Patient Care Centre Public Lecture
January 29, 2010
Centre for Health Design – Dr. Roger Ulrich and Amy Keller

How Well-Designed Health Care Facilities Contribute to Better Patient Care

Good Afternoon, my name is Rudi van den Broek. I'm the Chief Project Officer with the Vancouver Island Health Authority and it's my great pleasure today to have Dr. Roger Ulrich and Amy Keller come to speak to us about Evidence Based Design (EBD) and in particular, about Evidence Based Design and the Patient Care Centre.

So I'm just going to say a couple of words. About three years ago Howard Waldner was at a presentation by a gentleman named Blair Sadler, who is on the Board of Directors for the Centre for Health Design. The Centre for Health Design had something called the Pebble Project and Amy is going to talk a little bit more about that in a minute.

The Pebble Project is the idea that we can make decisions around the built form based on evidence and then report on the outcomes that we achieved from that design intervention after the fact, and contribute those findings to the broader design community so that future projects can build and start from where we left off. So since that time, 3 ½ years ago, the Patient Care Centre has been a designated Pebble Partner and I'm pleased to say we are the first international Pebble Partner and we have been incorporating evidence based design, which again we'll define in a minute, but design features into the building that are shown to have positive outcomes and that went through the specification through the procurement and through the design completion process and here we are, a little less than 11 months today actually, when the building will be turned over to VIHA by the Builder and these two fine people are here to tell us what is in the building from their perspective and what sorts of benefits we can expect to achieve from that investment.

So I'll turn this over to Amy Keller who is the Senior Research Associate at The Centre for Health Design.

OK – Hello, I'm actually here to just be kind of your teaser before the main course which is Roger and his knowledge that he is going to share with you today. As Rudi had mentioned the Centre for Health Design is a non-profit organization, it's a research, education and advocacy organization and the Pebble Project is one of the core components under Research.

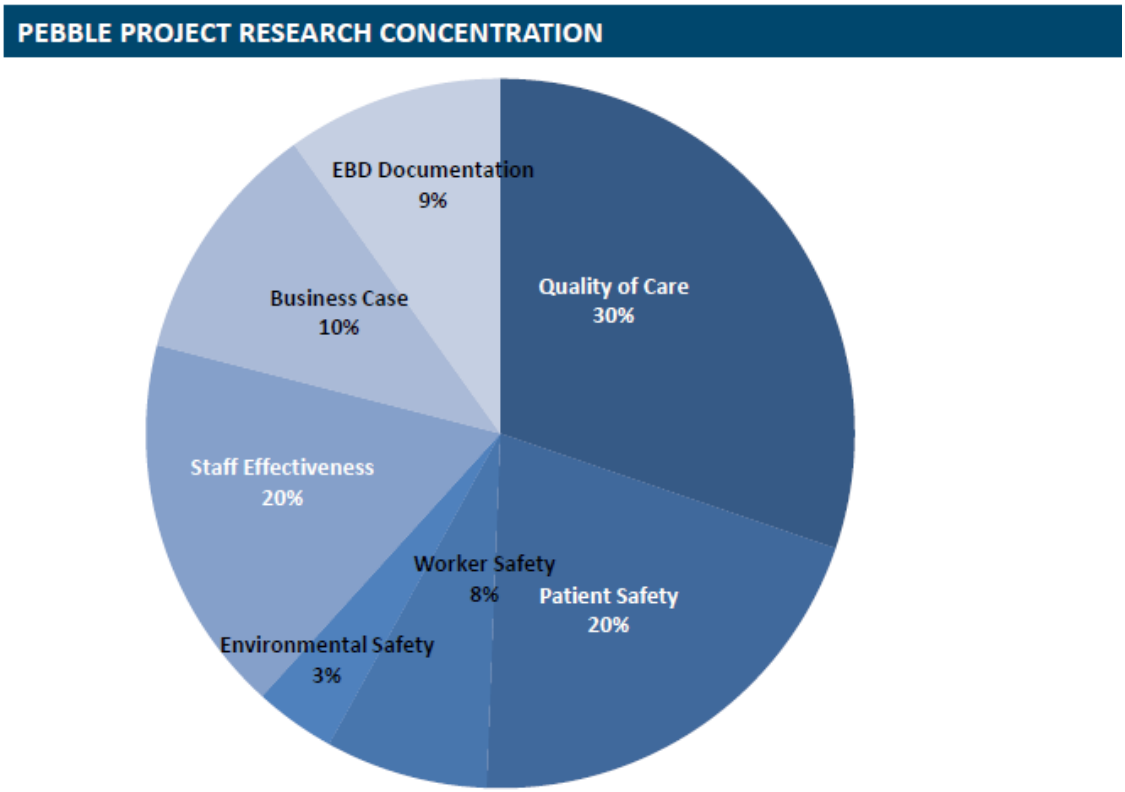
We are based in Concord, California which is a small city outside of San Francisco. We have about 20 employees and 12 Board Members as well. Roger is one of our Board Members.

So, Rudi had mentioned the catch phrase or the term Evidence Based Design. Evidence Based Design is the process of basing decisions about the built environment around credible research, with the possibility and the opportunity to achieve best possible outcomes. So here at VIHA you're really committing to a greater cause.

You are committing to designing your Patient Care Centre to promote and improve patient outcomes, as well as staff outcomes.

So the Pebble Project. Where are they located and who are they? There are 70 active Pebble Partner members across three countries, the UK, Canada and the US. There are 8 members in Canada: 3 in Alberta, 3 in Ontario and 2 in BC. There are three phases of being a Pebble Partner; you learn, then you do the research and then you share your knowledge.

You are also very much ahead of the curve in inventing your design solutions to your new Patient Care Centre tower here at VIHA so you are not necessarily just among the best, you are definitely among the elite creating the curve – you are a step ahead of the curve itself. So what is in the research – how are Pebbles focusing on the research?



