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Chair

Mrs. Joy Smith

Standing Committee on Health

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● (1100)

[*English*]

The Chair (Mrs. Joy Smith (Kildonan—St. Paul, CPC)): Good morning, ladies and gentlemen. I now call the committee together. Pursuant to Standing Order 108(2), we're studying technological innovation.

We have a special guest with us today. My grandson, Matthew, is here, sitting at the side.

An hon. member: Imagine that.

The Chair: He wants to take in the committee. My daughter also is here today. She's just coming through the door. They're joining us for the health committee.

I would like to welcome everybody here today. I know that we have a very busy day. I want to tell our witnesses there's a possibility there could be bells ringing at some point. My apologies in advance for that, but if the bells ring, we have to go back to Parliament and vote.

We have some very prestigious people today. From the Public Health Agency of Canada, we have Dr. Frank Plummer. Of course, everyone is well aware of who Dr. Plummer is. He's made a huge contribution to our committee and to health in Canada.

By video conference, from Vancouver, British Columbia, we have Dr. David Huntsman, professor of pathology and medical director, Centre for Translational and Applied Genomics. By video conference from British Columbia as well, we have Dr. Marco Marra, director of the Genome Science Centre.

Can you hear me very well, Doctors?

A voice: Yes, we can.

The Chair: Great.

We also have with us Dr. Warren Chan, professor at the University of Toronto. We're very pleased that you're with us.

A couple of other people will be joining us, I believe. Dr. Normand Voyer, professor, department of chemistry, from the University of Laval will be here shortly as well.

So we have a full house today.

Again, as you are aware, there are votes being set up right now, so I'm sure we'll have bells ringing before the end of committee. In advance, I would just like to apologize for the interruption, but we'll make a decision then on whether we'll be back, depending on how much time we have left.

I'm going to begin with the video conferences.

Dr. Marra and Dr. Huntsman, I know you're from two different organizations, but I'm going to start with Dr. Marra, from the BC Cancer Agency.

Can you begin, please, Dr. Marra?

Dr. Marco Marra (Director, Michael Smith Genome Sciences Centre, BC Cancer Agency): Thank you very much for the opportunity to address you today. I understand you're interested in hearing about the nature of our research: success stories, challenges, and recommendations.

I'll begin by providing a very brief history of the BC Cancer Agency Genome Sciences Centre, which is the entity I direct.

The Genome Sciences Centre was established by Doctors Victor Ling and Michael Smith in the late 1990s with a vision to develop technology to the point where routine decoding of cancer DNA would be possible. At the time I joined the effort, around 2000, there were something like a dozen employees. We went through a period of capacity-building and reputation-building over the next few years and the next punctuation mark in our development came, I would say, with the sequencing of the SARS coronavirus in collaboration with Dr. Frank Plummer, who is there with you today, and Dr. Robert Brunham at the CDC, and other folks too. Why that was significant in the context of our current work is that it established that DNA sequencing could reveal the enemy, if you will.

Capacity-building continued and in 2006 and 2007 we became one of four international early access sites for a new brand of machine, a new type of next-generation DNA sequencer. This DNA reader is capable of reading all the letters in the human genome at vastly increased rates. At that time, the price for a human genome was in the order of $75 million. Fast-forward to today. We are a leading international centre with the capacity to do something like 3,000 accurate human genomes annually and with world-leading computer infrastructure. Right now at our centre at the BCCA we have 60 teraflops of computer capacity operating, as well as 7,000 computer cores, and seven petabytes of disk space, with the cost of an accurate human genome now less than $5,000 and dropping.

In the last five or six years, we have seen the cost of a human genome sequence decrease from $50 million to $5,000 today, and around the world many have recognized the kinds of things that could be done with cheap and accessible DNA sequencing.

Today, principal investigators at the Genome Sciences Centre are involved in 392 projects, which total something like $590 million in research funding. Currently active are 110 projects valued at $248 million to the end of 2016, and 543 additional collaborations: 358 of those local, 83 pan-Canadian, and 101 international in scope.

Funding sources are a big deal. We spend between $20 million and $25 million a year, and we have to raise all but $1 million of that through grant applications, both Canadian and international. Our current funding distribution is 75% Canadian and 25% from the U.S.

Significant funders of our operation include Genome Canada, Genome British Columbia, CIHR, the National Institutes of Health, and the Canada Foundation for Innovation. This leads me to some of the challenges we face in the operation of our centre. Our centre is meant to be a highly collaborative entity, and in fact Dr. Huntsman, who is sitting here with me, and I work very closely together and will continue to do so as we use this kind of technology to unravel the mysteries of cancer.

● (1105)

In order to operate a centre such as ours and maintain the broad collaborative base that I think benefits us, and indeed the people who work with us, continued access to large-scale funding is absolutely essential. We applaud the existence of Genome Canada. We are encouraged that the Canadian Institutes of Health Research are also supporting genome science. We are grateful for access to the National Institutes of Health funds, which, over the years, have resulted in more than $135 million coming into B.C. for our operation. Without the CFI, the Canada Foundation for Innovation, we would have no access to leading-edge technology. We are truly grateful and thank all of these organizations for their continued support of genome science.

We would very much like to emphasize that a long-term commitment to keeping infrastructure current and at the leading edge is absolutely required for the success of large-scale activities like ours, and for success in the new era of personalized medicine.

CFI does an amazing job of making opportunities available, but we would like to recommend that the frequency of those opportunities be increased. In some instances, DNA sequence instruments may not compete with icebreakers for funding. We're less impressive than an icebreaker, I guess, but that's the kind of competition we find ourselves in sometimes.

This brings me to personalized medicine, which I was asked to comment on. As DNA sequencing costs have decreased, groups around the world have recognized the ability, or the imperative, to apply this technology to try to understand the molecular signatures in cancer and to develop more effective therapies.

We were one of the first in the world to publish, in 2010, our early observations on the use of DNA sequencing to treat a rare cancer. I'm pleased to report that we are engaged right now, in collaboration with Dr. Janessa Laskin here at the B.C. Cancer Agency, and Dr. David Huntsman and others, in an ongoing effort to more systematically apply the technology to try to understand—in poor-prognosis, treatment-resistant disease—how we might better use the resources of the health care system.

The project looks very much like sequencing DNA, finding mutations and other errors of the genetic code in the cancer, and then positioning those mutations and errors against existing drugs to try to find new drugs or new drug combinations that might benefit the patient. We think this is an entirely sensible thing to do, but it turns out that there are many roadblocks.

One of the biggest roadblocks for us is not the technological hurdles, but rather access to drugs. When we find a new drug combination that we think a patient should receive based on her molecular profile, that drug, in all likelihood, is not indicated for that condition. This leads to some roadblocks in trying to get new drugs for patients. In a discussion last night with an individual doing similar work in the United States, at an organization called TGen, it was interesting to note that they had experienced exactly the same stumbling blocks.

Perhaps this is something the committee would care to consider: in this era of personalized medicine, how do we make the latest drugs available to patients whose molecular profiles indicate that they might benefit?

That's the end of my comments. Thank you.

● (1110)

The Chair: Thank you very much, Dr. Marra. They are excellent comments. We've had some really good, new information this morning.

I'd now like to ask Dr. Huntsman to speak.

Dr. David Huntsman (Professor of Pathology, Medical Director, Centre for Translational and Applied Genomics; Director, OvCaRe, University of British Columbia): Thank you for the honour of speaking with you today. As Marco indicated, I work very closely with Marco and I, like many of you, wear several hats.

I run our ovarian cancer research team and we've managed to make huge progress in British Columbia in the understanding of this disease by having access to the infrastructure, which Marco and his colleagues have built. We've managed to find the mutations that drive and underpin several types of ovarian cancer, which has immediately led to new diagnostic strategies, and we're working on new treatments.

I also run the Centre for Translational and Applied Genomics, which takes our genomics discoveries and sort of beats them into clinically usable diagnostics, which we hope then to be able to translate and transfer to the laboratory communities not just in Canada, but internationally.

The last thing I'm involved in is the British Columbia personalized medicine initiative, which I'll come back to at the end. The personalization or individualization of disease control is something that is of great interest, because it's the only way we can move things forward at this point. Genomics is really the harbinger of high-content medicine. Our goal is basically to improve decisions. The vast majority of medical decisions are very much like putting on a blindfold and throwing a dart at a dart board. The people making the decisions don't have the information they need to make a refined choice for their patients.

As we move forward into more personalized medicine, we may wonder why genomics and also why cancer and microbiology? The reason that genomics is coming first is that DNA, as many criminals have discovered, is very difficult to destroy and nucleic acids are easy to study, and we can use digital technologies such as the amazing sequencing tools that Marco and his team have led in their implementation to decode cancers.

Everything we learn about how to use genomics could be applied to proteomics, metabolomics, and any other way of looking at biology in a deep and broad fashion.

Cancer and microbiology will always come first and this is why I think Dr. Plummer is here with us, because these are the two diseases where you can remove diseased tissue and you can actually look at the genome of the entity that is causing a problem—cancer or some micro-organism—and study it as being separate from the host. We're learning things in cancer that we hope will be applicable across medicine.

The discoveries we're making and the things that are coming into the clinic should improve both cancer control in terms of cancer susceptibility and also, as Marco suggested, treatment, a trial of on-the-fly whole genome sequencing to help patients, one patient at a time. But this is a very special project and it's strange. Even though this is something that we're all invested in and we're trying to figure out how to use the information, it's hard to argue that our genome sequence, as in our full genomes, won't be some kind of base part of our health care records in 20 years' time or so. How are we going to get there? If health care in Canada is going to keep up with the rest of the world, we'll have to find a way.

