, to manage patients before they enter the hospital?

Talmor: Originally, our decontamination team was composed of nurses, RTs, and physicians. We soon realized that this was unnecessary. To decontaminate somebody—strip their clothes off and wash them in water—you don't need any medical credentials. The only people who will need to be medically trained on that team are the triage team, who need to be highly trained and experienced. They will need to rapidly assess patients' respiratory status and differentiate between walking and nonwalking victims. There will also be an intubation team, which will need to include an RT. So it will be one or 2 positions that will require a protected RT working outside the facility. We will probably need several teams, because functioning in the protective suits is physically exhausting. But each team would require only one or 2 RTs.

Rubinson: The next questions are from Frank Rando of the U.S. Department of Homeland Security and U.S. Department of Energy from Tucson, Arizona. Eileen, the forward deployment of SNS assets such as the Chempack system is a wise move. Are there any plans for strategic placement, meaning forward deployment, of any medical equipment in addition to the Chempack?

Malatino: The Push Packages and some of our Managed Inventory are already strategically placed throughout the United States. We guarantee that Push Packages will arrive within 12 hours. So that's already in place.

Branson: Jan Bard from Virginia Mason Hospital in Seattle asks, are there any online ways for RTs to get continuing education units for emergency preparedness? I don't think there is anything specific. There are always classes that you can take from your state and systems in your state to get basic disaster preparedness. But the AARC does have at least 3 Webcasts.[1-3] On all 3 of those I think they would qualify and they are free on the AARC Web site.

1. American Association for Respiratory Care. The Strategic National Stockpile: what respiratory therapists need to know. Featuring Richard D Branson MSc RRT FAARC and Eileen Malatino MSc RN. November 1, 2006. http://www.aarc.org/education/webcast/archives/national_stockpile/index.asp. *Accessed November 15, 2007.*
2. American Association for Respiratory Care. Mechanical ventilation in mass casualty care. Featuring Richard D Branson MSc RRT FAARC. April 5, 2006. http://www.aarc.org/education/webcast/archives/mass_casualty_care/index.asp. *Accessed November 15, 2007.*
3. American Association for Respiratory Care. SARS: lessons from the front lines. Featuring members of the critical care and respiratory therapy staff at Mount Sinai Hospital, University of Toronto. June 17, 2003. http://www.aarc.org/education/webcast/archives/sars/index.asp. *Accessed November 15, 2007.*

Malatino: I recommend the National Response Plan, the National Incident Management System, and the FEMA courses that talk about incident command systems, to learn about the processes that go on when stuff is requested, and how it's managed, and the hierarchy of processes during a disaster. I think it's important to know that.

Rubinson: Charles Reick from Greater Baltimore Medical Center asks, in a major event how can you optimize getting your staff in to work when they may have fears about safety, or that they may never be able to leave the facility once they get there, if they have family care or other care issues,

such as childcare, caring for a partner, or elder care?

O'Laughlin: Most hospitals have an annual safety fair, and those offer a perfect opportunity to reinforce family emergency planning. Nobody is going to feel comfortable coming to work if they haven't taken care of their own family emergency planning and made sure their kids, elders, dog, cat, or whatever are taken care of. Family preparedness planning has to be done ahead of time, and it's relatively easy to do. It just takes some time to sit down as a family and figure out how you'll do things. And once you have addressed that, then there's still an education component, because if it is an infectious disease event, PPE and basic infection-control education will need to be reinforced. Do the basics over and over again, and that will take care of a lot of things, though not everything.

Talmor: The people I've talked to about the SARS epidemic told me there was minimal absenteeism. In Hong Kong the only people who were absent were the equivalent of traveling nurses, who weren't rooted in the community. In Toronto essentially anybody who wasn't told to stay at home for quarantine reasons was at work. So I think that health care workers tend to "run towards the fire" so to speak. I think absenteeism may less of a problem than some people are worried it will be.

On the other hand, you do need to set up family support mechanisms and be creative about them. In Israel during the Gulf War we went through a lot of very similar issues. The high school students in the community and the medical students served as family support workers. A lot of the medical students were working in kindergartens and daycare centers for the hospital staffs. They were set up in teams to go visit the health care workers' homes. These aren't jobs that you need people from the hospital to do; these are perfect jobs for volunteers from the community or educational institutions around your hospital. This is fairly easy to plan for, and I think that it would prevent a lot of problems in a time of need.

Rubinson: I went up and visited North York General Hospital in Toronto as SARS 2 was ending. The people that really kept their staff coming were their human resources folks. They took it upon themselves to make a number of things possible. Some people were on work quarantine and they couldn't even fill their gas tanks because they were only allowed to go to work and go home. They had a gas filling station come on site. People weren't allowed to buy groceries, so they bought groceries for people. Kids were getting kicked out of daycare, because of fear of the disease, so they provided daycare. It's really important that human resources provides crucial services to allow staff to focus on patient care.