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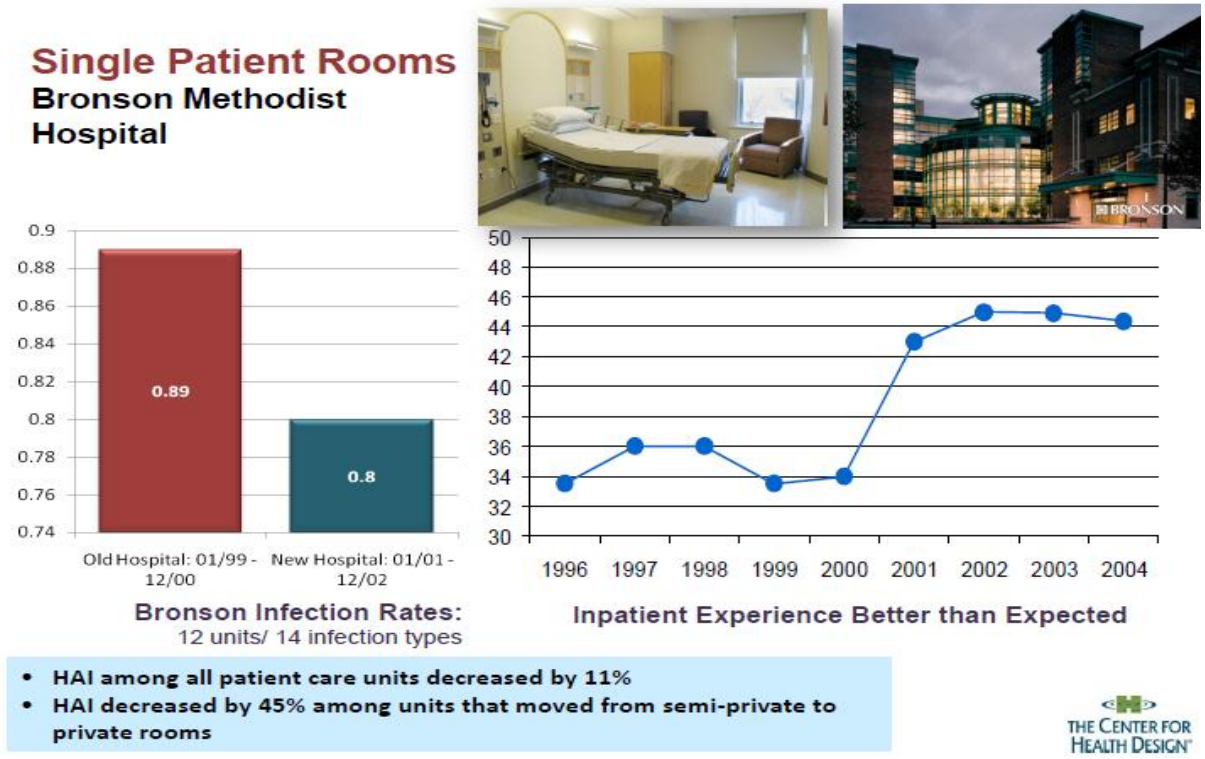
There are 7 primary areas of research:

1. Patient Safety
2. Quality of Care
3. Evidence Based Design Documentation
4. Business Case
5. Staff Effectiveness
6. Environmental Safety
7. Workplace Safety

There are issues around reducing noise, improving length of stay, reducing infections, reducing medication errors.

I just want to highlight three examples from some of our Pebble Partners before Roger gets into some of this information of how it's going to affect your hospital here.



Single patient rooms – this is actually a ten year old hospital. If you remember the graph "you are ahead of the curve" this is definitely ahead of the curve. So ten years ago Bronson Methodist Hospital in Michigan decided they wanted to create single patient rooms and they wanted to measure the affect of that change with nosocomial infection rates, as well as a number of other indicators. What was really exciting and very mind blowing at the time and really is now considered best practice was that infection rate decreased by 11% upon moving into a single patient room environment. As well, the hospital acquired infections decreased by 45% among the units that moved from the semi-private environment to private patient rooms. So if you can imagine ten

years ago this was something very new, but is now considered best practice. So as the bar begins to change in the other direction all these new discoveries are beginning to emerge through research.

Question – not audible

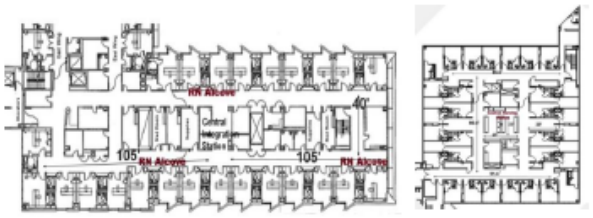
The Gantt graph is another indicator and here Bronson wanted to measure the inpatient experience; whether the patients themselves perceived the environment better than expected so it's a satisfaction measure. So they moved in 2000 and you can see the chart drastically jumped up ahead of the curve from when they moved into the new units.

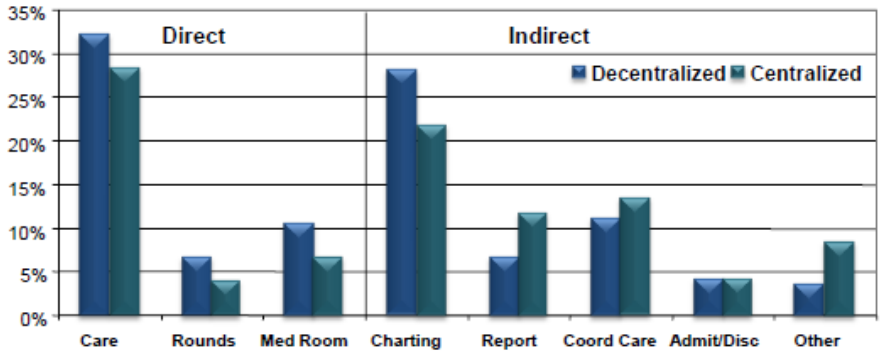
Question – not audible.

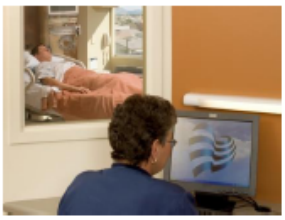
It's starting to level off because of the (question interrupted) 2004 and now. I do not have an updated graph but I definitely can get one and send it around for sure.

The purpose of that graph was definitely to point out, this was ten years ago so it was creating new innovative features and how to push the envelope a little bit – a step above the rest. So that feature itself is now considered best practice, it's in the guidelines in the US Standards, as well, and at VIHA here you are incorporating 83% of single patient rooms within your new Patient Care Centre.

Decentralized Workstations
Banner Health







	Decentralized	Centralized
RN time in patient's room	30% of shift time	26% of shift time
Total number of patient visits	192	138
Medication room visits	85	33

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Another example, at Banner Health in Arizona: They took the two projects, one a centralized nursing unit design, as well as a decentralized nursing unit design, two hospitals, and they wanted to compare the difference between a number of indicators on communication, as well as nurse/staff time in the patient room. What they found was direct communication between patients and staff drastically improved in a decentralized nursing model than a centralized nursing model. As well, the percentage of visits in a decentralized nursing model layout vs. the centralized nursing model changed, so there was 192 total numbers of patient visits in a decentralized model vs. 138 in a centralized nursing station model