We don't have to do this just in tertiary care settings. If we're really going to make a difference, we have to make a difference where most decisions are made, that is, even though we may start in cancer clinics and other academic enterprises, we have to move this process into primary care. And this is where the BCPMI comes in, where we realized in British Columbia that although we look for successes in the diseases we study as individuals, the challenges we face are shared across the whole of medicine, such as some of the ethical, legal, and social challenges of changing the way health care is done.

Genomics isn't the only underpinning; bioinformatics is the other. And if we're going to use information to improve clinical decisions, we have to improve the informatics not just in research centres, but also in decision tools in primary care as well. This is going to take a culture shift, but also a major change in the way we educate all types of health care practitioners.

At this point I would also like to echo my gratitude to the Canada Foundation for Innovation, in particular, because if not for their initial investments into the Genome Sciences Centre, none of the fantastic work that has happened in British Columbia over the past few years would have been able to occur.

● (1115)

Also, I suggest that we have to not just fund the infrastructure but also fund the projects—which have to be peer reviewed— that are going to use these infrastructures, such as the continued support of CIHR. If we are going to improve our health and also have a healthy economy, these are key things that we are going to have to accomplish.

Lastly, I would like to echo Marco's last comment. If we are going to personalize cancer care and personalize the care of other decisions, we have to rethink the way that evidence is perceived in making the decisions to approve drugs. The large phase III clinical trials, which were the mainstay of approvals over the past few decades, will not work for personalized medicine because we're shrinking things down into $n = 1$ treatment opportunities. There's nowhere you can do a phase III trial to assess that.

In every part of the pipeline from basic genomics through to validation, through to implementation in laboratories and clinics, into regulatory bodies, we are all going to face challenges. I think the potential benefits for our patients and the health of the nation—if we embrace these challenges and start supporting teams that are taking avant-garde approaches to restructuring around high-content, personalized medicine—will be massive. There's an opportunity for Canada to be an international leader moving forward. I know Marco and I are both really excited about the possibilities of participating and playing a leading role in that process.

At this point, I will be happy to end. We can both address any questions you may have.

● (1120)

The Chair: Thank you very much, Dr. Huntsman. We very much appreciate the collaborative approach you are both taking and your very insightful comments.

We will now hear from Dr. Frank Plummer. Of course you know he's the chief science officer and the director of the National Microbiology Laboratory.

Welcome again, Dr. Plummer.

Dr. Frank Plummer (Chief Science Officer, Scientific Director General, National Microbiology Laboratory, Public Health Agency of Canada): Good morning, ladies and gentlemen. It's a pleasure to be here. I thank you for the opportunity to talk to you today about how we use technologies.

We live in a remarkable time when it comes to technological advancements. Within the lifespans of most of us, we've gone from marvelling at a man on the moon, to people living on a space station; from computers that filled huge rooms, to having the world in the palm of our hand; and from the discovery of DNA, to being able to sequence a whole genome of an organism in a very short period of time.

To further illustrate this point and the rapidity of progress, in 2003, the genetic fingerprint or sequence of the SARS coronavirus was done in collaboration with the B.C. Genome Sciences Centre and the BCCDC , in less than two weeks, which was a remarkable feat at the time. By 2009, when we were in the middle of the H1N1 epidemic, it took us just a couple of days to sequence the pandemic H1N1 virus, and it would be even faster today.

These tools are extremely important in our ability to respond to infectious diseases. By various estimates, there have been between 35 and 50 newly discovered viruses and bacteria over the last 40 years. Some of the things we worry about a lot today, such as E. coli 0157, HIV, and so on, we didn't know about when I started medical school. These are all either newly discovered or new to humans. We have every reason to believe that more and more of them will be discovered. The rate of these new diseases happening is about one a year or so.

Why are these threats increasing? There are a number of reasons, including ecologic changes that make it possible for carriers of infections such as mosquitoes to inhabit new areas. We have dengue hemorrhagic fever, for instance, in Florida, for the first time in many years. There are also human demographic and behavioural changes: people becoming more concentrated in cities and moving away from an agricultural subsistence life; people moving into previously unsettled areas; and globalization, where the incubation time for most, not all, infectious diseases is less than the time it takes to get from point A in the world to point B.

We also have rapid growth in technologies, including health technology, which in spite of the improvements that they bring to our health also present new threats sometimes. And there is microbial adaptation and change; these bugs change much faster than we can change.

Infectious agents are an excellent example of Darwin's theory of evolution; it happens in a very short period of time with them. They are innately designed to adapt for survival by constantly evolving to beat human interventions. They have sex lives. They exchange genetic material, giving them new properties we haven't seen before.

We are kind of like the Red Queen in *Through the Looking Glass*. We need to run faster and faster to stay in the same place, to stay ahead of these threats. One of our biggest challenges in the public health realm of infectious diseases is to try to anticipate what's going to happen next. You can't really anticipate the specifics of it, but you have to be ready for pretty much anything.

I'll talk about five tactics that we use within the Public Health Agency and beyond to try to deal with these threats.

Tactic 1 is the rapid detection and alerting of infectious diseases. The Public Health Agency of Canada has a number of tools at its disposal for that, including some we developed ourselves to fill existing gaps. An important one is the Canadian network for public health intelligence, or CNPHI, as we call it. It's a secure, web-based system that compiles information from various surveillance platforms and issues alerts to users. We can use information, such as over-the-counter sales of antidiarrheal medication to detect aberrations. It doesn't tell you what is happening exactly, but it tells you that something is wrong. This was developed by the agency staff, and we currently have more than 4,000 public health officials across the country using it on a daily basis.

These tools also help us to determine the existence and extent of an outbreak through recognition of related cases across jurisdictions. This was used extensively during our response to the XL Foods E. coli issue a month ago or so.

● (1125)

Tactic 2 is rapid containment at source. Sometimes it's not possible to send the specimen to the lab, so we've developed a strategy for sending the lab to the specimen. Sometimes it's more expedient to send our people, with the necessary technology, to the site of an event rather than sending samples into the lab.

We've developed two very unique mobile laboratory systems. The first is a lab on a truck. This is a high-tech level 3 infectious disease laboratory that can travel to sites such as the Vancouver Olympics, and the G-8 and G-20 in Ontario, to monitor for acts of bioterrorism. Some of the work we do includes air sampling and testing of suspicious packages at such sites.

The other lab is kind of a lab in a suitcase, about 13 pieces of luggage that can be checked on a passenger flight. We respond to diseases such as Ebola in Africa. We recently had a team in the Democratic Republic of the Congo responding to an Ebola outbreak.

This is technology that has been adapted by our staff so they can safely work on specimens that may contain these agents. It allows the provision of rapid diagnostic tests at the site of outbreaks in the remotest areas of the world. This unit has been deployed to Angola, the Democratic Republic of the Congo, Congo, Kenya, Iran, and various other places.

It's really revolutionized the way the World Health Organization responds to an outbreak. You can imagine that getting a turnaround for a diagnostic test in two hours instead of two weeks, which was previously the case, makes a big difference to what you do on the ground in these situations.

Tactic 3 is using viruses to fight viruses. Our lab in Winnipeg is using the latest genetic engineering technologies to create new ways of developing vaccines. We're working on HIV vaccines and universal flu vaccines, but our most significant breakthroughs have been with two Ebola vaccines. In both cases we've used another virus, a virus that's harmless to humans, to deliver Ebola proteins and Marburg proteins to the body, basically fooling the immune system into thinking it's seeing the real virus and resulting in pretty robust immunity.

We're working with the private sector to commercialize these vaccines, which will have potential application for preventing biological warfare and responding to epidemics and accidental laboratory exposures.

Tactic 4 is using high throughput machines to understand genetics. Understanding the genetics of a virus as well as those of hosts, such as humans, helps us to identify further recurrences of the same outbreak, to create vaccines and treatments, to understand where the virus or bacteria originated, and in the case of a host, to understand how people become infected and why some people are susceptible when others are not.

This strategy was used extensively during the listeria outbreak in 2008, and also more recently with the XL Foods E. coli outbreak.

I've mentioned the technology we have in place for rapid genetic sequencing of viruses and bacteria. To complement that, we need capacity in what's called bioinformatics, which Dr. Marra and Dr. Huntsman have already referred to.

It is easy to generate large amounts of data these days, but understanding it is a huge challenge. We have a cutting-edge bioinformatics group that can analyze massive data sets using more than 1,200 central processing units and 250 terabytes of storage—not quite up to what Dr. Marra described, but pretty good.

In fact, this technology is so advanced that the Centers for Disease Control and Prevention in the U.S. came to us when they needed assistance in analyzing the genomes of cholera bacteria from the outbreak in Haiti.

Tactic 5 is using systems biology to understand infectious diseases. I mentioned the genetics of a host a moment ago. When we talk about hosts, usually we're talking about humans. Understanding our own biology and the interactions between biologic systems has provided a wealth of information related to understanding infection by pathogens such as HIV and influenza.

● (1130)

The agency has done considerable work in this field. We're hoping it will lead us to the key that stops the HIV pandemic altogether. There's a lot of hope being placed on drugs for HIV these days. Drugs are very important, but I don't believe we'll solve the problem with drugs. We need the vaccine.

These are some of the key tactics we use to stay ahead of outbreaks. I would like to talk a bit about some other ways in which technology is advancing public health.

We hear so much about social media these days and the impact it can have on opinions and the course of events. This technology presents, too, an opportunity along with a threat. New health threats arise because of these kinds of technologies. For instance, it has helped to promote the spread of sexually transmitted diseases. But social media can also be used for health promotion, for intervention, and potentially early warning purposes. During the H1N1 pandemic, the Public Health Agency used social media in its efforts to reach out to people through such tools as Facebook and Twitter.

With the time we have today, I've only been able to touch on some of the latest technologies using a few examples. From what you've heard, though, I think you'll agree that in a highly technical field where innovation is essential, the Public Health Agency is at the cutting edge of using these kinds of tools for public health.