On the other hand, it's also the employees' responsibility to be as prepared as possible, and we need to give them good guidance. I would like to see that no one gets promoted without providing evidence that they have an adequate personal family plan. We need to add incentive or it's never going to be an institutional priority. We need to make it the culture of the institution to be able to keep people coming.

Malatino: I'm also a Navy reserve nurse, and we are required to have a family plan in place for dependents such as kids, spouse, or elderly parents living with you. They also encourage people to think about their pets and other things. And it's not simply bringing in a plan and showing it to them; I had to sign a piece of paper that says I have a plan, so I had no excuses if I got recalled. We need to warn employees that this may happen, that they have to come to work, and these are the consequences if they don't.

Rubinson: We have a question from Dave Pierson from Harborview in Seattle. He says that in many ICUs under normal conditions there's numerous different modes and different ventilators in use and that the choice of ventilator and mode are discretionary. For instance, some people always use pressure control and other people always use APRV [airway pressure-release ventilation]. People always use high-frequency for refractory hypoxemia or ventilatory failure in ARDS [acute respiratory distress syndrome].

Rich, considering those practice patterns, what are the crucial device features you are going to consider for a surge ventilator that's acceptable for patients and supported by evidence but doesn't necessarily need to have all of the "bells and whistles," or does it?

Branson: We have to look at what the literature dictates; what's the standard of care? I think the right ventilator weighs 10 pounds, offers volume-control, PEEP up to 20 cm H_2O, controls F_{IO_2} [fraction of inspired oxygen], triggers reliably, works for adult and pediatric patients, and has low gas consumption and good battery life, versus if I had to spend another $8,000 to have the options of APRV, active exhalation valve, pressure control, and/or PRVC [pressure-regulated volume-control ventilation].

We should stockpile ventilators that meet the demands of the disease we anticipate. It's not like your full-feature ICU ventilators go away. You would use the less expensive stockpile ventilators for stable patients, and put the new avian flu patients or whatever on the full-feature ventilators. Obviously we can't afford a lot of $30,000 ventilators. Stockpile ventilators should only provide what is minimally required to meet standard of care. Perhaps this is an aspect of triage. Maybe a patient who can't be supported with low-tidal-volume ventilation, PEEP,

and a certain F_{IO_2} should only receive palliative care and the ventilator should be used for a patient who has a better chance.

I look at ventilators all the time and I still haven't heard a reason why every ventilator has to give a tidal volume of at least 2.2 liters. That seems ludicrous now that we know the importance of low-tidal-volume (6 mL/kg) ventilation. But it continues, because if I make a ventilator that provides 2.2 liters and somebody else comes out with one that only provides 1.2 liters, I would tell all of his customers that the reason he can't provide 2.2 liters is because his system is inferior, ignoring the fact that the ventilator that provides only 1.2 liters makes more sense because it has a smaller blower, which provides greater efficiency. Manufacturers engage in this "spec-manship" that does not help us. We need to be smarter consumers and get past that. Everybody should have the same absolute high threshold.

Rubinson: If you had a blank check and you could use $30,000 ventilators for surge ventilators, would you have hesitancy about getting more complex vents because of issues about staff knowledge, in-service needs, and whether the devices come with compressors and can operate on low-flow oxygen? If money were not an issue—say I give you 6 billion dollars to do surge mechanical ventilation—would you suggest any other strategy than you're proposing now?

Branson: If money were no object and you could start from scratch, you would build a ventilator that would operate on alternating current when it's available, but it could also operate just on pneumatic power.

My colleague Jay Johannigman suggested that we need a device where the first screen that comes up asks who you are: an EMT [emergency medical technician], a nurse, an RT, a surgeon, an intensivist, et cetera, and what you select determines what knobs you see. [Laughter and applause] If you're an EMT you can control rate, tidal volume, PEEP, and F_{IO_2}, and that's it. The device could also ask how tall is the patient? And when you tell it how tall the patient is, it sets ventilator parameters for you based on ideal body weight from height, per the ARDS Network [low-tidal-volume ventilation] algorithm. Such a device could act as multiple devices. For an EMT it's a simple replacement for a bag-valve-mask resuscitator; in the hands of an intensivist it's a full-featured critical-care ventilator.

I would also build an oxygen concentrator into it. I don't mean to disparage any one group's expertise in mechanical ventilation, but it would be a big advantage to have the device perform relative to the caregiver's skill and experience, as has been done with the AED [automatic external defibrillator].

