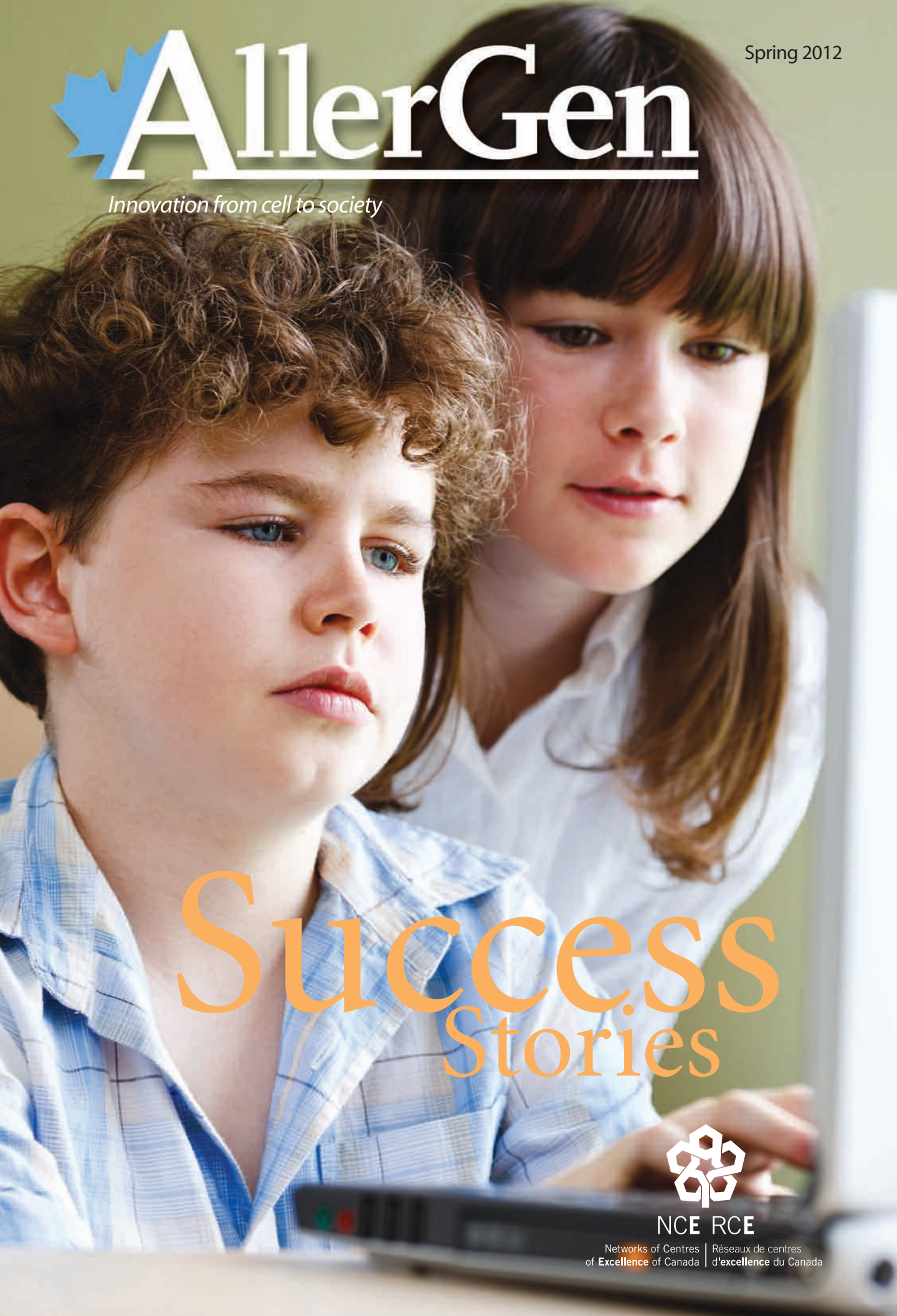
AllerGen
Innovation from cell to society
Spring 2012
Success
Stories
NCE RCE
Networks of Centres of Excellence of Canada
Réseaux de centres d'excellence du Canada

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Making a Difference
From cell to society

AllerGen NCE Inc. (AllerGen), the Allergy, Genes and Environment Network — one of Canada's Networks of Centres of Excellence (NCE) — is pleased to present the fourth issue of *Success Stories*, featuring research accomplishments of leading Canadian allergy, asthma, anaphylaxis, genetics, environment and education researchers, their students and research partner and patient stakeholder organizations.

In this issue, the results of five AllerGen-supported projects are presented. Feature stories include:

- Predicting allergies and asthma in babies by examining their stem cells
- New asthma diagnostic tests for infants and young children
- How airway cells respond to viruses and air pollution
- Online asthma and allergy education programs for children, teens, parents and healthcare professionals
- Easing the burden of asthma in the workplace.

Asthma and allergic diseases cost the Canadian economy billions of dollars in healthcare and lost productivity each year. The beneficiaries of AllerGen research results span the generations, from infants, children and teens, to their parents, families and Canadian workers. Healthcare providers are benefiting too, through access to new, specialized online learning programs, new and improved diagnostic tools and novel therapeutics.

AllerGen invests in research in the following broad programmatic areas:

1. Gene-Environment Interactions
Strategic Focus: Genetics, environmental exposures and gene-environment interactions in allergy and asthma

2. Diagnostics and Therapeutics
Strategic Focus: Biomarkers, immune monitoring and drug development/discovery

3. Public Health, Ethics, Policy and Society
Strategic Focus: Allergic disease management and surveillance.

In addition, AllerGen NCE supports four cross-programmatic, multi-disciplinary research teams:

i. The Canadian Healthy Infant Longitudinal Development (CHILD) Study

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ii. Food Allergy and Anaphylaxis – the Canadian Group on Food Allergy Research (CanGoFAR) team

iii. Mind-Body Interactions and Allergic Disease

iv. Occupational and Work-related Allergy and Asthma.

Since 2005, AllerGen NCE has brought together Canada's leading experts in allergic diseases and asthma. Working in partnership with organizations and stakeholders across sectors, AllerGen is addressing unmet needs for new knowledge, supporting its mobilization, generating new preventive strategies, diagnostic tests and therapeutic approaches, better medications, public policies and regulations and publicly accessible information and educational tools.