Thank you.

The Chair: Thank you very much, Dr. Plummer. As usual, it was a very helpful and insightful presentation for our committee.

Now we'll go to Dr. Warren Chan.

I understand, Dr. Chan, you have a PowerPoint presentation. Are you all set to go?

Dr. Warren Chan (Professor, University of Toronto, As an Individual): Yes.

The Chair: All right.

I must say to the committee, before Dr. Chan starts, that I've combined the two, genomics and nanotechnology, and we are now going into the nanotechnology part. I did that because, as you know, the bells are going to ring, and I wanted to make sure our presenters had a chance to give all of their information.

My apologies in advance for having to combine the two topics, but it was necessary to do that.

Please begin, Dr. Chan.

Dr. Warren Chan: I'd like to start off by thanking the committee for inviting me here to talk about nanomedicine and nanotechnology.

I'd like to start off by describing that nanotechnology is essentially an enabling technology that allows you to do different types of applications. We see nanotechnologies in making faster computer chips and thinner screens, as well as in the treatment and diagnosis of diseases.

Right now Canada doesn't have a major focus in nanotechnology research and development, compared to a lot of different developed countries in the world. To give you an example, right now, 16% of all publications that come out of Singapore have some aspect of nanotechnology. South Korea, China, and all the countries in Asia are actually putting a lot of emphasis on this.

In terms of the application of nanotechnology to medicine, the big driver in that particular space is actually the U.S. They started a cancer nanotechnology program about 12 years ago, which has now spun off seven cancer nanotechnology centres, and continue to produce new types of companies and clinical trials for new types of drugs.

I thought I'd spend this 10 minutes talking about what nanotechnology is, and why it's important. I want to describe that because nano now has become an interesting buzzword. You see it in tons of movies, always relating to villains trying to change some structure or something to become more villainous, right? Nanotechnology is a very interesting and growing research field.

The first thing I want to define is what nanotechnology is. There are actually three or four definitions out there. The U.S. has one, Japan has one, and the U.K. has one. The one I like is the British Standards Institution's definition, which essentially refers to nanotechnology as the intentional design, synthesis, characterization, applications of structures, devices, and systems by controlling size and shape in the 1 to 100 nanometre range.

To give you a perspective of what that size range means, if you look at the diameter of your hair, that diameter is 1 to 10 micrometres. Nanotechnology is about 100 to 1,000 times smaller than the diameter of your hair. It's very important that we work with materials in this size range, and the real reason is that you can tune the properties of the material. In the traditional method, if you want to make a new material, you have to start off with a synthesis and you basically have to make a new compound each time you want to make something with a new property.

The unique thing about nano is that in order to make the material with a unique property, all you have to do is change the size or the shape of the material. Something that is very small versus large; they have very different properties, but the method of manufacturing is exactly the same. It allows you to have a lot of raw materials.

I'm showing here the real crux of nanotechnology, and this is what drove the U.S. to put about a billion dollars in this for various applications. A good example is gold. All of us have gold jewellery and it looks yellowish, right? But if you look at gold at the nano scale, it's not yellow, it's actually red. The colour is actually different tints of red as you start changing the size of the material.

If you have something that's very small—for example, one atom or three atoms—the colour of that material looks white, so you can't tell the difference. But if you have something that's very large, 19 atoms to 26 atoms for example, it looks red. You can't tell the difference. At the 1 to 100 nanometre size range, you can change the colour of your material by changing the size, so something that is 6 atoms might appear blue, something that is 12 atoms may appear green, something that is 19 atoms will appear red.

If you have your gold jewellery, if you make it bigger and bigger, it still looks yellow. But if you start shrinking to the nano scale, it looks red, more red, sometimes orange or green, depending on the size of the gold you're working with.

The unique aspect of nano is the tunability and creation of large amounts of raw materials for a variety of applications. As I mentioned, you can tune the optical properties of material, tune the magnetic properties of material, and tune the electrical properties of material. That's why nanotechnology is very commonly used to make better electronics, because these are all electronics-related.

I have an example of five different vials of what are called quantum dots. These are nano crystals made of cadmium and selenium. They were initially made in the 1970s by the former Soviet Union as a way to create more energy for bombs and for biowarfare, but what ended up happening is that all the new Christmas lights that you might buy at Walmart have quantum dots in them. The new LCD screens from Samsung now contain quantum dots because they give better resolution. This is what this is starting to move to.

● (1135)

These five vials are the exact same materials, cadmium and selenium. The only difference is that the green is three nanometres and the red is six nanometres; that is the only thing we've done. The reason that at that size you have tunability is that you force the electrons to behave in a certain way. That is the crux.

If you look at the gold particles shown on the right of this slide, they look like loose spherical particles under a microscope. It is basically a hard metal that you chip, so it looks like a small size.

The next picture shows what scientists can actually make of nanomaterials now. You can see that you can make little structures. These are called nano rice, a nano star, nano cubes. Whatever shape you can see with your eyes on the global scale, you can make in the nano scale now. It took 20 years to perfect strategies to make these particular materials. Because you make them in different shapes and sizes, you can now tune the physical properties of the material. Again, there are a lot of different raw materials.

In the last seven or eight years there has been a focus on nanotechnologies to solve some of the medical needs at this point. I'll give you some examples.

The way you can think about it is that nanotechnology is essentially an enabling tool to solve some of the issues associated with cancer therapeutics and diagnostics as well as to detect infectious disease. It's also starting to evolve into vaccine developments and is being used for cardiovascular detection. I'll explain how it's being used.

It has a broad range of applications. Many interesting researchers are trying to make what are called theranostic agents: can you make a nanostructure, inject it into the body, detect the disease, and as it detects the disease slowly release the drug to try to treat the disease? It is based on the ability to detect and sense the local environment in order to tell it what to release and how to treat the system. This is a new concept that's starting to come into play.

As I mentioned, the big push in nanomedicine from the U.S. government, in the late part of the 1990s and early 2000s, was to establish what is called the cancer nanotechnology program. What they believe is that with nanotechnology you can detect the cancer as it begins. It's the concept of early detection: the quicker you can detect a cancer, the greater the chance of survival. Once the cancer starts moving around your body, it's very difficult to find. You want to detect it before it starts moving around, because once it starts spreading, it's like finding a needle in a haystack. It is everywhere in your body, and even if you treat one cancer at one site, another site may start to spring and grow.

The other application that cancer nanotechnology focuses on is targeted therapy. You can actually design these structures to carry the drug so that it can specifically only go to the cancer site and not to a healthy site. One of the problems of chemotherapeutics is that you're flooding your body with poison and hoping that the poison will kill more of your disease cells than your healthy cells. That's why you have all the side affects associated with chemo. But if you can trap everything in a nanostructure, protect it, and cause it to only release at the disease site, you basically will remove the exposure of the healthy tissues.

The third part is to try to improve surgical precision. When you try to remove a tumour, if two cancer cells survive, they can grow again. In some work being done at Rice University, they can take particles that produce heat, target a tumour cell, and then basically shoot a laser right at that spot to try to burn off the tumour at that site.

But there are two challenges in getting this to work. One is the delivery challenge. How do you actually get to the site? What is the proper size and shape? At this size range, below 100 nm, the particles can travel within your body, but how do you control the delivery process? There is also the toxicity of these materials: some of these materials are made of metal, and that becomes an issue.

The second aspect is nanotechnology diagnostics and how to simplify the diagnostic process. Here is a slide illustrating a strategy in which we can take beads, load them with nanomaterials of different colours, and make bar codes out of them. We all go to the grocery store: the bar code scans the product, allowing the store to monitor inventory of that particular product. Can we do the same thing with diseases? We can enable these molecular-scale bar codes to scan for different kinds of genetics, scan for different kinds of proteins associated with diseases. This allows you to then detect the disease not just by using one protein or one gene, but maybe a series of proteins or a series of genes to tell you that you have some disease.

What is being worked on now is to convert this technology into a hand-held device so that you can actually use it at the point of care, so that when you're infected it's all automated. You can essentially push a button and within an hour can say whether you have disease A, B, or C. On my final slide, I use malaria as an example, in which there is one strain that is very deadly and one that is not.

● (1140)

Within the next few years, there is going to be a lot of emphasis on translation and diagnostic devices. In vitro hand-held devices are going to be commercialized in the next few years in terms of development and patient care. With regard to the in vivo application, there's going to be a lot more work required, but probably, in about the next 10 to 15 years, it will be in play in order to inject into the body and be able to detect diseases or treat diseases.

With that, I'd like to thank you. That's my overview of nanotechnology at this point.

The Chair: Well, Dr. Chan, my goodness, that was amazing. Thank you so much for your presentation today.

We will now hear from Dr. Voyer.

Dr. Normand Voyer (Professor, Department of Chemistry, Université Laval, As an Individual): My presentation is going to be in French, but I am willing to answer questions in English and French.

● (1145)

The Chair: We have translation, so we're fine.

[*Translation*]

Dr. Normand Voyer: I would first like to thank...

[*English*]

The Chair: Do you want me to suspend?

You are all right? Okay.

[*Translation*]

Dr. Normand Voyer: That is fine, thank you.

I would first like to thank the members of the committee for inviting me to present part of my research work that, as you can see, is geared to the construction of bio-inspired nanostructures designed to kill bacterial or cancer cells.

I am a chemist and I thank

[*English*]

...Dr. Chan for the beautiful introduction...

[*Translation*]

on nanotechnology. So I won't have to redo it.

As chemists, we build molecules from scratch. We want to build nanoscale molecules to kill bacterial and cancer cells.