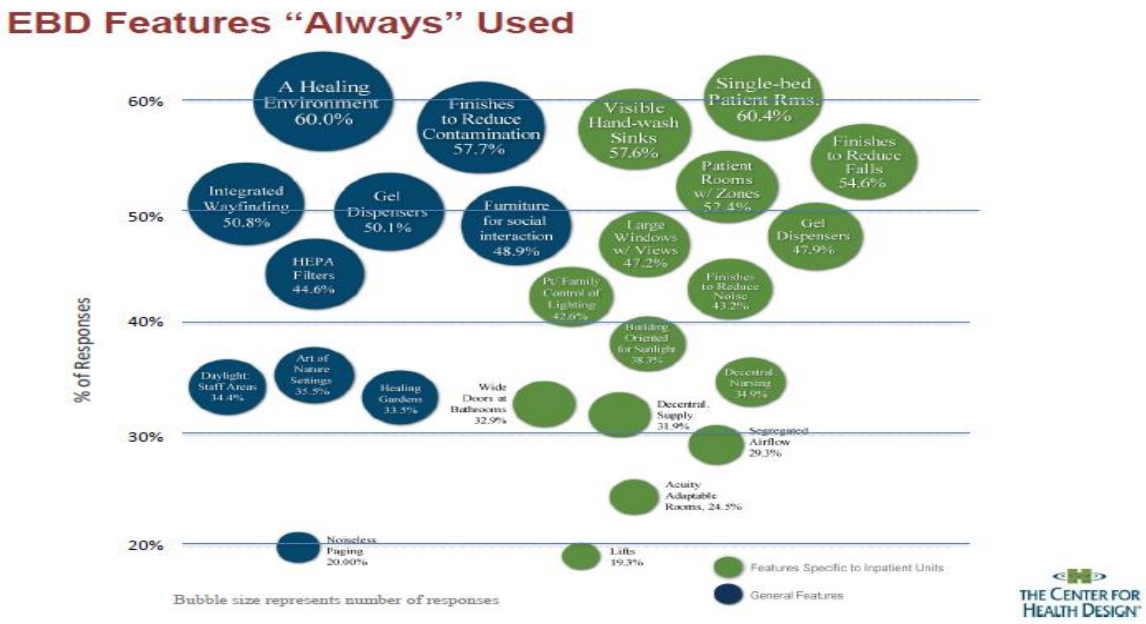
Question - not audible.
30 % of shift time - 4% of a difference (question from audience – not audible)

So that was just one of the indicators. There are several among the mix and that was something important to Banner House to identify that the time did increase so another one that was important for them to recognize, was medication room visits as well as the total number of patient visits that the nurses were in actual patient rooms and not somewhere else.

Another example: Acoustic design features and what you do to your interior design finishes and how that has a positive effect, not necessarily just on patients but staff performance. Several of our Pebbles have reducing noise as one of their main primary components. The purpose is really to recognize what features, whether it's flooring materials, wall panels, or the ceiling tiles, actually make a huge difference in the amount of noise or the sound level within the unit itself.

So Affinity Health in Wisconsin, as well as Palomar Pomerado Hospital, Jersey Shore University Medical Centre and a flooring manufacturer, Johns Manville as well as a few other Pebbles: Jersey Shore Medical Centre, Princeton University are all looking at noise as an issue. So a few of them got together and decided to survey some of their patients as well as their staff, about the perception of noise, as well as to do a formalized sound level decibel meter measuring the reading within their med/surg environment, their ED, as well as some of the waiting areas. That study is currently underway but the preliminary findings really revealed that the assessments, especially from the perception value of the noise, improved privacy feelings as well and has been significantly improved through all of those Pebble Partners – which is exciting.

So this chart here : See below



The Centre for Health Design conducted a survey in 1979 and 174 different countries responded to this survey. There were, I believe, 600 different applicants that responded based on their organization and this was identifying the percentage of time that Evidence Based Design features were used in their building. So if they were going through a health care building project and they decided, we are going to do private patient rooms, or we are going to do large windows with views, whatever the actual evidence based design feature was going to be put into their building, we surveyed it and said what are the chances that feature will be in your building which, if you can read this slide, I don't know if you can, but I can definitely rehash some of it. Single bed rooms, inpatient rooms - 60% of the time the applicants out of 174 countries said they would put single bed rooms in their hospitals; finishes to reduce falls – 54%, finishes to reduce noise - 43%, decentralized nursing stations - 34%, the acuity adaptable rooms - 24%, ceiling lifts - 19%, and just to give you an idea – this is just a broad brush of people who decided they were going to build an environment and incorporate these features. Pebbles pretty much incorporates 100% of these features and it's very important for Pebbles to recognize that they are part of this innovative elite group that is doing this great work.

And just to give you a snapshot of what you are getting here at the Royal Jubilee Hospital, are all of these features that I just identified: the private patient rooms, the acuity adaptable rooms, highly visible hand washing sinks, surfaces and finishes to reduce falls and so on. Including, above and beyond, in the blue box the natural light, positive distractions including art work, music, digital imagery, the furniture in waiting areas to promote social interaction. All of these great, wonderful things and we are so excited to hear about your project as well as what research you will be doing around these terrific features.

And with that I'm going to pass it on to Roger to highlight some of the research backing the foundation from these evidence based design features.

Roger S. Ulrich, Ph.D.
Professor of Architecture at Texas A&M University

Thank you, I am delighted to be here and thank you to the Royal Jubilee Hospital and VIHA for inviting Amy and me. You have a very exciting new building that will very rapidly become a finished building and be the state of the art facility, not only on Vancouver Island, but to my knowledge, in all of British Columbia and Western Canada, and it will be truly an outstanding facility not only by the standards of BC or Canada but really in major ways by international standards and I'll provide reference points for what you are getting at various times. I service and advise to Australia, sometimes Singapore. I have been senior Advisor to the British Building Program for new health care buildings in NHS for two years and I'm an Advisor to various countries in Europe, including Sweden and Denmark and at one time the Netherlands. Most of the really high performing safe systems, and of course, I have lots of experience in the States.

I was asked to list what I thought of all the features and characteristics stemming from evidence based design, what are ten of the most important that will be in your new building.

1. Single patient rooms with good visual access to patients...
2. Numerous sinks and alcohol gel dispensers in locations that increase hand washing compliance.
3. Acuity-adaptable rooms.
4. Air-flow segregation; and HEPA- filtered air for high acuity patients.
5. Noise-reducing features.
6. Decentralized nurse stations and supply storage.
7. Ceiling hoists for patients.
8. Daylight exposure.
9. Window views of nature, access to gardens, positive distractions.
10. Improved way finding.

There are many others but I think based on research these are the most important from the standpoint of actually improving outcomes for patients for decades to come who will be cared for in this hospital and for staff who will work in this hospital for decades to come, and in some sense you might say tax payers or public expenses because these measures while they sometimes cost more in the short run to build actually are quite significant in helping to control costs or reduce the always escalating very huge costs associated with health care. So it is very smart, I think, on the part of Vancouver Island Health Authority from the standpoint of long run financial performance and considerations.

Single rooms by far are the most important single gesture with good line of sight visual access by nurses and doctors from the hallway through windows which can also easily convert to privacy conditions via enclosed sandwich blinds. So these rooms will provide and flex easily between safety and high visual, excuse me, privacy or provide a high visual access for higher acuity or more clinically unstable patients.

There will be numerous hand washing sites, much more than in older hospitals or the current Royal Jubilee Hospital. Very important for hand washing compliance especially in an era with antibiotic resistant strains which requires hand washing and sometimes some strains are impervious to or not effectively handled by alcohol gel dispensers. Very importantly there will also be innumerable alcohol gel dispensers included in public areas but also in private rooms, near bedsides and this is known from much research internationally to substantially increase hand washing or hand cleaning hygiene thus fostering significantly better safety for patients, again, in this era of such increasing challenge world-wide, with respect to the increased growing serious problem stemming from antibiotic resistant strains.