In sharing these stories, AllerGen aims to decrease the burden that allergy and asthma impose on Canadian productivity and economic growth, contribute to Canadian innovation and commercialization, and improve the quality of life for Canadians living with allergic diseases, asthma, and anaphylaxis.

We hope you enjoy this latest issue!

Judah Denburg, MD, FRCP(C), Scientific Director and CEO

Diana Royce, EdD, Managing Director and COO

Early diagnosis of allergic disease provides greater opportunity for medical and lifestyle interventions that may alter disease progression and ultimately increase a child's quality of life while growing up.

Predicting Allergies and Asthma in Babies — Pioneering Canadian Scientists Discover that Stem Cells are "Crystal Balls"

Parents envision their newborn baby developing from a beautiful, active child into a healthy, happy and productive adult. They wonder what traits their son or daughter will inherit or develop. Parents who suffer from asthma and/or allergies worry about their child also developing these conditions as they grow up. New evidence from AllerGen-funded research shows that it may be possible to predict the risk of developing allergies and asthma much earlier in childhood — even at birth.

Dr. Judah Denburg, Scientific Director and CEO of AllerGen NCE and Professor of Medicine at McMaster University

An international team of scientists led by Dr. Judah Denburg, Scientific Director and CEO of AllerGen NCE and Professor of Medicine at McMaster University, has discovered that hemopoietic stem cells (*i.e.*, those giving rise to blood), found in abundance in a baby's umbilical cord blood, can help predict susceptibility to developing allergies and/or asthma later in life. Early diagnosis of allergic disease provides greater opportunity for medical and lifestyle interventions that may alter disease progression and ultimately increase a child's quality of life while growing up. Successful development of an early-life predictive test would revolutionize both diagnosis and management of allergies and asthma, resulting in the best possible health outcomes for children.

From Observation to Experimentation

Even though Dr. Denburg is the leader of an asthma and allergy research centre, he was trained in hematology, which is the study of blood, blood-forming organs, and blood diseases. In searching for a diagnostic test for a certain type of leukemia that involves many inflammatory cells also present in allergic inflammation (mast cells, basophils and eosinophils), Dr. Denburg used his own blood sample as the *control*, and found, to his astonishment, that it was replete with many hemopoietic stem cells that become mast cells, basophils and eosinophils. Since he did not have leukemia, Dr. Denburg began to wonder if his allergies were responsible for the increased presence of stem cells in his blood, and if so, if this condition was common to all people with allergies. Years of further research by Dr. Denburg proved that his initial hypothesis was correct, and that hemopoietic stem cells, and the bone marrow where they are produced, are in fact highly involved in allergies and asthma in older children and adults with these conditions.

Cord Blood Stem Cells as Allergy Predictors

Over the past few years, Dr. Denburg has been preoccupied with determining whether or not hemopoietic stem cells in a newborn baby's cord blood contribute to, or predict, the development of allergic disease. With funding from AllerGen NCE, the Canadian Institutes of Health Research, as well as several industry partners, Dr. Denburg assembled a team of pan-Canadian and international scientists to help investigate this possibility using data from several longitudinal birth cohort studies undertaken in Canada and Australia in which information on a baby's allergic risk, based on parental history and skin testing as well as maternal environmental exposures, was available.

In all, Dr. Denburg and his collaborators collected the cord blood of several hundred babies and then tracked them over several years. The cord blood samples were cultured in the laboratory and observations were conducted. The team confirmed a strong relationship between the levels and types of hemopoietic stem cells found in the babies' cord blood and the level of risk for developing allergies, as well as some early manifestations of allergic disease in the babies as they were growing up. For example, the team found that certain changes in cord blood hemopoietic stem cells are indicative of the extent to which a child will develop a fever and wheezing when battling a viral infection, and the development of eczema, an allergic skin condition, in the first years of life.

As a result of Dr. Denburg's research, we now know that the hemopoietic stem cells in the cord blood of *at risk* babies are programmed to generate inflammatory cells that are the key actors in allergies. "The cord blood really does have an imprint of allergy risk embedded in the profile of the stem cells. That's a really surprising discovery," says Dr. Denburg. The implications of this research are two-fold. First, there is an opportunity to develop a blood test that identifies hemopoietic stem cell programming for early diagnosis of allergies. Second, it provides a window of opportunity for development of novel treatments that go beyond managing allergy symptoms, such as a runny nose and wheezing, to actually modifying allergic risk early in life.

Dr. Denburg and his colleagues from McMaster University, several other AllerGen-associated Canadian universities, and institutions in Europe and Australia continue to examine the impact that maternal nutrition, smoking and exposure to chemicals during pregnancy have on a baby's hemopoietic stem cell programming. On the current AllerGen research team are also world-renowned scientists with different areas of expertise, including: Drs Guy Delespesse (Centre hospitalier de l'Université de Montréal – Research Centre); Mark Larché and Gail Gauvreau (McMaster University); Kelly McNagny (University

"Having a whole network approach has been invaluable," states Dr. Denburg. "It brought me together with other leading researchers from around the world...."