Why do we want to do that? Right now, the greatest threat on the planet—and Dr. Plummer talked about it at length—is that there are more and more bacteria resistant to current chemotherapy. An increasing number of cancers are resistant to the drugs currently being used in clinical settings. If we do not come up with new developments and discover new therapeutic agents with new modes of action, we are going to have a serious problem on our hands in coming years. It will be more difficult to counteract bacterial infections, viral infections and infections of all sorts, in addition to the problems with increasingly resistant cancers.

My area of research is promising in that respect. The new solution to combatting this scourge is called nanochemotherapeutics. As Dr. Chan said, when you develop nanoscale substances, their physical, chemical and biological properties are completely different from compounds that do not have nanometre dimensions.

Nature has been using nanotechnology for hundreds of thousands of years because it develops viruses, which are real nanorobots, as well as nanoscale toxins and proteins that have incredible properties. One of those properties is to alter the membrane of our good cells, which causes a great level of toxicity.

To better understand my area of research, you need to try and imagine that every human being is made up of billions of small cells. Bacteria are unicellular organisms, but humans have billions. The integrity of those cells is maintained by what is known as the cell membrane. It is a thin little layer, a type of Saran Wrap that keeps the cell intact. So when you manage to puncture the membrane of cancer cells or bacterial cells, they die. As a result, some toxins and substances secreted by the bacteria are able to break this membrane and kill cells.

At our lab at Laval University, our approach is to try to mimic these proteins, to design and synthesize nanostructures or nanoscale compounds that have the properties to mimic natural toxins that attack and puncture the membranes. We want to target the cells that need to be destroyed, meaning the cancer cells and bacterial cells that are increasingly resistant.

The benefit of using this technique is that it will bring us one day to a group of nanochemotherapeutic agents, as an extension of today's conventional chemotherapeutics. These tools will potentially be universal therapeutic agents for all bacteria and viruses since their mode of action is innovative. Actually, this type of mechanism will induce no resistance.

As an example, let me show you a prototype. As our inspiration, you see a protein on the left with green bows and small purple bubbles. This protein is secreted by bacteria and it is a toxin that destroys the red blood cells. If you are infected by the bacteria and this toxin is in your blood, it will destroy your red blood cells and you will die.

● (1150)

We have used this protein as an inspiration to create—as you can see on the right—nanostructures, three to four nanometres in size, that will be able to puncture the membrane of undesirable cancer cells. To date, we have managed to show their activity in killing cancer cells, as well as bacteria.

In the next slide, I am showing you a short film. You can see the same nanostructure going through a blood vessel. You see the red blood cells in the background. At the bottom you see the start of a leukemia cancer cell. The nanostructure will detect the presence of this cancer cell. Next, it will incorporate itself into the cell membrane to create a port that will allow excess sodium ions to enter. In so doing, the sodium ions will disrupt the internal biochemistry of the cancer cell. The cancer cell will die by itself through a mechanism called apoptosis. I will not get into the details, but it is a mechanical process that makes it possible to puncture the membrane of the cancer cell, thereby killing it.

Clearly, this is not going to happen overnight. How long do we think it will take until this type of nanostructure can be used clinically? We are talking about approximately 10 to 20 years. Right now, we are talking about very rudimentary trials. Work needs to be done. We need to prepare analogs, to gain a full understanding of how the mechanism of action works and to improve selectivity in killing undesirable cells, not the healthy cells in our bodies. We also have to determine the safety profile, the therapeutic dose, the efficacy and so on.

Why should the Government of Canada support this type of work? Nanomedicine, which includes nanodiagnostics—that was talked about at great length earlier—and nanotherapeutics, involves technologies with huge potential that can revolutionize the way we diagnose and treat patients. That will facilitate very early diagnosis, meaning

[*English*]

bedside monitoring, point of care.

[*Translation*]

Clearly, it will also lower healthcare costs and improve quality of life.

But the main reason why the government must fund this work, which is too risky for the industry, is so that, one day, we will be able to see our research work come to fruition in Canada. Actually, the industry does not have the money needed to study and develop technologies that will reach their full potential in 10 to 20 years. That will be very expensive and the industry does not have those types of resources. It is up to university researchers and those who conduct basic research in universities to develop those new approaches. Subsequently, companies will be able to build on them and develop concrete applications.

I would like to conclude by thanking granting agencies, specifically NSERC, which has always supported my research work.

I will be happy to answer any questions you may have.

[*English*]

The Chair: I thank you very much for your insightful presentation. It has been an amazing morning in terms of the presentations we've had here.

The bells haven't been rung yet, so I'm going to go straight ahead. I apologize in advance for when they ring, if they ring.

Dr. Plummer, I understand you have to leave at 12:15 p.m. I wanted to make the committee aware that Dr. Plummer has to leave at 12:15, so any questions for him should be asked before then.

Dr. Marra and Dr. Huntsman, I understand you are with us until 12 noon. Are you able to stay a few more minutes for some questions?

● (1155)

Dr. David Huntsman: Ten minutes or so more. The fact is he'd be late for the next meeting.

The Chair: Great. You're all probably getting together for lunch. If you weren't in B.C. and Dr. Plummer in Ottawa, I might say you were simply ducking out for lunch, but I don't think that's the case.

We're going now into Qs and As because we have the rare opportunity of asking some very learned people about things the rest of us don't have knowledge of.

I'll begin with Ms. Davies.

Ms. Libby Davies (Vancouver East, NDP): Thank you very much, Chairperson.

I hope I can ask some learned questions. I didn't think I would ever be at a health committee where we'd be talking about Christmas tree lights and how they function. That was very interesting.

It's a bit overwhelming, I have to say. I've been keeping notes and trying to keep up with all of your presentations. I feel as though we've had an hour's crash course in genomes, and nanotechnology, and so on. I absorbed a little bit, I have to say, and I know there are a ton of questions.

What I'm thinking about, though, is this. When we have this incredible research that's going on in various stages—and in some instances Canada is plowing ahead, which is terrific—the issue that keeps coming back to me is what challenges we face in making these incredible new technologies accessible to people.

I think it was Dr. Marra who mentioned the whole issue of personalized medicine; that, for example, access to some of these new drugs, based on personalized medicine and the research you're doing, will change the way we do clinical trials because we'll be down to a micro level. We've just had Dr. Chan tell us about his nanotechnology, and we're talking about 10 or 20 years from now.

The question I have, because we are doing this study, is what is it that we need to be prepared for in advance in terms of applications for what you're researching now? It sounds like we have a bit of a handle on some of it now, but for some of the information you presented, the timeline is much longer. It would be terrible to see a situation where we have made advances and yet we don't have the capacity, in terms of clinical trials or approvals or even accessibility for patients, to actually roll it out, and we end up with a big gap.

I don't know if this is a field that any of you get into. Maybe you're just at the front end, and somebody else does the other end, but you could address that and give us some ideas about what we need to focus on, as a committee, because we'll be writing a report. What is it that we need to prepare for, in terms of policy considerations, for how your research will actually apply and help people in the future? Would any of you like to address that?

The Chair: Who would like to start with that question?

Dr. David Huntsman: This does come back, I think, to some point that Marco and I made, and others alluded to. If we are going to embrace the concept of more individualized disease control as a way of improving the effectiveness, cost-effectiveness, and appeal of our health care system, we have to refit our drug approval processes and the way we consider new interventions so that they're tailored for personalized interventions, as opposed to what we've had in the past. Our whole health care system is based on the very kind of generic approaches to controlling disease. There are things that can be controlled federally, and, obviously, there are things that can't. That's something that is a federal jurisdiction.

Also, there is the funding of research into system changes. Our health care record systems are really designed for minimal amounts of data per patient. This isn't going to work in the future. We're moving into an era of high-content medicine, where patient genomes and other materials are going to be base parts of the health records. Perhaps we have to go way outside the box and look at patient-controlled electronic health records and other innovative solutions.

Federally, you could create a framework where different models could be tested, and then, if they were successful, we would hope they would be adopted nationally. All of these forays into more personalized high-content medicine would be research of different descriptions, be they health services research or more basic research. But to take the fantastic discoveries that are going on in many disease domains and make sure that Canadians benefit, we have to start looking further downstream.

● (1200)

Dr. Marco Marra: I'd like to echo David's comments there. The question was how we avoid ending up with a big gap. I would—

The Chair: Dr. Marra, we only have a couple of minutes left, and we have two other people who also want to answer. Could I just ask that you maybe take a minute or 30 seconds to answer so we can get everyone's answer in?

Dr. Marco Marra: Right.

It's not that we're going to end up with a big gap. The point I was going to make is that we're at the precipice, so we need to work quickly.

The Chair: Good point.

Dr. Plummer.

Dr. Frank Plummer: I would point out that these things are all happening very quickly, and I don't think our society is ready for them currently. There are all kinds of issues related to personal health information and how this information is used, which we haven't really thought through. It's upon us right now. I think the others would agree with that. There are many issues in that realm that need to be thought about.

The Chair: Dr. Chan.

Dr. Warren Chan: I just want to start with the life cycle of development. As academics, we're at the bottom of the scale of that development, and we need companies to translate or want to translate. Right now the challenge is the fact that there aren't any companies in this area. If I want to translate my technology, who do I go to? Actually I have collaboration in the U.S. Because I'm in Canada, I want to support the Canadian economy with this. That's one of the challenges.

What I've done is to start a company—again, at this early phase—and we're just selling materials. These materials are being sold to the world, and I'm hoping to use that as an infrastructure to bring the technology into the company as time goes on. We've already gone global in two years.

This is a major challenge in academic research—getting to people, how to actually move it from the lab into the real world environment. Without that commercial entity, it doesn't—nothing can be translated. It would be a nice paper, but it doesn't go to people.

The Chair: Thank you.

Dr. Voyer, you also wanted to comment.

Dr. Normand Voyer: Yes, I'll be quite short.