There will be acuity adaptable rooms, that means these rooms can flex readily between handling really sick patients or less sick patients and this capability has been shown in rigorous published research to drastically reduce the need for patient transports which saves lots of money and does all kinds of good things with respect to making patients safer. It also makes it much easier or work much more effective for staff. The new building will have state of the art air ventilation including HEPA filtering that creates very clean air. Why is this important and increasingly so? Because folks on Vancouver Island who are going to be at Royal Jubilee, like everywhere else in the world, with advanced health care systems in major hospitals will be getting increasingly sick, acuity levels are steadily increasing. With this, hand in hand, goes greater vulnerability of patients to infection. With this, hand in hand, goes a higher percentage of patients who are immune compromised and fragile, thereby again contributing to vulnerability. And we know from much published medical research that patients who are at high acuity and are immune suppressed do much better in terms of morbidity and in the extreme cases mortality in rooms with very clean air. They have to be single rooms so this is quite an appropriate and necessary response to the, again, challenges of antibiotic resistant diseases and the reality of the fact that the Royal Jubilee new Hospital will handle exceptionally sick patients.

Noise reducing features – very important and are emphasized in the new hospital. On the basis of upwards of 200 published scientific studies we know in recent years that noise is much more serious as a problem negatively affecting patients and staff than previously thought. So reducing noise is important for improving outcomes both for patients and staff.

Decentralized nurse stations and supply storage will enable and make it possible for nurses in the new hospital to walk less, be less fatigued, more satisfied, be able to do more work in terms having more time to actually care for patients and not engage in wasteful fetching as they go to some distant supply storage area as is the case with traditional nursing unit designs internationally.

There will be ceiling hoists for patients and this will benefit patients in very important ways related to safety and staff in extremely important ways related to safety and I'll explicate this more later.

Day light exposure will be enhanced. Of course, Florence Nightingale wrote well over a century ago that greater daylight exposure was health promoting for patients and in some general sense she had it right although she was wrong in her reasons, but it took neuroscientists about a century to come along and explain the mechanisms by which daylight exposure does for instance significantly reduce patient depression or does for instance, and this is a very important recent finding, reduce patient pain, a major problem in health care, of course. There will be window views of nature which are not just nice to have, they are health promoting as you will see. They can even shorten stays, reduce pain and reduce stress and improve way finds. So in this vast complex building, patients, as well as their families and visitors will be able to more easily locate their loved ones, or find laboratories for tests, or offices and experience less stress finding their way about.

Let's start with the first one: 83% single bed rooms and moreover they are acuity adaptable, Bravo, Bravo for Vancouver Island Health Authority. I advise other Provinces in Canada. I'm an adjunct scientist in Ontario with the Ontario Agency for Health Protection and I think, based on my knowledge, this is the best any hospital has been able to do in Canada. The previous record was 80% single bed rooms but there are some reimbursement quirks in Canadian payment policies that make it difficult to go above 80%. But it was done here and that is incredibly important. Why? A great deal of research running to hundreds of studies shows convincingly no question that single rooms is the single most important Evidence Based Design or EBD feature for improving outcomes in quality for all patients and a vast amount of evidence obtained from studies around the world has shown that single rooms are significantly safer for patients, they are less stressful, they are more healing and if properly designed, create much better work places for staff.

These are just some of the many outcomes for which, again, so much research has shown convincingly singles clearly out-perform multi-bed rooms with respect to impacts and outcomes, reducing health care associated infections, medical errors, I'll explain why later, and falls. Staff observation of patients, how can that be enhanced with single bed rooms? Well, imagine an older style patient room, traditional, with say six or eight beds, and the hospital is at 100% occupancy and they are in Western Canada, they are full to the gills, and every bed is taken and the curtains are pulled to provide at least a gesture of privacy that obscures visual access and several countries have reported patients dying in those circumstances from lack of surveillance. Also, again, if single patient rooms are well designed then there can be direct excellent, superb visual access right at the patients head provided for staff out in the hallway where they don't have to noisily visit the patient, wake them up, disturb them and so actually surveillance of the patient, which is important for safety and good clinical care, will be, I think, significantly better in these new single rooms.

Staff/patient communication is vastly better and more private in single bed rooms. We've know that for decades internationally. Staff talk longer and are more candid, they

tend to be more emotionally supportive – this is what data from other countries tell us. Both doctors and nurses if they are talking to patients in single rooms where there is privacy as opposed to multi-bedrooms where they strongly tend to automatically censor what they are saying and abbreviate what they are saying out of respect for privacy. Increasingly, internationally, that is mandated by regulations with "teeth" to protect patient confidentiality. For example, in England right now it is difficult for a nurse to communicate at all with patients about their conditions in a multi-bed room because it would be a breach of confidentiality regulations. I believe, based on what is happening everywhere else internationally, there will be increased weight or importance given to patient confidentiality in Canada. It's a question of time and when this comes I think Vancouver Island Health Authority will be very well served by this benefit and advantage of single bed rooms. The presence of family – one of the most important things internationally for reducing patient stress, increasing overall satisfaction and quality of stay and often for lessening family stress, as well, and we know from much research this is rather intuitively self-evident that visits are relatively, comparatively more and frequent, and much shorter for patients in multi bed rooms where visiting hours are limited, where the family is sometimes not welcome and where there is little if any furniture to support physically their presence. Visits last a lot longer in single bed rooms. What else does that do for patients? As we will see – it reduces falls. If patients' families are in the room for longer periods of time that's been shown to be associated with significant reductions in falls simply because patients are not going to get out of bed unassisted to go to the toilet. So this is important and I think patients will be happier, and their families, with these rooms.

Right now there is a lot of mixed gender accommodation on Vancouver Island and in Canada more generally. This is inevitable – it is unavoidable – most rooms are multi-bed and hospitals are running again – full to the gills – 100 – 103% occupancy and mathematically it's impossible not to have mixed gender. Increasingly, countries, England, for example, Western European countries, are forbidding mixed gender accommodation, viewing this as negative which cuts payments to the hospital where this occurs. It shows up in press and so on. Now it can't be avoided but with 83% single bed rooms it can be because administrators and managers will have much greater flexibility in assigning rooms and experience at many hospitals and documented in many countries. France, for example, has shown single rooms enable better patient flow and efficient use of each bed and thereby there can be greater numbers of patients flowing through a hospital with somewhat fewer beds with better quality outcomes if there are single bed rooms. Less noise, single bed rooms are the most important thing for reducing noise, improves sleep quality, very important for healing, influencing lots of other outcomes, reduced pain and patient stress. Daylight exposure is better. If some of you have been in the hospital, and doubtless, some of you have, in a multi-bed room you can get daylight access if you are lucky and you have the bed next to the window. But if you are next to the hallway forget it. When the curtains are closed, there is essentially no measurable daylight hitting those patients at all and as you will see that worsens outcomes.