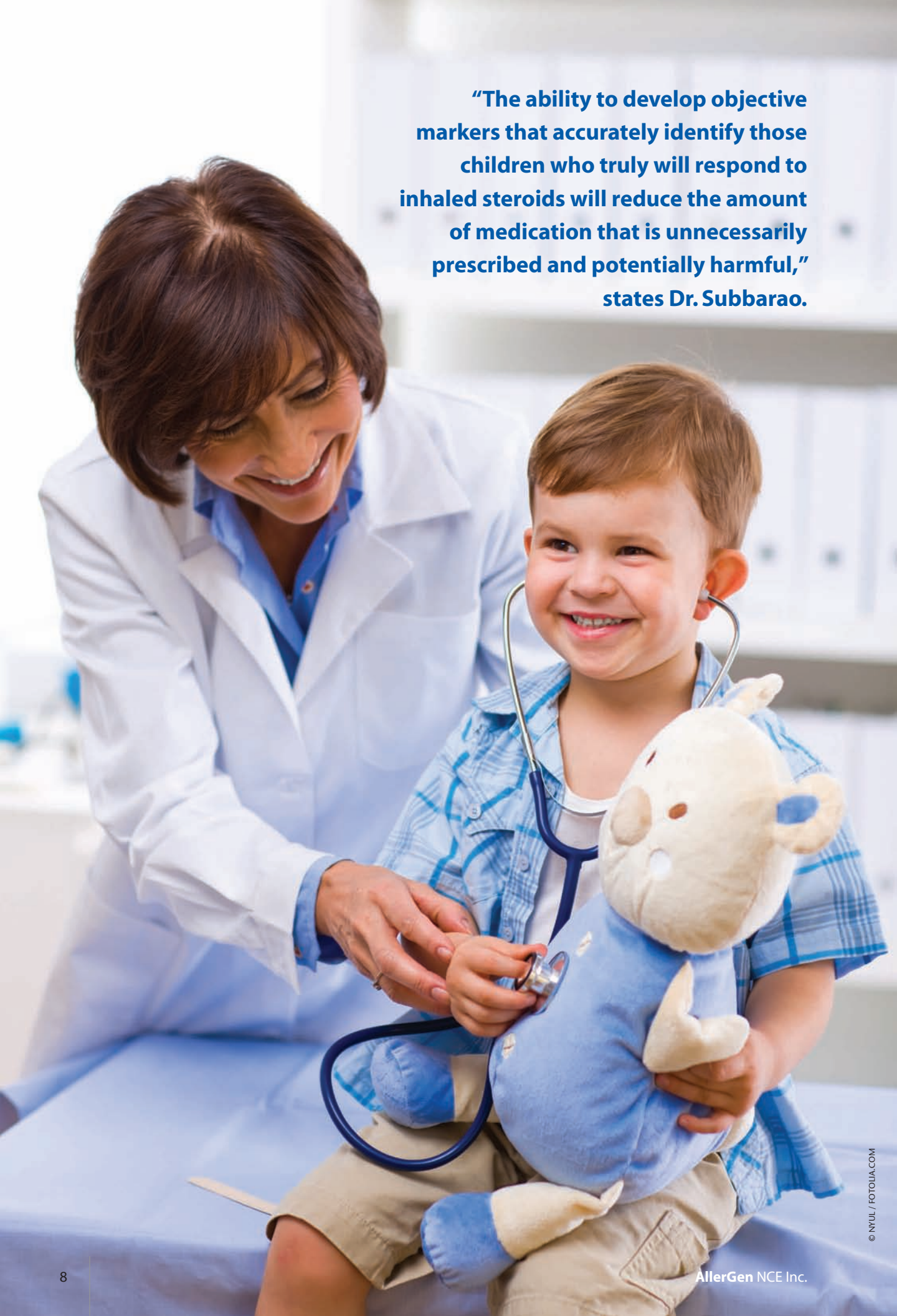
of British Columbia); and, Anne Ellis (Queen's University). This team, called "STEM" (Stem-cell Team for Emerging Markers) is financially supported by AllerGen NCE, the Canadian Institutes of Health Research (CIHR), the National Research Council (NRC) and industry partners.

STEM is now poised to apply stem cell analyses to cord blood samples from AllerGen's own Canadian birth cohort study, the *Canadian Healthy Infant Longitudinal Development* (CHILD) *Study* collected at The Hospital for Sick Children site (led by Dr. Padmaja Subbarao). The CHILD Study, directed nationally by Dr. Malcolm Sears (McMaster University) is the largest birth cohort study ever undertaken in Canada to uncover the causes of allergic disease and asthma. The CHILD Study is a joint initiative between AllerGen NCE and CIHR, with several federal and provincial partners, and will provide abundant biological samples for future study.

The Benefits of a Research Network

AllerGen NCE is known in the scientific community for promoting team-building across multiple research disciplines. "Having a whole network approach has been invaluable," states Dr. Denburg. "It brought me together with other leading researchers from around the world, and provided added-value funding for networking and collaboration. We are now part of a team. These are the windfalls of having a network."

To most parents, having Canada's best scientific minds working together to tackle the growing problem of allergic disease is comforting, particularly when newer and better options for diagnosis, management and treatment are found. Results arising from the STEM team's efforts are leading the way forward to that end, providing us with a valuable new stem cell "crystal ball" with which to predict allergies and asthma in early life.



"The ability to develop objective markers that accurately identify those children who truly will respond to inhaled steroids will reduce the amount of medication that is unnecessarily prescribed and potentially harmful," states Dr. Subbarao.

When is Your Child's Wheeze a Sign of Asthma? Canadian Researchers Establish New Diagnostic Tests for Infants and Young Children

This is the story of a Toronto pediatrician and her drive to find cutting-edge tests for lung function and airway inflammation that could be used to objectively identify infants and young children with asthma. Thanks to the efforts of Dr. Padmaja Subbarao and her team, Canada is poised to become a world leader in preschool asthma research.

Dr. Padmaja Subbarao, Clinician-Scientist, The Hospital for Sick Children and Assistant Professor, University of Toronto

Wheezing Kids and the Need for Non-Invasive Diagnostic Tests

Wheezing is generally described as a chesty, whistling sound that is heard when a child breathes out and sometimes also when they breathe in. In children under the age of six, episodes of wheezing are exceedingly common. In fact, nearly half of all children have experienced a bout of wheezing. There are a wide variety of underlying causes for childhood wheezing, including lung infection that develops from viruses like the common cold, being born with abnormally small airways, cystic fibrosis and, of course, asthma.

Dr. Subbarao is a pediatric respirologist, or more simply, a child lung doctor, who was frustrated that she and her fellow physicians didn't have handy diagnostic tests to determine which wheezing children under the age of six have asthma and which don't. They relied solely on X-rays and clinical symptoms in order to make their diagnoses.

Currently, most children who experience wheeze are treated with escalating doses of powerful inhaled steroids. What troubles Dr. Subbarao is the fact that only 15% of these children have allergic asthma that responds to such drugs. "The ability to develop objective markers that accurately identify those children who truly will respond to inhaled steroids will reduce the amount of medication that is unnecessarily prescribed and potentially harmful," states Dr. Subbarao.

Around the age of six, children are typically able to perform the traditional lung function test, which involves blowing into a tube. Children younger than four years of age usually haven't mastered how to blow out through their mouths. If you have ever watched a young child try to blow out candles on a birthday cake but cannot, "It's the same reflex. They want to be able to do it, but they don't know how," explains Dr. Subbarao.