I want to say that I think we need—this was alluded to before—a national strategy for research in nanomedicine that incorporates companies as well. We need a research and development strategy that incorporates fundamentalists as well as engineers and companies.

The Chair: Thank you so very much.

We'll go to Dr. Carrie.

Mr. Colin Carrie (Oshawa, CPC): Thank you very much, Madam Chair.

I just don't know where to start. It's been such an interesting forum of witnesses here today.

Maybe I'll start with Dr. Plummer, because I was very interested when you were talking about viruses to fight viruses. I remember hearing about this years ago from a researcher in autoimmune diseases. I think he was studying ankylosing spondylitis or something, and he found that if you had an innocuous virus, you could give a person an innocuous virus and it actually helped the symptoms of these autoimmune diseases.

You mentioned that you are working on a couple of Ebola vaccines, and you mentioned commercialization as well. How extensive is this research? Do you see this being available in the next few years? And how difficult is it to commercialize something like this?

Dr. Frank Plummer: Using viruses to deliver a gene of interest is a sort of standard thing in gene therapy and also now in vaccinology. We use two viruses to deliver Ebola genes: one is a nanovirus, and the other is a cow virus called vesicular stomatitis virus. Both produce very robust immune responses that protect monkeys against a thousandfold lethal challenge with Ebola. Also they have some efficacy post-exposure, so after somebody has been exposed accidentally to Ebola, it probably has a role in therapy.

This kind of gene therapy approach has a lot of different potential applications, in which I'm not an expert, but they would certainly include cancer and certain kinds of genetic deficiency diseases. It hasn't made its way into the mainstream yet for the most part, but we're forging ahead with commercialization of these two vaccines. We have companies that are interested. They either have licensed or are interested in licensing the technology, and over the next couple of years we will be doing some clinical trials with them.

The market for these vaccines is not huge. It's a niche market—military, the security community, laboratories. But I think within a couple of years, you'll see them commercially available.

● (1205)

Mr. Colin Carrie: Thank you very much.

My next question is to Dr. Huntsman. How can the government help reduce red tape to facilitate joint research developments from projects that are funded at the provincial and federal levels? We hear today that things are moving so fast and government has to come up with a regulatory framework for all these things. What do you think we could do to start reducing that part of the red tape that researchers have to face?

Dr. David Huntsman: I think that researchers tend to be very imaginative and carrots tend to work very well. You do control funding. If you decide that removing red tape is a valuable thing to do, you can work on it inside Ottawa, but also you could present funding opportunities that have to be interprovincial and address major issues surrounding the personalization of health care. Then you're harnessing the imaginations of a large number of other people to try to find solutions.

In the drug-approval space this is something that is inside your domain where you could make a huge difference and work with the community to reshape drug approvals surrounding personalized medicine indications. There are a lot of people who have probably spoken with your group and others, such as Janet Dancey from the Ontario Institute for Cancer Research, and individuals from the National Cancer Institute of Canada Clinical Trials Group, about how we need to rethink drug approvals. It could make a huge difference.

Things don't have to be completely approved. They could be approved for on-the-ground study without having a global approval. There would be different ways of looking at this.

But in the funding domain, if opportunities were presented that encourage people to work together between provinces you would see solutions coming out of that.

Mr. Colin Carrie: Good.

Dr. Marra, I wanted to expand on what Libby was talking about, because this field of research has a wide range of applications but it will be very costly to apply across society. I was wondering if you had any ideas or if you could expand a little bit more on ways to control costs in order to make these applications scalable and more affordable to Canadians.

Dr. Marco Marra: It is still very much in development. The rate of change of technology will continue to drive costs down. It's not at all clear to me, based on what I know of the cancer treatment system, that costs for detailed genome analysis, even in a clinical setting, are prohibitive. If you consider that the direct costs of a bone marrow transplant are somewhat north of a quarter of a million bucks, $1,000 for a genome analysis to predict who should get that transplant and who should not is an investment, it's not a cost. That's where we are right now. That's why this business of personalized medicine is rearing its head and that's why genomics is being used very heavily in this context.

Dr. Huntsman made the point that there are other measurement tools that can and will be applied to personalized medicine. It's absolutely true. We don't know at this particular point whether or not we will need to do a whole genome analysis on every single patient who might benefit.

One does not have to invoke cost reductions of the technology beyond what exists today to know that personalized medicine is here.

There is an interesting corollary to all of this that emerged in the public domain that some people refer to as “recreational genomics” where you could interface with a company and you could spit in a tube and send them DNA. For the cost of a few thousand dollars you would get back a non-medically relevant readout of what your genome reveals, a propensity for earwax included. These kinds of things were purchased by the public without medical benefit at all. That's why I refer to them as recreational genomics, but it shows what the uptake has been. There were companies founded around this.

Now we're in an era where people are information-aware and they're coming forward. They want this kind of thing. They want personalized medicine. The public will demand it. The question is how do we get there and achieve medical benefits along the way.

Cost reductions will happen and the more we use the technology and, as Dr. Huntsman pointed out, the more people are engaged in using the technology, the more the costs will continue to drop. That will improve feasibility, but it's not going to change the fact that it's real and it's now.

● (1210)

The Chair: Thank you very much for your answer, Dr. Marra. You had told us that you had to leave at this time. Dr. Huntsman and Dr. Marra, can you stay a few more minutes or will you be leaving right now? I want to thank you for being here. What's your answer?

Dr. Marco Marra: Four minutes for me.

Dr. David Huntsman: I can do another five minutes as well.

The Chair: That's great.

We'll now go to Mr. Easter.

Hon. Wayne Easter (Malpeque, Lib.): Thank you, Madam Chair.

Thank you, witnesses.

I will admit that I'm not a regular at this committee, but this has been probably one of the most interesting and forward-looking sessions I've been at in a long while.

I might say that I've just come back from meetings in the United States—Canada-U.S. interparliamentary association meetings—at which their fiscal cliff was on the agenda, and their whole health care system versus ours, etc. There's a real fear in the United States, given the need for the government to get its deficit under control, and there's some of that here as well.

There is a fear in many sectors that R and D will be cut back, and I think we can see, Madam Chair, in listening to the presentations, that it would not be a good idea for us to do so. Two things seem to come out of what has been said.

One of you—I believe it was you, Dr. Plummer—mentioned that we need to refit our drug approval process and that “tailored for personalized intervention” needs to be done faster. Someone said that. The other was that we need an R and D strategy that incorporates nanotechnology, etc. What needs to be done to accomplish those two things?

The Chair: Who would like to take that on?

Dr. Plummer.

Dr. Frank Plummer: I wasn't the one who commented about the personalized drug approval process. I think that's an important issue. I don't have an answer for it, but it's something that needs to be considered as part of how these technologies change the way we do things within the health care sector.

For me, as someone who used to spend a lot of time applying for research grants—not in nanotechnology but in other areas—I think we need larger grant amounts and targeted funding more often than we have currently so that we can actually focus our efforts on a given area, whether it's nanotechnology, or genomics, or whatever.

The Chair: Dr. Chan.

Dr. Warren Chan: For nano, I think the first thing I would do is actually build capacity within the universities for young researchers who are working with nanotechnology. There were programs from NSERC and CIHR, and what ended up happening was that people were just modifying their research to fit the nano space when they were not really nanotechnology researchers on a global scale.

The first thing is, how do you get the universities to bring in smart people who are in this area? I'm not from Canada, but I was brought in. I was one of the first ones working on nano with biology, on nano with medicine. How do you bring these people into Canada?

The next thing is to develop a strategy, build centres, and build infrastructures. There are enough infrastructures from CFI grants, but we don't have enough smart people in that particular space at this point compared to other countries. Everyone is competing right now: Singapore, South Korea, and the U.S. The next capacity is actually how to get them funding to allow them to compete.

I think that's the first thing that needs to be done: building people, getting the right people in place who can compete globally. In my opinion, right now we don't have that in the nanomedicine space. We have people who dabble in it, with a few experts, but if you look at capacity compared to Singapore, we don't have the capacity at this point.

● (1215)

The Chair: Dr. Voyer.

Dr. Normand Voyer: I think Canada has been pretty successful in the genomic area by building capacities, by linking people together, and I think our colleagues can comment on that.

With Genome Canada, what we need is some sort of a “Genome Canada-Nanomedicine Canada” that will bring together scientists. In regard to nanotechnology and nanomedicine, it's a multidisciplinary research area. It's very complex.

A voice: That's right.

Dr. Normand Voyer: We need engineers, chemists, biologists, and medical doctors to work together. We need a network of scientists to work together. We can create that with a national facility —

The Chair: Dr. Plummer.

Dr. Normand Voyer: —of programs—

The Chair: I'm sorry, Dr. Voyer.

Dr. Plummer.

Dr. Frank Plummer: I will just say that I was going to reinforce that point. Genome Canada has been very successful in building genomic capacity, and it may be a strategy that could be looked at for —

Hon. Wayne Easter: Maybe the two gentlemen in B.C. want to respond as well?

The Chair: Mr. Easter, Dr. Huntsman wanted to comment on your last question. Is that okay?

Hon. Wayne Easter: Yes.

The Chair: Dr. Huntsman, please go ahead.

Dr. David Huntsman: I think in Canada it's not just about having the best health care, but it's about having the best health care equitably delivered. It has to be equitable within provinces as much as possible, and between provinces as well. In terms of drug approval, Health Canada controls that process. I would think of calling brainstorming sessions with Health Canada and the drug approval teams within Health Canada to start looking at this particular issue, because it is going to take some outside-the-box solutions. But there are people who are working on ideas and they will be well known to the decision-makers within Health Canada.