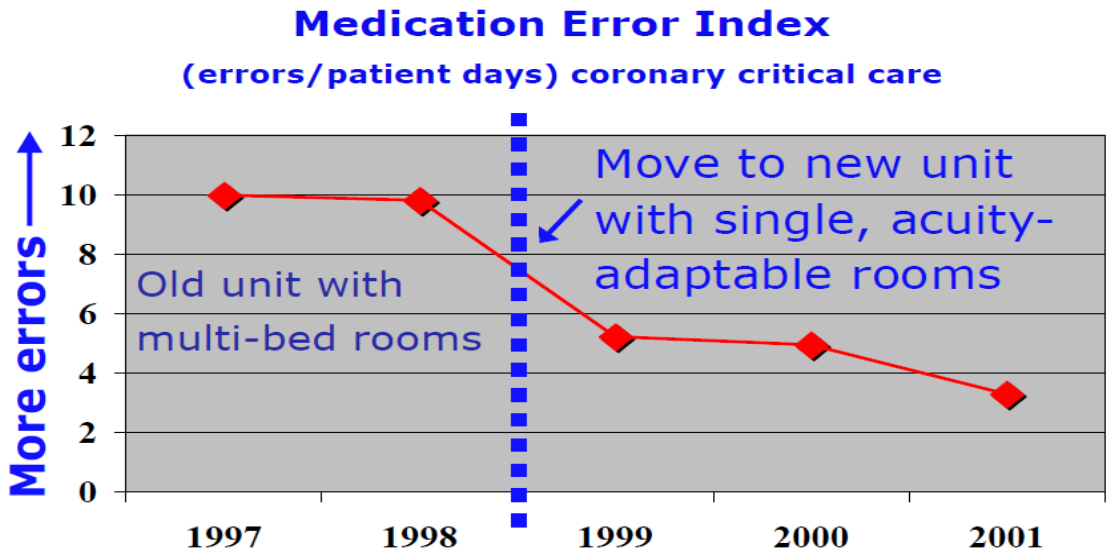
Staff satisfaction is higher, reducing room transfers, managing bed availability may cost a bit more but studies internationally, including in the UK, have shown repeatedly they save all kinds of money in the long run and deliver, as I've emphasized, much better

outcomes. However, you might ask, and there is some intuitive possibility to this, if patients are assigned to single bed rooms predominantly, will they be isolated socially, will they miss having a room-mate, is the benefit of multi-bed accommodation health promoting, stress reducing, social support from room-mates. We have a lot of data from research on this and the answer is clearly no. In England and America more than 90% of the time, 92 or 93% of the time in the States, a room-mate is a major source of stress. Oh yes, it does occur that room-mates get along, a large number of events given the large number of patients but as a percentage it's a tiny minority. Having a room-mate is most disliked in Western Europe and the States by female patients, also by males but even more by female patients, especially if they are younger patients - that is younger than 50. Is that because females are anti-social in different countries compared to most males? No, completely the opposite. One of several key reasons why females really, strongly, overwhelming, consistently request single bed accommodations, especially if they have experienced it once, is that they are more social and they really want to have social support but not from strangers, rather from good friends and family; people who matter to them. Not from strangers. This is empowered in single bed accommodations. Multi-bed accommodations trigger many patient transports which again have many side effects. For example, if one patient gets infected you have got to find another room – someone has to move.

Studies in the States of older hospitals in the 1950/60's with many double bed rooms at least 15% of all transports for all reasons stemmed simply from incompatibility between room-mates. One has considerable pain and keeps the other awake all night; one has a very large extended family that wants to visit and is a stresser to the other patient, etc. etc. So this incompatibility causes many transfers. Why is that bad? Transports are seriously negative in many, many ways. They increase infections, removing beds, mattresses, sometimes equipment and people across spaces and sometimes across departments and units and that is known to be an infection risk for cross infection. Transfers cause medical complications and worsen outcomes. Again, acuity is higher and higher. This is where folks on Vancouver Island go if they are really sick or for super acuity surgery in many cases. The risk of there being negative impacts on patients stemming simply from the experience of transport goes above 80% of all patients experiencing such negative impacts for high acuity clinically unstable patients such as those who are ventilator dependent or those with cardiac instability. The data are grim and the rate, intensity, the frequency of the adverse side effects and outcomes are explained almost completely on two factors, the time duration of the transfer and secondly how sick the patient is – their acuity level. So cutting transports sharply is a way to make patients safer. It also makes patients safer because transports are notorious for causing discontinuities in communication, systems change, staff change, there can be shift changes. Even at the Mayo Clinic in Rochester, NY, one of the safest, best hospitals in the world they were stunned to find that whenever they transported a patient for whatever reason there was a lower bound risk of at least 70% of one or more medication errors occurring. So cutting transports again makes patients safer. Transports involve manual handling of patients and in this way they cause and are known to cause many staff lifting injuries and lost work days.

According to the US National Academy of Medicine or the Institute of Medicine in Washington, each transport requires more than five hours of paperwork, bureaucratic

work, is costly and according to American Hospital Association data, transports in the United States at an average add ½ day to length of stay – and these are just some of the effects. How can we cut transports? First, very laudably and importantly patients will be in single rooms predominantly in the new hospital. But going way beyond that the new hospital is providing acuity adaptable rooms - single rooms. Peer reviewed, scientific medical studies have shown that when the care culture can be organized to be flexible in adjusting between acuities and the rooms are designed with upgraded head walls with gases and equipment and so on that enable very sick patients to be cared for, then such configurations, such organizational architectural – this combination of changes can reduce up to 90 % of all transports. For example at Methodist Hospital in Annapolis (O/H Acuity-Adaptable Single Rooms Substantially Reduce Transfers) when they shifted their Cardiac surgery and Coronary intensive care patients to single acuity adaptable care they cut 90% of all transports, so for instance a patient in the throes of acute myocardial infarction could be initially assigned a single room, it could be upgraded because of the head wall and she or he could be treated with full high acuity surroundings by a team with high acuity training. As the patient stabilized they are not transported to a lower acuity unit. The only time they are transported is, for example, imaging, when necessary. And so the patient is ultimately discharged as they get better and better and more stable, the acuity is flexed down, the staff flexes to lower acuity and the patient discharges and goes home – never having left the room. This saves millions of dollars per unit and in so many ways as we have just seen – makes patients safer and staff safer.



Source: A. Hendrich (2004). In *Keeping Patients Safe: Transforming the Work Environment of Nurses. Quality Chasm Series,* Institute of Medicine

Here is what happened in that unit and these are data from the Institute of Medicine so they are very high quality and have been vetted showing what happens to medication errors as the single rooms the unit is transferred from an old unit and transformed with multi bed rooms to a new unit with not only single bedrooms but acuity adaptable rooms.