The problem with waiting until a child is capable of performing the traditional lung function diagnostic test is that, in the meantime, the child's airways are potentially being damaged by asthma if the child in fact has the disease. The latest research demonstrates that the disease develops early in a child's life, perhaps even in the womb. Thus, the earlier the diagnosis can be made, the better. This could mean improved control and management of the disease, which will hopefully result in not only fewer hospital admissions and missed school days, but also better quality of life, less anxiety and less time

away from work for parents. According to the Asthma Society of Canada, this disease is currently the leading reason for children missing school, as well as for hospital emergency room visits.

Based on the limitations of current diagnostics tools, Dr. Subbarao set out to develop cutting-edge tests for lung function and airway inflammation that could be used to objectively identify infants and young children with asthma. The tests needed to be safe and comfortable for children to undergo; otherwise they too would be ineffective. "My work in this area is really born out of a clinical need," says Dr. Subbarao.

The data generated by the CHILD Study will offer insights into how allergic diseases get their start. It should be noted that this data will be clinically useful for research in every area of paediatric respiratory disease, such as cystic fibrosis, congenital lung disorder and interstitial lung disease....

Canada's First Infant Lung Function Laboratory

With funding from AllerGen NCE and The Hospital for Sick Children in Toronto, Canada now has an infant lung function laboratory. This is a major accomplishment, since there are only a few centres in the world that do specialized testing on infants due to the extensive training required of both the physicians and technologists involved.

Dr. Subbarao and her team, Drs Malcolm Sears (McMaster University; St. Joseph's Healthcare); Martin Post (University of Toronto; The Hospital for Sick Children Research Institute); Felix Ratjen (University of Toronto; The Hospital for Sick Children); Hartmut Grasemann (University of Toronto; The Hospital for Sick Children; The Hospital for Sick Children Research Institute); Dean Befus (University of Alberta); and Darryl Adamko (University of Saskatchewan) are working on multiple tests to measure lung function and airway inflammation that involve both developing new and testing existing technologies.

The big question to be answered is whether or not these tests are able to accurately predict asthma in infants and children before they are able to perform the standard lung function test by blowing into a tube. While research is ongoing, Dr. Subbarao and her dedicated team have thus far established that lung function tests can be done on children as young as three months of age. It causes them no discomfort. In fact, she notes that they are able to sleep through the test.

The team has also looked at and ruled out *Exhaled Breath Condensate* as a useful test for diagnosing preschool asthma; a surprising result given the buzz about this new test in lung research circles. Dr. Subbarao explains that researchers expected to find at least one correlation between what is breathed out and airway inflammation measured in the sputum of asthmatics as a result of chance or statistical error. However, there wasn't even one correlation among the fifty different parameters measured. She concluded that "this test was extremely unimpressive."

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While they were disappointed with the *Exhaled Breath Condensate Test,* the team has been impressed by results from the *Multiple Breath Wash Out Test*, which is a lung function test developed in Sweden by paediatric respirologist, Dr. Per Gustafsson. This test measures how well the lungs perform in breathing and clearing gases. If a person has airway obstruction resulting from inflamed airways due to asthma, it is hard for them to get air in and out of their lungs.

Performing this test involves wearing a face mask and breathing in a precise mixture of gases while hooked up to a machine that measures the concentration of the different gases exhaled. "It's an amazing technology because it can be applied

to infants as well as to adults," says Dr. Subbarao. What is remarkable about this test is its ability to detect lung disease in early life. Originating from research that has been done on children living with cystic fibrosis, the test is very precise in that it has very tight cut-off markers for what is normal and what is abnormal lung function.

Dr. Subbarao describes the *Multiple Breath Wash Out* test as "leading-edge technology." The laboratory that she helped establish is the only one in North America that has this test available. "With respect to the technology development that we have done here in Toronto, this is the jewel in our crown," she says.

What's Next for Our Infant Lung Function Laboratory?

Once Dr. Subbarao and her team have confirmed which tests have predictive value and have perfected the techniques for using these tests, they will be put to use as part of the *Canadian Healthy Infant Longitudinal Development* (CHILD) *Study.* This multidisciplinary study of 5,000 Canadian children, enrolled from pre-birth and followed for five years, is by far Canada's biggest asthma and allergy focused birth cohort study. It will allow this team to administer the tests easily and effectively so that they may diagnose or rule out asthma in early childhood.

Dr. Subbarao is excited that the CHILD Study is collecting data on children with healthy lungs, in addition to data on children diagnosed with asthma. In terms of lung health, control data from healthy subjects has never been collected in Canada before, so researchers don't yet know what is *normal* for Canadian babies and young children.

The data generated by the CHILD Study will offer insights into how allergic diseases get their start. It should be noted that this data will be clinically useful for research in every area of paediatric respiratory disease, such as cystic fibrosis, congenital lung disorder and interstitial lung disease — not only the development of asthma and allergy. "This data will be important for Canada and the rest of the world," says Dr. Subbarao.

The lung function and airway inflammation tests that Dr. Subbarao and her team are establishing could soon be used to not only diagnose asthma earlier and in mild cases, but also to serve as a vital tool in disease management. "Ultimately, we hope that a combination of these lung function measures, once tested within the CHILD Study, will help us to diagnose infant asthma," says Dr. Subbarao.

These new tests will also become important for future drug trials. The *Multiple Breath Wash Out Test* has already been used in the cystic fibrosis population and has been shown to reduce the number of child subjects needed for a study. The result is that researchers can now do *proof of concept* studies for new therapeutics with increased efficiency. Previously, 200+ children were required to perform a study in order to show that a drug has treatment effect. Now, because the *Multiple Breath Wash Out* test is very sensitive, researchers can measure as few as 17 children to show therapeutic effect for a new drug. This leads to tremendous reductions in cost as well as the potential to speed up the rate at which a new drug can reach the market and be used by Canadians.

Additionally, these new tests could also help researchers develop new therapies for non-asthma wheezing. "We have very little to offer those kids in our emergency rooms that have wheeze, but are not necessarily asthmatic," says Dr. Subbarao.

The Vital Importance of AllerGen NCE Funding

With funding from AllerGen NCE, Canada is one of the few countries in the world to have an infant lung function laboratory. "AllerGen plays a very significant role in trying to understand and reduce the burden of allergic diseases in Canada," says Dr. Subbarao.