If we can move forward with this, then Canada will be in the vanguard of more individualized approaches to cancer and other treatments. If we can't, then we will fall behind, which would be very tragic considering that a lot of the base data, which we use to make that move, would have come from Canadian researchers and Canadian government investments.

The Chair: Dr. Easter—you have been promoted. Mr. Easter, you now have one more minute.

Hon. Wayne Easter: Is enough being done in terms of especially national, but also in this area international, coordination to be successful? I think that Genome Canada is one that has worked really well, but do you go to that model with nano? Somebody has to show the leadership to get us there, I guess that is what I am trying to say.

Is that what's required to find a way of tying all the components together nationally under federal leadership, including the research sector, university sector, etc.?

The Chair: Who would like to answer?

Dr. Chan.

Dr. Warren Chan: I think there needs to be a clear link with the international community in terms of nano-medicine and nano bioresearch in that sector.

We collaborate with people in the U.S., and right now I am debating about helping to set up a joint program between Toronto and Nanjing University. Those are things that are in discussion.

At the end of the day, there's a lot of talent throughout the world. There's also talent in Canada, but it is a global—

The Chair: Thank you, Dr. Chan.

We'll now go to Ms. Block.

Mrs. Kelly Block (Saskatoon—Rosetown—Biggar, CPC): I just want to know, Madam Chair, if the witnesses who are joining us by video are leaving right now? I know we keep asking for a couple more minutes, but can you just confirm if they are staying?

The Chair: Do you have to leave, or are you available for another couple of questions, Doctors?

Okay, Ms. Block, go ahead.

Dr. David Huntsman: I think Marco was waving goodbye, and I can't stay for more questions.

The Chair: Oh, goodbye Marco. We're holding you hostage, Doctor. Thank you so very much.

Dr. Plummer, I know time has passed for you as well. Dr. Plummer, Dr. Marra, Dr. Huntsman, thank you so much for being with us today and for your very helpful and insightful comments.

We do say goodbye to you, and we'll go on to our next question, Ms. Block.

Mrs. Kelly Block: Thank you very much, Madam Chair. I must admit that a few of my questions were for the witnesses who are leaving. But I do also want to echo the comments of many of my colleagues around the table today in regard to the information that we've received. It is incredible to think about all of the research that is going on in this area and the limited understanding that we have around this table.

I do want to pick up on some comments that were made with respect to this technology. I just wrote down some comments: these things are happening very quickly, society isn't ready, we're on the precipice. And I guess I just want to give those witnesses who are with us an opportunity to expand on any concerns you may have about the pace that this technology is happening at and what we need to do to be getting ready as a society and as a government in terms of regulatory framework.

I'll turn it over to both of you to answer that question.

● (1220)

Dr. Warren Chan: Coming from the nano perspective, the challenge right now is that the different agencies don't know how to regulate it. Do you regulate it as a drug, or do you regulate it as a device? I work with both the U.S. FDA as well as Health Canada and they are trying to figure it out. Right now it's actually considered a special case, based on a case-by-case basis. That's one challenge.

The second challenge is information. We're developing ways to detect genomics. Is it too much information? There are ethics associated with it. We know that somebody has certain genetic predispositions. Especially when you're using a point-of-care device, how does that affect the person who is actually doing the analysis? Facebook and social media have changed the way we look at communication, so technology is improving the way we are communicating. If you can look in your own iPhone and find out that you have a genetic predisposition for genetics A, B, C, and D, what are you going to do with that information? That's what we're left with at this point.

It's an ethical issue from that perspective.

The Chair: Dr. Voyer, go ahead.

Dr. Normand Voyer: Thank you very much for giving us the opportunity to comment on that. I think one of the dangers right now is that we're lagging behind many countries in many parts of the world. Europe and the U.S., and even Singapore and Asia, are really cracking down on nanotechnology, especially for medicine.

The danger I see right now is that all the money that has been invested in Canada for fundamental research, that is bringing new devices, new developments, will end up in companies abroad. If we are dedicated to taking as much as we can from the investment we've already made in nanotechnology, we definitely need to get together, talk together, develop a network of scientists and companies in Canada that will be able to translate fundamental research into practical applications for the health and well-being of Canadians.

Mrs. Kelly Block: You mentioned the need to bring together industry and the researchers, companies, to start this sort of partnership. How would you advise we do that?

Dr. Warren Chan: Here's the first challenge. There isn't really an industry in Canada in nanotechnology. Even if you want to bring industry in, there's not that much nanotechnology going on, necessarily, in bigger companies—maybe a small startup company of five people, three people—but the global players are not here as much.

The first thing is that if you want that model, how do you do it? How do you get companies interested in setting up and actually being successful, not just by name? That's a challenge. I work with companies in the U.S. at this point because they have more infrastructure, and they have the patents, and have some of the capacity to translate some of these things. We're trying to set up our own thing in Canada, but again, it's a challenge.

You can't do academic, industry, and then other things—so really the first thing is, how do you actually build an industry in these emerging technologies? That requires more thought, in terms of translation as well.

Dr. Normand Voyer: I also think there are opportunities in Canada, even though the industrial sector is not developed as well. You probably know that the pharmaceutical sector and biopharmaceutical sector is completely changing in Canada, with all these big pharmas moving out of fundamental research. There's a task force of amazing scientists who can contribute and be a part, and startup companies we should subsidize differently, as well. There's a new model that needs to operate with this high-risk research that can lead to potentially great discoveries and new technologies for treating cancers, and resistant bacteria, and so on.

Diagnostics is one of the areas coming very quickly in the nanotechnology agenda. It's already there.

● (1225)

The Chair: You have about one more minute.

Mrs. Kelly Block: Dr. Chan, I want to ask you a question specifically about your timeline. Within the context of the previous questions, how do these factors, these realities, impact on your timeline?

Dr. Warren Chan: I'm building. It's almost like I'm a scientific architect. I started 10 years ago. I know that commercialization is important, and that's why we started this company in Burlington. Last year, we started selling materials. We don't need to do high-end stuff. We sell materials. Last year, we were at about $500,000 in revenue already, after year two. We've set up global networks. We just got a distribution hub in China, and one in Australia. I'm using that part to build that scenario, to build the expertise, so that when we're ready academically, I have a place to translate it.

This is just my own strategy, but again, not everybody has those kinds of strategies. The thing is, because we don't have a network in Canada, that's what the seven cancer nanocentres are doing. They're focusing on getting collaborators, industrial partners, and clinical trials. I'm also related to a couple of those centres, in terms of collaborations, where they need expertise from us.

Again, it's like you either, as a academic, build it because the expertise is not there or you let industry do it, but sometimes industry doesn't really understand emerging technologies. You also have to train people so that they're able to translate. Because these are newer areas, some people who might want to start a company may not understand why nano is important. It's experience; they read it, but sometimes they need practical experience associated with it.

The Chair: Thank you very much, Dr. Chan and Ms. Block—very good question, very good answer.

We're now going to go into our five-minute round. I can't believe that the bells haven't rung yet. This is wonderful.

A voice: There's no vote.

The Chair: Okay, it's been changed. Thank you.

We'll go to Dr. Sellah for five minutes.

[*Translation*]

Mrs. Djaouida Sellah (Saint-Bruno—Saint-Hubert, NDP): Thank you, Madam Chair.

I would like to thank the witnesses for joining us here in person or through videoconference. Unfortunately, they will not be able to hear me.

As a Canadian, I am very proud of new technologies being developed in public health, including nanotechnology and genotechnology, if we can call it that. However, I am disappointed to see that, although we have the potential to be a leader in those two technologies, there are obstacles, from what I understood from your presentations.

My first question is for Dr. Voyer.

Based on the list I have before me, your work is mainly on basic research. In your view, how will the current government cuts affect tomorrow's applied research? I think that there will probably be economic consequences. My fear is that the current cuts to fundamental research will have an impact on applied research, which in turn will have an impact on the access of Canadians to modern technologies.

The second part of my question has to do with funding. How do you see the balance between public and private funding, given that the purpose of private funding is to obtain dividends from applied research?

Thank you.

Dr. Normand Voyer: Thank you. Since you asked me the question in French, I am going to answer in French.

In all the countries around the world where research is conducted, we are seeing a strong tendency to reduce public funding for basic research in order to support targeted research. There is really no harm in doing targeted research; it is even desirable when it comes to development. But the fact remains that great scientific discoveries that have a real impact on the quality of everyday life stem from basic research. For instance, just think about the discovery of nylon or Teflon. It started with basic research in a lab. So basic research must be funded.

However, the basic research of today is not what it used to be. It is now much more transdisciplinary. We no longer work in silos. We are using a horizontal approach. For basic research to lead to practical discoveries, we have to work with scientists from various sectors. As a result, grant programs need to reflect this reality.

I have been with NSREC for a number of years. For the time being, grant programs are affecting a number of areas. We are trying to adapt, but we need more flexible programs that will allow us to conduct basic research in the preliminary stages, to be able to make great discoveries and then work with the industry and benefit from

● (1230)

[*English*]

bridging money.

[*Translation*]

What was your second question?

Mrs. Djaouida Sellah: I was talking about public funding versus private funding.

Dr. Normand Voyer: Researchers always need more money. As Dr. Chan said, the development stage is more and more expensive. The only way to be able to continue with development is to make sure that companies with capital invest in basic research and continue to support industrial research. Research is what will allow nanotechnology and nanomedicine to generate real practical applications that will serve Canadians.

[*English*]

The Chair: Thank you, Dr. Sellah.

We'll now go to Mr. Lobb.

Mr. Ben Lobb (Huron—Bruce, CPC): Thank you, Madam Chair.

Any time that I start thinking I'm pretty smart, I'm going to take a look back at the minutes of this meeting and just get grounded right back down again.

My first question is for Dr. Chan. How did you get interested in this line of work?