Talmor: I agree with Rich that the type of ventilator is an aspect of triage. If you can't survive with what a transport ventilator can deliver, then you are probably so ill that you would be triaged to expectant [palliative] care. If I had an unlimited budget I would try to fill another large hole in our preparedness, which is monitoring. We've talked a lot about ventilation, but there is no monitoring capability in the Strategic National Stockpile. Most states, as far as I know, have not stockpiled any monitoring capability. That is more important than purchasing a slightly better mechanical ventilator.

Branson: Yes, an ideal stockpile ventilator would have a built-in pulse oximeter. Pulse oximeters are now so small and require very little power, if you don't need all the fancy stuff and you just want to see the heart rate and blood oxygen saturation; that would be a simple addition to a ventilator. And I would suggest the same if I were a manufacturer making mass casualty ventilators. I would also include noninvasive blood pressure measurement. Perhaps it would also be possible to get blood pressure from a pulse oximetry probe? This is wishful thinking, but adding those functions should not be that expensive or difficult.

Rubinson: And I think cost is going to be the key; it's the trade-off of cost. We as a group need to come up with what are the appropriate trade-offs. I also think we need to take it on ourselves to study what are the minimum features that would allow a device to work for many, where we have optimized the interplay of cost and features. Whether it's with animal models or utilizing other surrogates to find out what is really essential, we need more data.

When you look at the ARDS Network data, generally about 13% of the 30–40% who died did so due to hypoxemia or ventilatory failure.

Pierson:* I think you're referring to 2 studies from Harborview (rather than from the ARDS Network per se) that examined the causes of death in patients with ARDS.[1,2] Consistently over a 25-year period, of all patients who developed ARDS and did not survive, only about 15% died of refractory respiratory failure and our inability to support them with the machine. So if overall ARDS mortality is about 35%, and 15% of those people die of actual respiratory failure, as you say, Lewis, only around 5% of the time are we unable to support them in terms of ventilation and gas exchange. The great majority of ARDS patients die of multiple organ failure and things other than respiratory failure.

1. Montgomery AB, Stager MA, Carrico CJ, Hudson LD. Causes of mortality in patients with the adult respiratory distress syndrome. Am Rev Respir Dis 1985;132(3):485-489.

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2. Stapleton RD, Wang BM, Hudson LD, Rubenfeld GD, Caldwell ES, Steinberg KP. Causes and timing of death in patients with ARDS. Chest 2005;128(2):525-532.

Rubinson: I think that goes to Danny's comment on how the ventilator is a triage mechanism.

Branson: Regarding the whole market—and this is just the way things are driven, I guess, for the military and the government—you make a ventilator, and all of sudden states are buying thousands of ventilators, so you run back to the office and you take your ventilator and you spray paint it bright orange and put a hazmat [hazardous materials] sticker on it and take out an ad that says it's ideal for mass casualty ventilation.

What we really need is to sit down and design a ventilator for mass casualty ventilation, rather than trying to find a mass casualty niche for an existing ventilator, with marketing and add-ons. So far the market isn't big enough to attract big companies to pursue this, and only small companies have been doing it.

Rubinson: Sandra Barnes from Olive Harvey College School of Respiratory Care in Chicago asks, has anyone approached the governor of their state to ask for a Good Samaritan law to cover mass disaster training for Project XTREME trainees or other volunteers?

Hanley: I don't know. One of our recommendations was that we thought that laws should be passed to protect extenders who are to some degree practicing outside their scope of practice.

O'Laughlin: In Minnesota we've adopted that as part of the Emergency Health Powers Act. Some other states have also looked at that, but I don't know how good the language is; it differs from state to state.

Rubinson: But your Emergency Powers Act would cover people working outside their scope of practice?

O'Laughlin: Persons who are acting consistent with a regional emergency plan, even if operating out of their usual area of care (such as at an alternate care site), have some Good Samaritan protections if acting in good faith, as long as they adhere to what would be considered the accepted level of care for the situation.

Hanley: As I recall, for issues of personal liability, those are governed by statues at the state level, not the federal level. Though it's important to encourage the passage of statutes that would protect extenders, it's not a federal issue, but a state issue.

Rubinson: At least that is how the legal folks have explained it to us. There's no legal expertise on this panel, although some of us have had consultations from some very bright legal minds on these issues. So it seems to be a state issue. However, the "investigational new drug" designation and paperwork is under federal control, under FDA, I think. Scope of practice is controlled at the state level.

If we have regional uniformity of practice, that would presumably help in the case of a criminal or civil liability case. And if there is federal guidance, it may not be a mandate or it may not be legally binding, but it can be a 2-pronged approach from grassroots going up and federal going down, to states being able to support the folks who are doing their best to care for patients during a difficult situation.