AllerGen NCE funding has made cutting-edge techniques for measuring infant lung function and airway inflammation available in Canada and more importantly, has enabled validation of these new techniques on the Canadian population. The payoffs will no doubt be significant — reducing the financial burden on the health system and reducing the disease burden borne by those living with asthma. These tests will be instrumental tools for CHILD Study researchers, helping them in their quest to understand the origins of allergic diseases. They are also set to become useful tools for physicians in diagnosing and managing preschool asthma, not to mention a host of other lung diseases. In addition, these techniques are extremely important to the development of new therapeutic treatments and for use in future drug trials.

Recent studies on children have shown that remodelling happens earlier than previously thought, and before a child shows visible signs of having chronically inflamed airways. Thus, a child has damage and airway changes far in advance of experiencing asthma symptoms, such as laboured breathing or wheezing.

Internationally Acclaimed Canadian Scientists Discover How Airway Cells Respond to Viruses and Air Pollution — Is a Revolutionary New Drug for Airway Diseases on the Horizon?

Dr. Tony Bai, Division of Respiratory Medicine at the University of British Columbia

Research scientists have known for many years that viruses and air pollution contribute to the development and worsening of airway diseases like asthma and Chronic Obstructive Pulmonary Disease (COPD), but did not fully understand the reason. With funding from AllerGen NCE and the Canadian Institutes of Health Research (CIHR), Dr. Tony Bai and his world-class team in the Division of Respiratory Medicine at the University of British Columbia (UBC), embarked on a mission to determine the mechanics of cell damage and repair that takes place in the epithelium lining of the airways after exposure to viruses and air pollution. This team's ground-breaking discoveries concerning damage and repair in asthma-affected airways are causing a major "buzz" within international research circles. Their discovery could lead to the development of a new type of medication that actually delays, changes, or interrupts the progression of asthma and COPD, instead of just managing the symptoms.

The Epithelium — More Than Just a Barrier Structure

The epithelium is a lining that is composed of cells and is found in all the cavities and on all the surfaces of structures throughout the body. These epithelial cells are the first layer of contact for particles after air enters the nose during breathing. It was first thought that the epithelium served to moisten the airway and act as a barrier structure protecting the underlying connective tissue from disease-causing pathogens and harmful particles. However, scientists now know that the epithelium is also involved in the airway's inflammatory responses to viruses and air pollution.

Dr. Tony Bai and his co-investigators at UBC, Drs Delbert Dorscheid, Darryl Knight, Stephan van Eeden and Richard Hegele, were interested in understanding exactly how the airway epithelium responded to common environmental exposures such as viruses and air pollution. They were also curious to find out whether or not individuals with diseases such as asthma would respond differently.

The team extracted epithelial cells from lungs obtained from the International Institute for the Advancement of Medicine, an American non-profit organization. A total of 25 lungs deemed not suitable for transplantation were obtained. Half of the lungs came from individuals with a history of asthma, while the other half had no previous history of the disease. These epithelial cells were then grown in a culture of air and liquid, giving the culture a three dimensional quality that mimics the actual airway epithelium. This cutting-edge technology was obtained from MatTek Corporation, the world's largest independent producer of ready-to-use *in-vitro* 3-D human epithelial tissue equivalents. This technique is superior to the traditional culture, where a single layer of cells is grown on a flat piece of plastic. The team also collaborated with Dr. George Agnes and PhD student Teresita Cruz from Simon Fraser University, to come up with a method to create a particle that holds both a virus and carbon. Carbon represents the largest component of air pollution. The particle mimics real life scenarios where cells are simultaneously exposed to viruses and air pollution. The particles were then deposited onto these 3-D cultures of epithelial cells and subsequently, responses were measured and analyzed.

The team discovered that the epithelium of the lungs with asthma had *heightened* or *exaggerated* responses to viruses and air pollution compared to the epithelium of those with no history of the disease. This means that people with asthma produce a significantly greater amount of inflammatory chemicals in their cells in response to cellular damage. Additionally, the team

found that asthmatic airway cells take much longer to repair than non-asthmatic cells, once damage has occurred. This study also highlights the differences in the composition of epithelium cells in asthmatic patients, as opposed to non-asthmatic patients. For example, asthma patients have a significantly greater number of mucus cells present in their epithelium, which explains why they experience more congestion and cough. Asthma sufferers also have more stem cells present in their epithelium. Stem cells are *immature* cells important for cellular repair of the epithelium, which is damaged by asthma. Mature cells have tiny hair-like structures called cilia that help to move mucus along the airways; stem cells do not. Therefore, more epithelial injury and mucus producing cells and less mature cells with *cilia* mean more congestion and shortness of breath as the asthmatic epithelium never seems to become normal. The research team is not yet sure whether or not people with asthma are born with more stem cells in their epithelium, or if the number of stem cells increases as the disease progresses.

The Epithelium and Airway Remodelling

Over the past 40 years, asthma has traditionally been thought of as an inflammatory process in the airways. Therefore, all asthma medications were produced to inhibit or reduce inflammation. Scientists now know, however, that it is more complex than that as inflammation is also part of normal repair processes. People with asthma undergo a process of permanent change to the very structure of their airways, called *remodelling*. This results in a thickening of the airway walls, which ultimately narrows the airway passages causing the disease to progressively worsen over time and respond less well to treatment.

Scientists previously believed that remodelling occurred long after a patient had first been diagnosed with asthma. It was

thought that remodelling was brought about by the continual cycle of cell damage and repair that occurs in inflamed asthmatic airways. However, recent studies on children have shown that remodelling happens earlier than previously thought, and before a child shows visible signs of having chronically inflamed airways. Thus, a child has damage and airway changes far in advance of experiencing asthma symptoms, such as laboured breathing or wheezing.

Dr. Bai and his team investigated the role of epithelial cells in remodelling, as the epithelium is important in the development and progressive worsening of asthma. They discovered that epithelial cells in people with asthma are quite *plastic*, compared to the epithelial cells in those with no asthma. *Plastic* epithelial cells are more likely to change into fibroblasts, which are cells that play a critical role in wound healing by producing the matrix that epithelial cells like to stick to and migrate on. However, excessive matrix growth in asthmatic airways contributes to tissue thickening and remodelling, further narrowing of the airways and increased breathing difficulties.

This research identifies the need for an asthma medication that targets the remodelling process along with traditional medications to control airway inflammation. There currently exists no medication on the market that stops epithelial cells from transitioning into fibroblast cells or promotes repair. Unfortunately, it becomes difficult to reverse the remodelling process once fibroblasts lay down matrix and thicken the airway walls, so promoting epithelial repair appears to be the best solution.