Single bed rooms are very important for protecting patients as I have emphasized from infection. Why do multi bed rooms worsen infection control problems and infection control problems are becoming, as I emphasized, more challenging because of the appearance everywhere, not just in hospitals and all countries but in the community increasingly of antibiotic resistant strains? I am going to show you a little scenario, very evidence based, very conservative, of how infection contamination - contamination of surfaces and risks to patients can spread in a short period of time in the adult intensive care unit with an open bay six bed design in this particular case. This is conservative, it has been vetted by scientists, and my collaborator on this is Peter Wilson, Professor of Microbiology and Senior Consultant in Infection Control at University College, London.

Let's imagine, this is a six bed adult general intensive care unit. Part of it and we will say it is empty at the moment and during the weekend we somehow magically completely decontaminate the unit. There will be endemic contamination in an older unit, ventilation systems, and on lots of surfaces even after cleaning. Let's say we bring in hydrogen peroxide vaporization and we inundate this place over the weekend and it's thoroughly clean and on Monday morning on first shift we admit six patients one to each bed. We'll say hypothetically just for our little scenario they are all males, and one of them, the guy over in the right hand bed is an unrecognized carrier of an antibiotic resistant pathogen – we'll say MRSA - very common. One out of the six - an unrecognized carrier – is that realistic? - Yes. When I was with the NHS there were hospitals where there was one out of four patients that was an unrecognized carrier. If it was in the Netherlands or Sweden this would be a lower risk than that. So this is reasonable. By the way, to put this in perspective, a recent study of six East Coast Hospitals in the US found that 58% of people admitted to acute care in six hospitals from East Coast homes – home based care – chronic illness patients and from Nursing Homes, 58% were carrying one or more antibiotic resistant strains. This is conservative. All right. This is a smart unit, people wash their hands at above average levels, say 35 or 40% which is high by international standards for very high acuity which is so demanding people are so preoccupied so busy. So we will assume that doctors and nurses they all adhere to barrier precautions, so for example a nurse tending to a patient out of the view to the left would be assiduously careful not to touch things around other patients who are not her or his responsibility, knowing that there is a theoretical risk that they could be carriers. This unit also has active surveillance and calls for everybody to be tested upon admission. How long does it take to get the results back for the guy at the end? If it is done properly? Internationally, in Western Europe, Australia or America – more than 99% of hospitals take three days for the MRSA tests to come back. All right, what happens – three days, we are not talking three days, we are talking about what happens between 8 am and 11 or 12:00 noon the same day. Two to four hours and this is based on scores of published medical studies in Infection journals. I am going to start some animation and you will see the surfaces glow red. If they are red that means they have a risk of 25-45% of being contaminated with MRSA. That means if a nurse or patient touches them they are contaminated. What is the risk rate, the transfer rate, if for example a work surface is contaminated and a nurse touches it? What is the risk that she or he will then carry that, be hot as well, and can transfer it to a patient? For MRSA smooth surfaces it is over 90%. Work tables, computer keyboards in the UK 55-65% risk (there is not one in the picture), bed

rails higher than 50% in many countries, equipment switches, the curtains this very much understates what would be on the curtains. Curtains are just very contaminated, they are not washed very often and the mere act of examining a patient who is colonized and then the mere act of opening a curtain creates a hot space of contamination.

These new rooms here at Royal Jubilee Hospital will not have curtains and have imbedded blinds and this is very important from the standpoint of reducing contamination. Again this is conservative and I've had it vetted by microbiologists and they have said this is not real – there are actually more risks involved. If we could enter the room with microscopes in our eyes this is what we could see – it's "snowing" MRSA and this snow consists of skin scales that are microscopic that are shed by patients with staphylococcus aureus diseases and this has been known the 60's. They all culture for MRSA. What is the density of this snow? - 4,000 skin scales per cubic meter according to Japanese studies. How far do they drift? If the beds are spaced are you safe? - No. With standard ventilation they drift about 15-18 meters. S o it's a mine field. How can the most careful doctor, the most conscientious professional nurse, provide safe care in this kind of environment? The difficulties are underscored by research findings for example from University of Yale Professor John Boyce and others showing that nurses and doctors who behave very carefully as I've described, if they enter the room uncontaminated there is a risk of about 44% that they will be hot on their hands, their gowns, and elsewhere by the time they leave the room. In an era of antibiotic resistant strains you can see why the world is converting to single bed rooms. They do not eliminate the risk by any means but they do make it more manageable. You can proactively separate patients on admission so you get the culture results back and find out they are in fact OK before they are mixed with other patients. If they are mixed right away it is too late and transmission occurs, that's been shown in studies. If the patients are isolated by the time they get positive test results back it's too late. Transmission has occurred. It's much easier to clean the rooms after discharge and with en-suite toilets there's not only a huge step up in privacy and dignity for patients but a significant step up in safety from such very serious deadly infections as Clostridium Difficile or even Norovirus, the "wild fire", so it's very good news indeed there will be an overwhelming majority of single bed rooms but a host of other factors, very good ventilation to protect patients, hands free sinks, more sinks than rooms, physician, evidence based ways to produce sustained increases in hand washing alcohol gel hand rub dispensers as I've mentioned earlier, far more better positioned surfaces and finishes to reduce contamination and facilitate cleaning and no privacy blinds but sandwich blinds in rooms in the windows to the hallways that will be less of a cleaning and contamination problem. I've emphasized that low hand washing rates are everywhere a problem, not just in Canada. How could it be otherwise? With 100% occupancy, patient sickness levels increasing, staff overworked and preoccupied, some psychologists would say these staff are cognitively swamped. Unfortunately research has shown repeatedly that programs which emphasize education to increase hand washing are often unsuccessful. The results are unsatisfactory, about half the time, internationally there is no increase if we teach nurses and doctors and send them to workshops, exhort them to wash their hands, clean their hands, about half the time there is no effect but half the time there is a big positive effect that lasts about two to three weeks and then it's back to baseline. The good news here, and there is some, is

that recent research suggests that education plus better location, better human factors, and the placement of hand washing resources does much better than education alone in terms of creating consistently substantial increases that are sustained or permanent and you will have these good locations in the new facility.

Falls are on the rise. They are a major problem in the current hospital and for VIHA. They are everywhere, falls are the number 2 source of cost in many high acuity hospitals internationally. Why are falls increasing? The falls underscores the vulnerability of patients increasing because patients are getting older and frailty is a major risk factor. Patients are sicker, more patients have dementia - a major risk factor and more patients are taking certain drugs which heighten their risk for falls. The result is kind of a perfect storm of things coming together. So designing to reduce falls and organizing the culture to be safe in reducing falls is of great importance.