Dr. Warren Chan: By training, I am actually a chemist. My Ph.D is from 1996 to 2001. I was doing chemistry. Nano was not a national agenda in the U.S. What ended up happening was that in 2000 or 2001 they started doing the cancer nano program. My training is in chemistry. I know how to make materials. Then I did my post-doctoral training in biomedical engineering, where we are now actually learning to work with tumours, and learning to work with what it means to create a new diagnostic to create new therapeutics. That was two more years of training. Then I moved to the University of Toronto.

Mr. Ben Lobb: Your education was in the U.S., then?

Dr. Warren Chan: Yes.

Mr. Ben Lobb: What attracted you to move to the University of Toronto?

Dr. Warren Chan: It's kind of interesting. I like the city. I visited the city a long time ago and I quite enjoyed the city. I grew up in Chicago. When I was looking for a faculty position, I wanted to move back to a city because going to grad school in a small town for my undergraduate degree, I kind of missed the city flavour. That is how I ended up moving to Toronto.

Mr. Ben Lobb: Prior to an hour and half ago, I didn't know anything about this. Maybe that's my own fault. You are talking about building the industry. You are talking about building capacity. Part of that is building human resources, developing here at home, but then also attracting talented people such as yourself. Give us an idea of what would the next five to ten years look like? Your path took about 10 years. How do you do it domestically, and then how do you attract the people who are already doing it?

Dr. Warren Chan: I think one of the good ways to do it is to offer competitive start-up packages. In the U.S. right now, for a new faculty it's usually around $600,000 to $700,000 simply to start to build your lab area. Sometimes it may be difficult to do that at the universities in Canada, because start-up packages are not that high. The way you do it is to offer a good strategic network, people who attract other people.

Scientists are interesting. When you have one research lab that is very good, you attract other people who want to work in that particular area because people want to combine and solve things. That's why we do what we do. We like to solve things.

Going back to the U.S. again, the reason they build those cancer-nano networks and sensors is to have a conglomeration of people from different areas to try to solve a problem. Again, Genome Canada has done a very good job encouraging genomic research, but with the nano and so on I would like to go to the broader picture of the emerging technologies, not only nano. Nano is one area of emerging technology. We don't have those particular hubs, so that's where one of the challenges is.

Again, if you want to recruit people to Canada, you have to give competitive packages. That's first. Then you have a little bit of capacity at this point. Then have these guys go out and sell, and also encourage publications in good journals. That's the other thing. When I am looking for someone to collaborate with, I like people who are at the top of the game. In academia, the way you tell is from the level of journals. There are 6,300 journals. In nano, there are three or four top journals that are nano-focused. I know who those players are globally, and that's what attracted me.

● (1235)

Mr. Ben Lobb: If you look at the business you have started, I am guessing you have generated this through your own university income plus the income that you created through the revenue you mentioned. Your business would be similar to many other small start-ups. What are some of the issues you see down the road? Whether it's access to capital, venture capital, or partners, where do you see that going?

Dr. Warren Chan: That's a very good question.

I believe in people. The CEO I am with is amazing. He's a salesperson. He's aggressive. He knows how to build structure. We actually built this company without any financial support, so he hasn't had a paycheque in three years. He's living to try to build the company. We have been using different types of grants to be able to translate. Right now, the company is three to four people. It's not so big, but the fact is, we have positive revenue after two years. With every dollar we are making, we are buying more equipment. Instead of going for venture capitalist money, we're investing every dollar back into building infrastructure. We did not go for venture money because we don't want someone to control what we're doing. We are competitive right now because our materials are much better than what is available through other companies, and they are much better characterized.

Mr. Ben Lobb: One other quick question—

The Chair: I'm sorry, you're out of time. My apologies.

Mr. Ben Lobb: It was around intellectual property.

The Chair: Thank you.

We will now go to Mr. Kellway.

Mr. Matthew Kellway (Beaches—East York, NDP): Thanks, Madam Chair.

I agree with Mr. Lobb that it's all very intimidating. I think I took grade 12 chemistry when we had grade 13 in Ontario, so it wasn't even that high a level.

During the course of our study, we've heard, Dr. Chan, about this frustration with the commercialization of research in Canada. I have to confess it's not clear to me how this stuff should progress from basic research to, I presume, health care delivery for Canadians with illnesses.

To both of you, could you take a few moments to spell out where basic research should end, and what the role is? There has been reference to industrial research. Is there a way to define or describe it? How does that move into actually delivering this technology into the health care system?

Dr. Normand Voyer: The reason I went into academia was that I didn't want to have an industry. I didn't want to work in industry. I wanted to be free to do whatever research I wanted. I found out that this was not actually possible, but I was young and restless.

But I really admire scientists who create their own start-up companies. I think the role of academic researchers is to evolve, have new ideas, and develop and train the brightest minds to work in those start-up companies. For me, the best tech transfer I can do is to train good grad students who will work at Dr. Chan's company.

I think the best thing we academics could do right now is discover something with great potential. We create intellectual property. We protect it. We should have a task force to license those technologies, those patents, to companies. As to what I think is lacking in Quebec, this is basically it. I think that we need to have more people who will help and some money that will be diverted to universities for people who will be helping scientists write patents. Of course, you need to make money out of those patents. It's one thing to get a patent, and it's another thing to get money out of it.

Dr. Chan probably has some IP in his research, and the only reason he's making money on it is that he started his own company. Do the fundamental research, create intellectual properties, transfer it to local industries, and train the brightest minds to be able to work in these companies.

● (1240)

Mr. Matthew Kellway: What I may be missing is industry's role in this process, from a health care perspective.

Dr. Warren Chan: If there is an industry in an emergent technology, they're the perfect people to translate what's being developed. The challenge we're facing at this point is that industry is not there. I think the real question is: how do you create these industries in Canada? That's a billion-dollar question, and almost every country is asking it. In Korea, the way they've done it is that Samsung just took over. They bought hospitals. They know it's important to go into health care. Because Samsung is a global player, they've made their own impetus. They decided this was what they were going to go after.

In the emerging technologies in Canada, we don't have a full industry. How do we create the necessary energy? You have two options. One is the lottery approach, which is to start a bunch of companies and hope one or two are successful. The other is to take a targeted approach, focusing on a couple of areas and hoping they will come through in a few years if you give them support.

This is a big question that everyone is asking. I want to explain a little bit about how I came to be doing what I'm doing. When I was a grad student, the quantum dots you saw, those vials, that's what I developed in graduate school. I wanted to use those things in biology. Everybody used them in electronics. I read a 1977 paper from a Russian scientist. My adviser said we could use the quantum dot for biology, so we patented it. We sold it to a company, the Quantum Dot Corporation, but after four or five years, it never translated.

As a scientist, you are emotionally involved with your technology, because you are the one who developed it. It frustrated me because it wasn't translating and I couldn't understand why. I learned later on that there was a lot of infighting and different focuses, so that drives me to have a little bit more control of how to do translation. But I'm not sure if there are a lot of sciences that have that particular aim. It's just because I want to see things go forward.

Mr. Matthew Kellway: I don't know how comfortable you are at talking—

The Chair: I'm so sorry, Mr. Kellway.

Mr. Matthew Kellway: I was watching you, Madam Chair.

The Chair: I know that, but I wasn't watching you. As much as I'd love to, Mr. Kellway, I just missed that minute.

We'll go to Mr. Lizon. Thank you.

Mr. Wladyslaw Lizon (Mississauga East—Cooksville, CPC): Thank you, Madam Chair. It's too bad the other presenters couldn't be here.

Thank you, gentlemen.

I'm at a bigger disadvantage than Mr. Kellway because I graduated much earlier from university.

Dr. Normand Voyer: Come on, nobody has to apologize for science here.

Mr. Wladyslaw Lizon: I'm trying to digest what I heard; they were very interesting presentations.

The first question I have is this, and it's too bad the other presenter is not here. How does that different work come together, or does it? Does anybody work on getting the results from your field of genetics and putting it together? It looks to me like the work is being done in completely separate channels; there is no interconnection there.

Dr. Normand Voyer: That's totally untrue. Nanotechnology had the greatest impact on genomic research, because that's how nanotechnology has been able to provide nanochips and that's how you can now sequence all the genes for a thousand dollars. It used to be a billion dollars for a gene. Nanotechnology has already impacted genomics research, so intrinsically, fields work together. Discoveries in nanotechnology have an impact in different fields, but when we describe it—and now it's just regular business—people doing genomics just take everything for granted and they now want to use this to translate into personal medicine. But nanotechnology has impacted genomics research.

Mr. Wladyslaw Lizon: How does it work on the international level, because we have thousands of scientists working in different countries? Is there an exchange of information? Or are we all trying to reinvent the same wheel?

● (1245)

Dr. Warren Chan: I collaborate with people outside Canada. The great thing nowadays, with Skype and FaceTime, is we have regular meetings to discuss projects and we actually apply for grants together. The U.S. allows people from outside the U.S. to apply for money. When we do joint grants, if we get something, then they can siphon off some for me to do research up here in Canada.

Research right now is global, scientists are starting to be global. There are a lot of scientists who have a laboratory in Saudi Arabia and then have a laboratory in the U.S.; this is the trend. In Saudi Arabia, it's the same for the way they're doing it. They're just dumping money to people and forcing people to move part time, but you don't leave your job. Science is really international. When we get results, we share with our collaborators in the U.S., or in China, or somewhere in Europe. It's not a silo. In the old days, I think it was a silo area. You had countries competing with each other, but nowadays everybody is working together, trying to figure out a way, from a health perspective, to try to improve health care. This is really at the end of the day what scientists are trying to do.

Dr. Normand Voyer: The gold standard for a scientist is to publish his research. We do a lot of research and we publish a lot, and we read what the other scientists are publishing. We know who's in the field and we go to meetings as well, so we hear what's going on and we participate in lots of international collaboration in Europe, Japan, and China nowadays.