AllerGen NCE has recognized the critical importance of developing a medication that stops remodelling and progression of the disease. Led by Dr. Dorscheid, AllerGen NCE recently invested an additional $100,000 into the development of such a medication. If this dedicated research team is successful, a new medication will revolutionize asthma treatment not only in Canada, but globally.

UBC's Respiratory Department Ranked 3rd in the World

The publication *Science Watch* recently compared the performance of academic institutions around the world based on published research output and frequency of work referenced in other academic works. UBC's Respiratory Department at St. Paul's Hospital, the home of the aforementioned research team, was ranked 1st in Canada and 3rd in the world. Dr. Bai and his team have generated five research papers about this discovery to date. Two papers are found in the field's top journals, while three are pending publication. Results have also been presented at national and international conferences generating a great deal of interest from within the scientific community, particularly with respect to remodelling and the transition of epithelial cells into fibroblasts.

UBC's Respiratory Department at St. Paul's Hospital, the home of the aforementioned research team, was ranked 1st in Canada and 3rd in the world. Dr. Bai and his team have generated five research papers about this discovery to date. Two papers are found in the field's top journals, while three are pending publication. Results have also been presented at national and international conferences generating a great deal of interest from within the scientific community, particularly with respect to remodelling and the transition of epithelial cells into fibroblasts.

Reflecting on the impact of AllerGen's investment in this team, Dr. Dorscheid noted that "AllerGen NCE funding is unique in that it encourages a multi-disciplinary approach and allows researchers within different disciplines to work together. The AllerGen NCE grant allowed our team to broaden the project and look at both virus and particulate matter exposures, as well as focus on developing new methods for cultures and designer particles."

Having a child that lives with a chronic, potentially life-threatening condition is extremely stressful for parents. Parents of children with severe allergies and asthma interviewed in the second study said that it is a "journey of worry" where there is "no escape."

Using the Internet to Improve Education and Support for Canadian Children, Teens, and Parents Affected by Asthma and Allergies

Recent research reveals that traditional disease management and health education strategies do not significantly contribute to children's and teenagers' skills for coping with asthma and allergies or improve their lives. Isolation and loneliness are common among children with asthma and allergies. They want to be like their peers, and may not reveal their condition to others. Improving support seeking and other coping skills could result in higher quality of life for children and teens, less stress on parents, and reduce the need for health services.

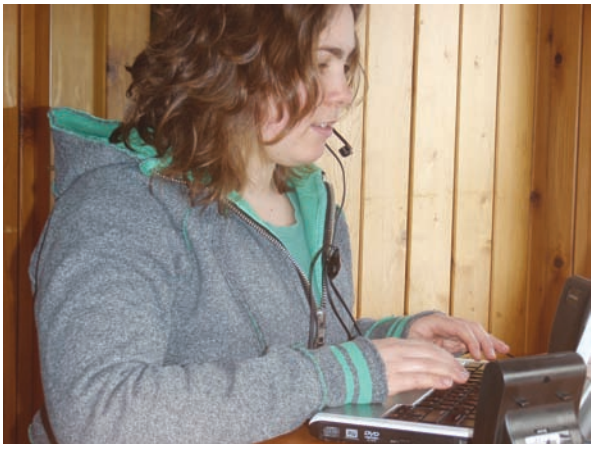
Dr. Miriam Stewart, AllerGen Investigator and Professor, Faculty of Nursing, University of Alberta

Dr. Miriam Stewart, AllerGen Investigator and Professor, Faculty of Nursing, University of Alberta, and her research team recognized that few researchers had directly asked children, teens, and parents how they would like to be supported and educated for managing allergies and asthma. She and her team, including Drs Jeff Masuda (University of Manitoba), Nicole Letourneau (University of Calgary), and other researchers and organizations in Canada set out to do just that. Then, they harnessed this new knowledge to design and test new web-based support programs that have been used and applauded by children with asthma and allergies and their families.

Dr. Stewart and her team, including Shawna McGhan, RN, Alberta Asthma Centre, also assessed the educational and support needs of health professionals that provide services for children and teens with allergies and asthma. They found that these health professionals, who reported having limited time and professional development options, would benefit from web-based programs on how to effectively educate and support children and teens living with these chronic diseases.

Listening to Children and Teens with Allergies and Asthma

The children and adolescents who participated in these AllerGen-supported studies revealed that the lifestyle restrictions resulting from severe allergies and asthma made them feel socially isolated and frustrated. They experience difficulty breathing when running or playing sports, are unable to have a pet, and constantly worry about having an asthma or allergy attack. Those with food allergies are unable to eat meals with family and friends without confirming every ingredient. They avoid social events like birthday parties and sleepovers. In short, children and teenagers with allergies and asthma often feel lonely and excluded from social circles. The children in the study also shared that although their mothers were their main source of support, they craved support from peers, particularly in a group setting. To learn about managing allergies and asthma, the children expressed a strong preference for mentoring from older children who also had allergies and asthma, and who, as peers with first hand experience, could offer advice on how to cope with these diseases. Parents also believed that support from peer mentors with similar experiences would enhance their children's health behaviours and increase their ability to manage asthma and allergies in home, school and community settings.



Erika Ladouceur was a mentor for both youth and children's groups.

Manuel Mihai — Youth Intervention Group member

Matthew — Youth Intervention Group member and mentored in children's intervention

Kaitlyn — Youth Intervention Group member and mentored in children's intervention

Based on the children's preferences, Dr. Stewart's team created and tested secure, weekly online support groups for children. These groups were facilitated by trained peer mentors — teens with allergies and asthma — and supervised by a health professional. The online support group meetings ran for eight weeks, with an overall attendance level of 87%. "Parents said children were very eager to participate," states Dr. Stewart.

The program proved to be highly successful. After it was completed, the children reported that they felt less lonely and isolated. Their perceived support and their support seeking skills increased significantly. They learned that other children who have allergies and asthma face similar challenges and like themselves, struggle to break down social barriers. As a result of the online support program, the children reported that they had more control over their health condition and felt more confident in communicating their needs to other children and to adults within their schools and community.