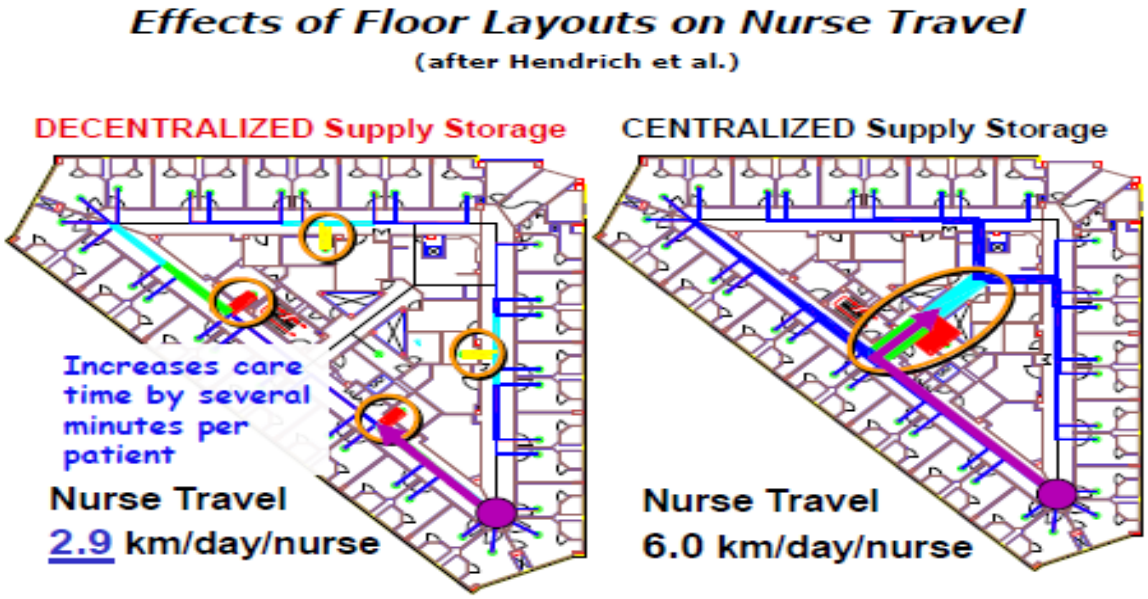
Ceiling mounted lifts are being provided to the toilets. This is cutting edge by world standards to help reduce patient falls and very importantly, reduce the single major staff safety problem, if you take an international factor, tends to be staff back injuries. There is a novel design to the rooms which enables the patients to have access to the en-suite without ever walking unassisted by hand rails. We'll see this. Wide doors that permit two staff to be on each side of a patient as they enter an ensuite. Traditionally narrow doors are not only unsatisfactory from an accessibility standpoint but they pruned off one of the assistants. With the increasing number of obese patients in all countries, especially Eastern Canada, especially the US and Britain has caught up the US and has closed the obesity gap. This has meant that, for example we now have video tapes of nurse injury occurring when the nurse is pruned off in assisting a heavy patient trying to get behind the patient as they walk through the door in a position that seems perfectly configured to inflict serious back injury.

Surfaces and finishes and colours that make it easier for older adults to distinguish floors, to see the toilet. Amber night lights aid night vision. A host of interventions that will be very important.

There will be a host of very important features to increase staff effectiveness and care and their satisfaction. Staff burn out, turn over, and attrition are major problems in all countries. Design can help. It is not just management it's design of better workplaces that can contribute to lessening this problem.

Decentralized nursing stations, for example. Here are some data from the Institute of Medicine, it's a US study and happens to be a California Hospital, a few years ago. Just to illustrate how conceptually, actually, fairly simple some of these ideas are. Traditional wards consisted of long corridors often double loaded, that is patient rooms radiating on both sides and traditionally the nursing station being very centralized with say clean supplies and soiled supplies also centralized there. This meant that if a nurse needed to see a patient at the end of the hallway and a patient called the nurse and a nurse would have to run all the way down and you can observe this happening – it's been measured a lot in different countries. And then you can see her running back to get a glass of ice and then running all the way back down the hallway and then all the way back to the Central Nursing Station and you wonder is that really necessary, isn't

that kind of wasteful use of nursing time and that nurse must get awfully worn out by the end of the shift. Where the data internationally, especially from the UK indicated in such traditionally designed units, the average walking by nurses per 8 hr shift in inpatient units ranges from 12 to about 20 km per 8 hr shift. That's fatiguing but it also shouts loudly that's a lot of time taken away from direct patient care activities.



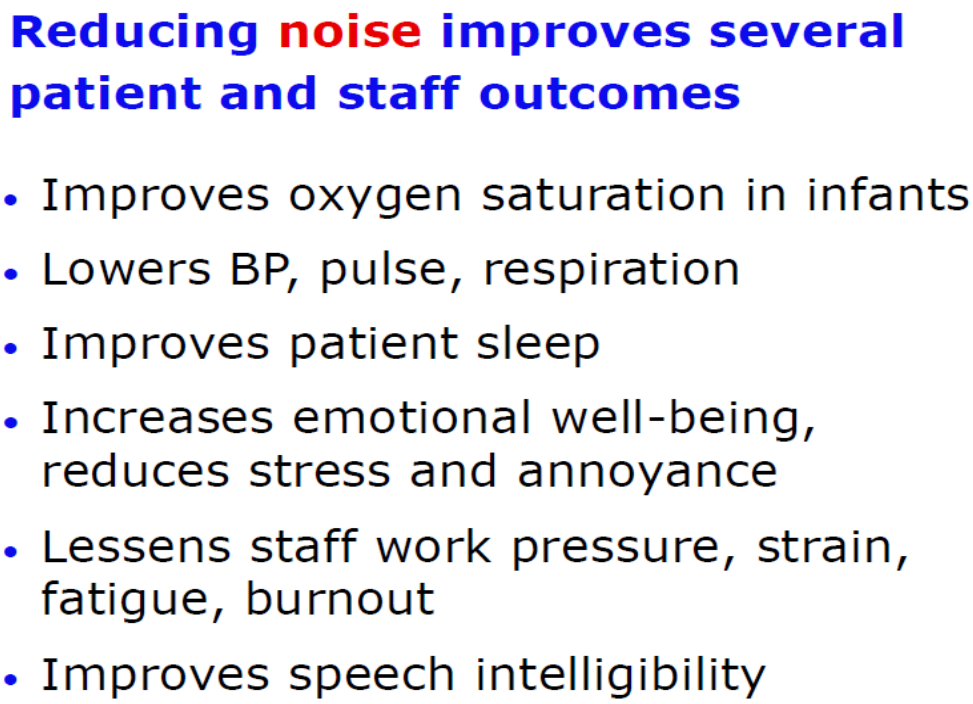
Well here is a well designed unit with single beds and the purple dot indicates a little localized nursing station responsible for four patients, and the lop in the middle is where the supplies are stored centralized; and this is a well designed unit and results in 6 km per day of walking per nurse and these consist of innumerable trips back and forth to the central supply location. Now we'll make one small change. We'll take the same nurse, same patients, same everything, same supplies, except we'll somewhat localize the supplies in four closer locations. This simple gesture halves the travel time, or the travel time and distance for an 8 hr shift and in doing so it increases the actual direct care time each patient receives from that nurse by several minutes per shift. In this way taking it to a more extreme logical design expression it's possible to come up with these comparatively traditional units of travel with much less care time received by patients.