Mr. Wladyslaw Lizon: I probably am going to run out of time for my last question. You mentioned that it's difficult to translate your research into a practical way to get industry involved. Let's say I am a businessman, I'm interested in your work, and you come to me with the results of your research. How would you explain to me what you're trying to build? Let's say you came to me and said that you wanted to build a scanner that could scan the entire body and would show the genetic codes of every cell. It's probably not possible, but let's say something of that sort may be down the road. What is actually your goal? What are you working on right now? What would you like to develop?

Dr. Warren Chan: Right now, the first device that we're going to be translating is a hand-held system for infectious disease diagnostics. We're taking all the genomic information that you heard about and we're building it into our bar-coding system. Can we essentially develop a system where we bar-code your blood to tell us what you have, and then start to build databases out of that?

I gave a talk to the DIA, the Defense Intelligence Agency in the U. S., because they're also interested in that concept, for monitoring of activities. We also find collaborators right now. I have a collaborator in Minnesota. We have collaborators in South Africa and Nairobi. In fact, some of the samples we might be analyzing are from Nairobi hookers, who have very dirty blood samples, who have different infections. We're taking information that's being developed by the genomics guy and we're now adding that information to our nano to develop these hand-held devices. So again, if you're a business person, I would try to sell it to you differently from an academic.

The Chair: Thank you, Dr. Chan.

We'll now go to Dr. Morin.

[*Translation*]

Mr. Dany Morin (Chicoutimi—Le Fjord, NDP): Thank you, Madam Chair.

If you don't mind, I am going to take one minute of my time to introduce a motion. I would like us to go over this motion together when we will study current committee business.

You can circulate the motion.

It reads as follows:

> That the Committee study resources to ensure that Canada is able to fulfill its responsibility to develop a national blindness prevention strategy, pursuant to resolution 56.26 adopted by the World Health Organization in 2003, called Vision 2020: The Right to Sight. The strategy should be based on four major objectives: to integrate vision care into already existing health care systems; to provide sustainable funding and other resources; to ensure that the care is fair and accessible to everyone, not only to the rich; and to ensure excellence on all levels.

My apologies to the witnesses for introducing it right away, but I would like Canadians to be informed of what we do in committee, since I find in camera meetings exasperating.

I am now going to ask the witnesses questions. In November, the Conservative government made significant changes to the National Research Council Canada. One of the first effects of those changes is the loss of hundreds of research jobs related to the National Research Council Canada.

As a witness, do you feel that the changes made by the Conservative government to the National Research Council Canada will help you in your work? Is that a good thing for research in Canada?

● (1250)

Dr. Normand Voyer: That is an excellent question. Actually, the Government of Canada has always had research centres. The National Research Council has always been an incredible ambassador for Canadian research. However, over the years, we have seen the potentially useful proliferation of national research councils. But, since grants for basic research were becoming increasingly harder to find, the government had to choose between NSREC, CIHR and other organizations such as CRH, in addition to supporting research conducted in universities.

It is unfortunate that some research councils in Canada had to close. Over one hundred very experienced scientists are going to lose their jobs. However, in Canadian universities, more and more very promising young researchers are sorely lacking grants and, as a result, are not able to conduct high-level research and compete on the international stage.

Yes, it is unfortunate for the National Research Council, but university researchers on the ground agree that it was necessary to streamline the National Research Council. However, if that is done at the expense of all basic research, I don't think that we will gain anything from that in Canada.

Mr. Dany Morin: Thank you for your answer.

That leads me to the second part of my question.

John R. McDougall, president of the NRC, confirmed that the changes made to the council would affect the type of research that the NRC will conduct. He mentioned that there would be less scientific and basic research and more research on the impact on the industry and commercial sale.

Do our two witnesses believe that this new mission for NRC is good?

[*English*]

The Chair: Dr. Chan.

Dr. Warren Chan: I just want to comment.

I think the way it went about converting the NRC from basic research to applied research was not right. As scientists, you're trained to think in a certain way. All of a sudden you make this change within a year. It's hard for people to make that change along the way. It's kind of like a fish out of water, right? I think that's one of the challenges with researchers at the NRC at this point. I have talked to a number of them and we're thinking about collaboration. That's one aspect.

The second aspect is that everyone's moving to applied research, but eventually, when you don't understand how something works, it will dry up. How do you build computers? The reason you have computers is that people figured out how electrons work. If you don't know how electrons work, how can you build a computer? You can't change the flow of electrons.

Part of the challenge now with the NRC, in my opinion, is how to balance enough fundamental research to allow them to lead, but then have an applied focus, where they can actually translate these things, right?

Again, if I was head, I would have done it in a five-year to seven-year stream, slowly evolving the process so that it becomes less of a heartache for the current scientists. You can't make scientists be something they're not, which is really what the challenge of the system is at this point for the NRC.

The Chair: Thank you very much, Dr. Chan and Dr. Morin.

My side of the House has given me a chance to ask a question. It will be our last question because our time is running out.

You talked about cancer and nanotechnology. You talked about how with early detection, you have a better chance of survival. You said with targeted therapy you have fewer side effects. As we know, when toxins go into the body, the issue is that sometimes the cure can be worse than the cancer, if that's understood. It can affect the heart, it can do all sorts of things.

You said that cancer nanotechnology would improve surgical precision. When cancers like lymphomas move, it's almost impossible to find them. How would nanotechnology apply to that? Could this be helpful, in terms of causing someone to live? Has it become so advanced that at this time they can see the tumour sites throughout the body?

Dr. Warren Chan: Are you asking the question from the point of view of metastasis, once the tumours move, how would nanotechnology help?

The Chair: Yes.

Dr. Warren Chan: Once a tumour starts to break apart, once it starts to move and regrow, the surface of these cells contains a unique fingerprint, so there are molecules that are unique to it. With nanos, if you know what those molecules are, you can colour them with, let's say, the five different colours that we show and you can inject a bolus, a combination of these markers that have different targets on it. It'll travel through the body and then hopefully it'll find the different targets and you can colour-label them. That's one example of how it's used.

This is where basic research becomes very important, because we still don't fully understand how the particles move within the body once you inject them. We know they can move very freely because of size. Your body is basically full of compartments. It can access certain things. We don't understand that. If you develop this thing, it may also have side effects. If it goes into compartments that are protected, that you normally can't access, it causes problems.

The fundamental studies to understand how to design the particles will allow you to better design your structures. But, at the end of the day, it's when nano combines with biology. The genomics guys and the proteomics guys need to find these targets. We now hook this up to our particle, inject it together, combine it into the system, which then allows us to light up the disease.

● (1255)

The Chair: It's a rare combination to see a scientist who's developed a business, and it's very good, very intriguing to see that happen. As a scientist and as a business person, when you were talking about targeting your research and trying to get a grip on.... As I heard you say earlier, there are no really big nanotechnology industries here in Canada. You've come from the U.S. and you now live in Toronto. From what I heard you say this morning, there are limited opportunities, so how do you build that business?

Federally we've put a lot of money into cancer over the years. I'm wondering, if you focused on something like cancer—one in four people in this country will be touched by cancer—couldn't you get other people in other businesses? Have you ever considered that? It seems to me, from your demonstration today, that you have a clear idea of how you could develop this nanotechnology in the field of cancer. Am I right or wrong?

Dr. Warren Chan: I have 20 researchers in my lab right now. We're focusing on two areas: one is diagnostics and one is in vivo cancer application. It's very clear, the directions are there. Because we work in an academic system, students graduate. By the time you train them well enough, they move on to do something else, so I keep on restarting the process every few years.

The way we do research in my lab is that everyone comes in and we're solving one set or block. When that's done we go to the next block in the next four years. The reason we have to do it that way is that CIHR grants, NSERC grants, are not enough to be able to move in that direction. My average CIHR grant is about $100,000, which will fund a couple of students, but you need a mass of people. That's one challenge.

The second challenge comes down to people. I'm on a CIHR review panel, which is why I'm stepping out to be here. Not that many nano cancer people have the expertise to review these things. A molecular biologist may not understand this aspect of cancer application. This is why they brought me in to do the nano. But if I'm applying, there might not be a person who understands this particular category. From that perspective, what we've done is piece a bunch of grants together to have enough money to move from step one to step two. I have about 13 grants right now. If you average 13 grants, each one is maybe about $50,000 or $55,000; combined it's about $600,000. That's my budget for 20 people.

The Chair: No, I fully understand, and it's very exciting to see what you're doing, but I'm just thinking that when you look at businesses wanting to invest, businesses do want to earn the dollars for their own development. How rigorously have you also approached businesses to help out? Do you have an opportunity to do that? Or how do you do it?

Dr. Warren Chan: I actually have U.S. companies interested, not Canadian companies. One of the companies is one of the first companies in the U.S. that the Gates Foundation invested in. I'm in continual talks with their CFO and their COO, plus some work.... It's not on paper, but at one time they were interested in moving to Toronto to work with us on some of this. Again, the problem is that I couldn't get matching money. NSERC has matching programs, but you have to be an established Canadian company even though you'd be bringing money into Canada.

They actually support one of the cancer nanocentres in North Carolina. They thought, oh, maybe it would a good idea to do them both, Canada and North Carolina, so that we can combine the two infrastructures to bring some of these technologies forward.

So far, most companies have approached me based on our publications. They see our papers, they need expertise, so they call me up to work with them.

● (1300)

The Chair: Both of you, and all our guests today, have contributed in such a major way to our health committee. It would be really nice to have you back sometime, if that's the will of the committee. It's been a very interesting day today, and I thank you.

With that, I have to dismiss the committee. I'm so grateful we didn't have any bells ringing today.

The committee is dismissed, with our thanks.

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