In another study, Dr. Stewart's team discovered that teen - agers also preferred peer-based learning and support. Challenges facing teens include moving from parent-controlled care to self-care, dealing with peer pressure, and seeking a sense of normality. Based on this information, Dr. Stewart's team set up weekly online chat sessions that ran for 12 weeks. Similar to the children's online support program, the group sessions were facilitated by trained, older teens with severe allergies and asthma. These sessions were supervised by a health professional.

The online chat sessions for teens were also successful. The participants reported that their feelings of social isolation and loneliness were significantly reduced following the 12 week online support program. They also felt more confident in managing their asthma and allergies, and more comfortable handling bullying and peer pressure. The teens enjoyed the sessions so much that when the program was completed, many continued to meet on Facebook and some became peer mentors for the younger children's online support program.

Helping Parents Cope

Having a child that lives with a chronic, potentially life-threatening condition is extremely stressful for parents. Parents of children with severe allergies and asthma interviewed in the second study said that it is a "journey of worry" where there is "no escape."

Parents also reported that they feel alone and isolated, and at times unsure about the best way to help their children. Parents indicated that they would benefit from emotional support from other parents of children with asthma and allergies who would understand their stress, but noted that they had been unsuccessful in locating peer support. Parents wanted access to and help interpreting health and disease management information and needed practical support from their communities, especially from their children's schools. For example, they want to know if school professionals are able to handle life-threatening emergencies resulting from allergies, and whether or not they can feel safe sending their child to school.

After assessing parental support gaps, Dr. Stewart's team developed online support group sessions specifically tailored to meet parents' needs. In these sessions, the team connected parents of children with asthma and allergies and children's peer mentors. They discussed topics such as the transition to middle school, risky behaviour, and self-care. They also discussed health information with a health professional. The main advantages of meeting online, according to these parents, were that they

didn't have to leave home and arrange care for their children, and that they could connect with other parents regardless of geographical location. "Parents recommended that this type of online support intervention be readily available, particularly for parents of newly diagnosed children," noted Dr. Stewart.

Educating the Educators

Dr. Stewart, Ms. McGhan, and the research team were also the first to study the perspective and learning needs of health professionals as potential support providers for children and families affected by allergies and asthma. They found that health professionals have limited time, funds, and options for allergy and asthma-related professional development activities, and that they want web-based education with access to experts and peer group discussions. Health professionals wanted clear and concise course content that teaches them practical skills for supporting children who have allergies and asthma, and which addresses challenges such as dealing with teens who don't take their medications because they want to fit in with their peers. An important advantage of web-based education is that busy health professionals can participate at their convenience.

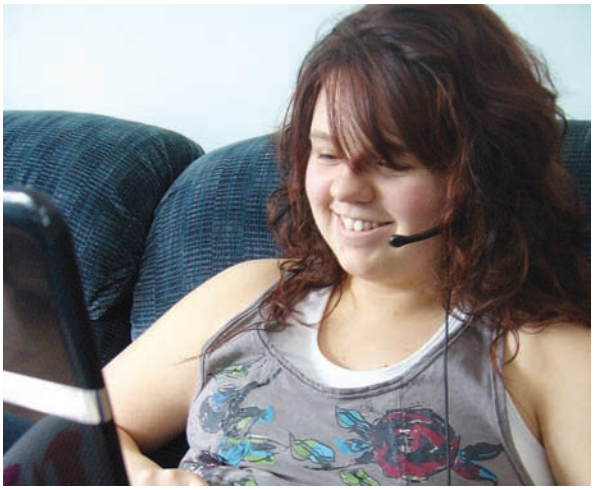
Insights from health professionals, who represented a variety of disciplines and were all engaged in the care of children and teens with allergies and asthma, guided the research team's design of a twelve week online educational program. Those who participated in the online program reported that it was relevant to their practice. Furthermore, 84% of the health professionals planned to change their practice based on what they learned.

Why Support for Children, Teens, and Parents Living With Allergies and Asthma Matters

These AllerGen NCE funded studies were the first to directly ask children, adolescents and parents how they would like to be supported in managing allergies and asthma. The web-based support tools and education programs designed by Dr. Stewart's team not only meet the needs of children and teens living with severe allergies and asthma regardless of where they live in Canada, but also the needs of their parents. These online support programs help children, teens and parents feel less socially isolated, improve coping skills in a variety of stressful situations, and increase their confidence to take control of managing allergies and asthma. This translates into better quality of life for children, adolescents and families affected by these chronic health conditions, enhanced disease management and more effective health service delivery.

In addition, Dr. Stewart's team was also the first to design an online course tailored to the learning needs of health professionals as potential support providers for children and families affected by asthma and allergies. All of the online support programs were successful. "The interest and participation in these studies was exceptional," says Dr. Stewart.

These Canadian studies, undertaken by Dr. Stewart's team including Drs Masuda, Malcolm King, (University of Alberta), Heather Castleden, (Dalhousie University), and Susan Elliott



Annelise Knoot — mentor to younger children's group

(University of Waterloo) have led to new initiatives that involve assessing the unique support needs of Aboriginal children and teens that have asthma and allergies, as well as their parents, and the team is designing and testing support and education programs based on their preferences. This study, also funded by AllerGen NCE, in collaboration with a host of allergy and asthma advocacy associations, non-profit foundations, and health professionals' networks across Canada, is both innovative and timely. Dr. Stewart notes that "Aboriginal children and teens are particularly vulnerable to asthma and allergies and they and their families are isolated and have very limited support resources. Culturally appropriate peer support and education programs are best designed in collaboration with First Nations, Métis and Inuit communities."

Building upon the positive results of their initial AllerGen studies, this team will make available innovative web-support programs to a wider range of Canadians who stand to benefit significantly from new web-based approaches to providing education and support for Canadian children, teens, and parents affected by asthma and allergies.

Industries with a high prevalence of childhood-onset work-exacerbated asthma include: health technology; nursing and nursing aides; domestic and personal services; construction; and metal trades.

Asthma in the Workplace: Looking to Ease the Burden through Identification and Prevention

Asthma and related illnesses can take a large financial toll on businesses and cause major disruption to productivity in the workplace due to lost hours and wages. In any given year, based on a population of 13 million working age adults, more than 44,000 workers across Canada may be suffering from asthma that is either caused or exacerbated by workplace exposure. Naturally, this places a significant strain on workers, health-care providers, worker compensation boards, workplaces and the health care system.