Traditional vs well-designed floors: Effects on nurse effectiveness

- *Travel:*
  - Traditional: 10-18 km per day
  - Well-designed: 2-5 km
- *Care time* received by each patient:
  - Traditional: 16-24 minutes per shift

Actually 16 min has been beaten out by 12 and 14 min figures for being bad in a number of countries. When care time increases all votes go up, patient safety, patient outcomes and generally staff satisfaction. The Institute of Medicine, paramount scientific institute for medicine in the US, has coined the term some years ago for wasteful nurse travel and behaviour called “Hunting and Gathering” – it’s wasteful fetching. The same term is used by NHS. In traditional units, Hunting and Gathering, measured by many countries accounts for 40% of all nurses time. A recent study by the Royal College of Nursing in England in the UK suggested its 46% in Britain. Surely we can do better and your new hospital will do much much better. Nurses will be more decentralized, supplies will be more decentralized, walking will be less, there will be more care time and less fatigue, more satisfied nurses.

Noise reducing design features. There are noise absorbing features in the rooms and certain classic, rather needless noise sources and quite annoying ones measurably for patients, such as over head paging will be eliminated. Noise is serious and these are just some of the negative effects as revealed by over 200 published studies. Focus on an example of a baby in the Neonatal Intensive Care Unit - very fragile, premature. If there is a noise emitted in the room, even a low one up in the decibels in the 50s, like my voice if I am talking without a microphone to a friend two feet away - my voice would be about 63 or 64, so 58 is not a loud noise. Right away, almost in real time, you see decreased oxygen saturation in the infant. If the noise continues or goes above 60 then the risk for having to administer oxygen therapy goes up like this.



The mechanisms are well understood. For adults and pediatrics patients, reducing noise lowers blood pressure, pulse, and respiration in good ways, clearly improving patients' sleep, improves emotional well being, and lessens staff work. Pressure and high noise levels over time have been linked to the major problem world wide – nurse burn out. Here is an example of what lessening a noisy unit can do in terms of improving outcomes. My colleagues and I – I do much of my research in Sweden at the Karolinska Institute of Medicine Technology in Stockholm. We studied the effects of lessening the effects on 94 Swedes in the throes of acute MI. These were taken to the Karolinska Hospital in Stockholm and worked up in the ED, taken upstairs several floors to a dedicated Coronary Intensive Care Unit where the research team, a group of us mainly from the Karolinska, including two Cardiologists and myself. All we had done was to have previously arranged with a firm to install a slightly suspended acoustic ceiling which you see as indicated by blue eclipse. That actually created better acoustics than the original condition and we asked the company to make two types of ceiling tiles. One was OK and cheap and the type of acoustic performance that absorbed some noise but mostly reflected noise, but of the ceiling tiles installed internationally they are typically about this effective. The patients when the good ceiling tiles that cost more were in place they systematically had lower physiological stress levels for example lower blood pressure their whole stays, they slept better, they felt the quality of care was much better and the nurses agreed. They were more satisfied with their stays and our two Cardiologists understand this lowers blood pressure and understand the mechanisms, they can confidently expect that the patients treated with the good ceiling tiles, because they healed better they have had a better course during their stay and will be at less risk for emergency rehospitalizations. Rehospitalizations in this group often reach 30% or more internationally. Is rehospitalization cheap? – No - you have to start all over again; work them up in the ED, set them up, care for them. Rehospitalizations were way down for those treated in the less noisy conditions.

The Chief Financial Officer at the Karolinska Institute did a cost analysis on payback time. If the entire Cardiology ward was upgraded how long would it take to save enough money from improved outcomes to pay for the better ceiling tiles? They were very conservative - it was one month maximum. This recurs over and over again, this is an exceptionally fast payback time, there are lots of one year, two year one month pay-back time for outcomes This is why it makes compelling financial sense and you save a lot if you spend a bit more on evidence based upgrades for a really good hospital in the long run.

Daylight reduces depression, reduces pain. For example, a seriously depressed patient in a study has been replicated in Canada, Alberta, by Dr. Peter Hay and Dr. Katherine Bosimie with very similar results. Those with higher sun/daylight exposure have significantly shorter stays. The evidence is so strong, for depression it has become routine internationally to require more light for patients experiencing depression such as in this new high acuity, locked psychiatric facility in Sweden.

Nature has been shown in scores of studies, many of them randomized perspective trials to effectively and speedily reduce stress and reduce pain. Abdominal surgery patients randomly assigned to beds in rooms that were identical to those of other matched patients, the same surgery, the only difference being that some of them had a

brick wall view and some had a view of trees. Controlling for factors such as age of the patient,, their previous history of health, their doctor and so on. Those patients with the window view of nature were in less pain and had shorter stays, fewer minor complications such as persistent headache and nausea, and better emotional well being. What happens when you take traumatized family members of patients into a real garden?

We studied the sum data of 22 traumatized parents with children with cancer, some of them terminal, so these parents were in fundamental respects patients themselves. We studied them on two days, two different days, and one day half of them were taken individually to a garden where they rated their feelings and spent some time relaxing. Two or three days later the same individual was taken to a comfortable indoor lounge with good light, no nature, magazines, a nice place; not crowded or noisy. The other half were first taken to the lounge and then to the garden. Every single person compared with themselves did better in the garden. Every single person! You don't have to really – well this is data and there are lots of these kinds of data and maybe there is a real reason you like the look of the sea in the summer time or go out to the Islands in your boat. And Vancouver Island has incredible advantages compared to Western Europe or many parts of the States with respect to creating views with not only light but in hospitals to come, fantastic views of nature which really are therapeutic. So here is a stress reducing view of nature in the garden ingeniously designed for high security, high acuity psychiatric patients that can be kept under close observation at the same time by staff. Hospitals now often have 100% window views of nature.

Many studies using a published randomized control trials - this eccentric study published in a major medical journal in Hong Kong. Interesting way of course residents of Hong Kong – very high density, little experience with nature as compared with patients in Canada. Would nature be healing? Here is what that study consists of.. That a fellow is actually going through full colonoscopy awake - usually general Anesthesia. He has been given a controller and there are lots of feedback things attached to him and there is Anesthesiologist. This is patient controlled and one/third of the patients are randomly assigned to have virtual reality goggles where there is nothing on. These patients just tap the sedation to put themselves promptly to sleep as the data indicated. One third of the patients were randomly assigned to take an animated walk through the woods – those patients tapped the sedative far fewer times and two or three kind of staggered through the whole procedure in a semi-awake state, most were asleep by the end. The third group was given both the walk through the woods and the sound of the birds and the breezes, the sounds of nature a more engrossing immersive distraction that is know from pain therapy to be more effective. The greater the distraction the greater the bang in reducing pain. They had the fewest taps and most made it through conscious. Distraction matters. Emotionally positive distraction matters and much research on arts, nature shows that these will be wise investments in terms of improved outcomes and reduced costs in the new hospital. You see the Swedes taking advantage of different mechanisms to reduce pain stress and depression, providing direct views of nature and well lighted ones at that, and you will have nature in your new building. Thank you.