Malatino: We do exercises with the states, maybe every month or a couple of times a month, and a lot of questions have come up about the use of items from the Stockpile, such as who can dispense the medicines? The Stockpile does not make recommendations. That's CDC's job. SNS is part of CDC, but we're more logistics than anything else, even though we have medical people working for SNS.

If you get a chance, do participate in an exercise in your state, particularly if it involves Stockpile assets. Our trainers go out to the states, and they practice taking Push Package materials off, distributing them, going to points of distribution, and getting whatever those products happen to be, usually pills or antibiotics, and getting those to people, and they do these drills. So there are some opportunities there for people to learn and to be heard, because they're dealing with state emergency people at that time, and these issues can be brought up.

Rubinson: It's best to get guidance from legal authorities in your own jurisdiction, because it varies state by state. There are various interpretations, because there's a lot of uncertainty. I encourage everyone working on disaster preparedness to make sure you have good legal consultation. Don't rely on legal advice from medical people.

The last question is from Eric Gjerde from Airon in Melbourne, Florida, who asks, taking an all-hazards perspective, should we rely only on ventilators that operate on electrical power or should we have a mixture of pneumatic and electrical ventilators?

Ritz: I am hesitant to recommend a pneumatically powered ventilator, given the possible difficulty of supplying oxygen in a disaster scenario. As well, many hospitals have reasonably robust electrical backup systems that will probably supply adequate electricity. Having lived through a couple of these disasters myself, our institution ran on reserve generators for 4 or 5 days and could have gone longer than that. Although, as Rich said, it would be nice to have a ventilator that could use either electrical or pneumatic power.

Branson: I think Eric asked the question partly because his company makes pneumatic ventilators, which is OK, but

the issue is, does the ventilator meet all the other criteria, such as can it deliver a tidal volume small enough for pediatric patients and how high is its gas consumption? Does it meet the important disaster-ventilator criteria? If so, then perhaps a pneumatic ventilator is worth considering, but, like Ray, I would not recommend stockpiling them. If your hospital wants some of them for patient transport, that's great, but the big problems are situational.

If we have 3 RTs who usually work in the pulmonary function testing lab each watching 6 or 8 ventilators and tasked with alerting the physician to problems—if all they have is pneumatic ventilators and they're only capable of telling me when they're disconnected, and there's no high-pressure alarm or other alarms, then it's a safety concern.

I stress that I am commenting only about stockpile ventilators for use in the hospital. We have not discussed use in the field, or in moving patients to the hospital, or between hospitals; those are where pneumatic ventilators could play an important role.

Rubinson: I would also advocate, if you are ultimately moving patients towards hospital evacuation, then you're probably going to be outside of the ICU, but not able to move all of your patients immediately to another location with copious high-pressure medical gas. You're not going to have 50 air medical units landing all at once. It's going to take a while. Most of our air medical units can only move in onesies or twosies for people who are critically ill. So because of that, the expectation is that you are going to be out of the unit and you're probably going to be working on compressed gas for a while.

And the question is, will your oxygen-conserving device be more appropriate? When you're prospectively planning on stockpiling, what equipment do you really want to buy? Do you want to buy equipment that just gets you by, or do you want to buy equipment that is most likely to meet the needs that you have? Different places have different needs. I would encourage you to deliberately think about the need and then determine the product, rather than just getting a product and hoping that it meets your need.

Branson: OK, we're done. I want to thank you all. You didn't sign a form of consent, but you have been part of an experiment; we've never done a Journal conference in front of an audience before. Thanks to Ray Masferrer and the AARC for sponsoring the conference. Thanks to Lewis Rubinson, who over the last 5 years has taught me a lot and become a good friend. His expertise was essential for putting this conference together. Special thanks to Ray Ritz, because I gave him the hardest job, which was to figure out something that nobody knows anything about: oxygen. He took it on without complaining. I would have complained a lot. And thanks to everyone else who came. You've all done a great job.

Ritz: I complained behind your back a lot. [Laughter]

Branson: I'm going to have Dave Pierson give us a final comment.

Pierson: I think what we have heard and discussed and learned in the last day and a half is something unprecedented, certainly for this organization, and for people in this specific field. I was tremendously impressed with all the presentations. The primary purpose of our Journal conferences—this one, like all 39 previous ones—was to generate the corresponding 2 special issues of RESPIRATORY CARE that come in your mailbox a few months later. The articles, which will be written by the individual speakers, in some cases with collaboration from other coworkers at home and elsewhere, will cover everything that has been discussed, and in some cases a lot more. They will certainly be resources that we will all find informative and helpful in a practical sense.

Finally, let me add my thanks as editor, on behalf of the Journal and the AARC, to all the faculty members—and especially to Rich Branson and Lewis Rubinson—for the tremendous amount of effort they put into the conference and the great success it has been.