Dr. Mieke Koehoorn, Associate Professor, School of Population and Public Health, University of British Columbia

Different work environments can lead to either adult-onset *occupational asthma* and *work-exacerbated asthma* or *childhood-onset work-exacerbated asthma*. Population-based surveillance using existing health databases can help to document the burden of work-related asthma and identify high risk groups. Analysis of provincial administrative data in British Columbia (BC) revealed that for males, higher asthma rates were observed in the utilities, transport/warehousing, wood and paper manufacturing, health care, education, and public administration industries. For females, higher rates of asthma were observed in the waste management, healthcare, public administration and education industries. BC data confirm a high prevalence of active asthma in the BC working population, and in particular higher rates among females compared to males, especially in industries with known respiratory sensitizers such as dust and chemical exposures.

National survey data used by the team for analyses, indicated that industries with a high prevalence of adult-onset occupational asthma include: mining, oil and gas; art, culture, recreation and sport; fishing and fish processing; agriculture; other manufacturing (plastics, rubber, furniture, boats, upholstery); nurses and nursing aides; metal trades; and domestic and personal services. Industries with a high prevalence of childhood-onset work-exacerbated asthma include: health technology; nursing and nursing aides; domestic and personal services; construction; and metal trades.

In comparison to the general population, workers in these industries are at a higher risk to suffer from some form of asthma. In turn, the increasing need for time-off required by at-risk individuals results in a direct loss of wages and a corresponding reduction in overall productivity for their employer. However, asthma symptoms can be mitigated and managed with a combination of education and proper care.

An AllerGen research team led by Dr. Mieke Koehoorn at the University of British Columbia (UBC) using administrative data and Canadian survey data, and a related Master's degree thesis completed by Nichole Garzia, investigated the association between asthma rates and work characteristics among British Columbians in order to identify high-risk groups, as well as to target specific preventive educational activities. The team used data obtained from the BC Ministry of Health, WorkSafeBC and PharmaNet *via* PopulationDataBC to examine asthma rates among 'at-risk' exposure groups based on their industry of employment. This was complemented by a follow-up project that looked at asthma rates across Canada using Statistics Canada survey data.

Accomplishments: Obtaining Knowledge and Developing Researchers

These studies provided expert information on asthma rates across different job categories in BC and throughout Canada. In addition to the asthma rates among workers, Dr. Koehoorn and her associates looked at how this information is used and how the lines of communication between workers, physicians, compensation boards and other policy makers can be improved.

While developing this study, it was discovered that current health surveys did not ask questions that specifically addressed the onset of asthma. A research database tool called the *Asthma-Specific Job Exposure Matrix* that identifies jobs where workers have an increased risk for asthma (previously created by Dr. Susan Kennedy, a co-investigator on this project who studies occupational respiratory disease epidemiology at UBC), was used by the team to assign occupational exposure risk and to estimate the burden of work-related asthma.

Preparing the Next Generation of Researchers

Dr. Koehoorn believes that the project's success extends past the team's accomplishments and data obtained. Opportunities created for trainees to work on related research projects offer added value to the experiences that build careers for the next generation of investigators in this field. "The AllerGen network has provided more than just a monetary grant," Ms. Garzia states. "What's really great is the opportunity to present this data to various audiences — physicians and other researchers at major conferences both inside and outside of the AllerGen network; it has really helped me as an independent researcher." Ms. Garzia feels that AllerGen NCE also provided opportunities to interact with researchers in the same field and make contacts with researchers in other disciplines that she would not otherwise have crossed paths with.

Ms. Garzia has now started to work on her PhD at UBC and attributes her academic success to the AllerGen-funded project she worked on during the course of obtaining her Masters degree. Since she began her work, Ms. Garzia has increased her research and knowledge mobilization capacity and has become confident in conducting research and communicating her findings to a wide variety of audiences.

The Next Step: Raising Awareness and Education

According to Ms. Garzia, prevention is one of the best tools to reduce asthma that is caused or exacerbated by the workplace. Educating the right people (*e.g.*, physicians, worker's compensation boards, industries) on the potential risks associated with different jobs can lead to more effective disease management by not only encouraging workers to take better care when performing tasks but also ensuring that the right protective equipment is worn for certain jobs, or by reducing their exposures. If these steps are taken, workers in high-risk environments can minimize their asthma-related risk and limit aggravation of their symptoms.

Raising physician and policy maker awareness regarding work-related asthma and the steps that can be taken in order to mitigate health effects can promote proper treatment that will reduce lost productivity and wages and reduce the chance of asthma re-occurrence or a severe attack. This communication is ongoing through seminars with physicians, policy makers and other researchers. AllerGen NCE provided the necessary support to ensure that Ms. Garzia and other team members could participate in these seminars and transfer the knowledge arising from this study. However, Ms. Garzia believes that more research is needed in this field and that communication will be the key to easing the healthcare burden caused by work-related asthma.

Legacy: Creating Relationships and Enhancing Knowledge

In addition to the networking opportunities that AllerGen NCE provided, AllerGen's investment in this project helped leverage an additional $75,000 from the BC workers' compensation system, WorkSafeBC, to further support this research. One of the most important relationships stemming from the BC study was the team's knowledge translation collaboration with WorkSafeBC about under-compensation of work-related asthma in BC. Their evidence, in conjunction with the broader body of evidence, informed changes in BC as to how work-related asthma is compensated.

This study on BC workers and a follow-up Canada-wide study were among the first studies that involved data collection from a wide variety of sources including PopulationDataBC, Statistics Canada health survey data, and WorkSafeBC data. Not only did the study look at the burden of adult-onset *occupational* asthma, but also childhood-onset *work-exacerbated* asthma. Ms. Garzia noted that "Statistics Canada has given me the opportunity to provide them with feedback" and feels that workers with work-exacerbated asthma are often overlooked and will continue to be overlooked if data collection is not properly undertaken.

The success of this project is two-fold. First, information on the prevalence of asthma by occupation and industry within BC, as well as across Canada was established and can be used by policy-makers. Second, this project helped establish a new way to obtain information on occupational-related diseases by employing administrative data. This project is considered a leading study examining the burden of work-related asthma in North America.

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On the whole, Ms. Garzia feels that this project was a great success and that future projects examining rates of asthma in different industries will be very beneficial, not only to Health and Safety Boards, but also to Canadians working in these industries.

Success Stories

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