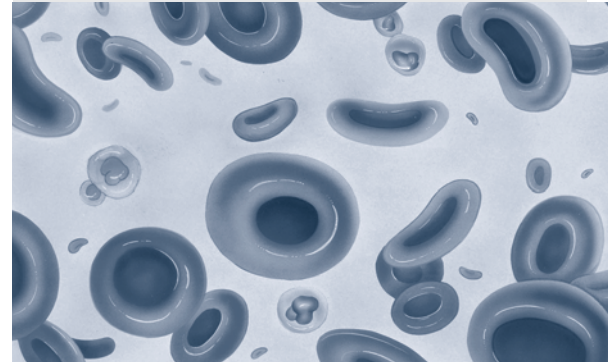




Because patients with Type 1 diabetes can't produce their own insulin, human stem cell-based transplants that produce insulin would be a major breakthrough.

Current laboratory methods of culturing human stem cells result in very limited quantities, far short of the quantities necessary for therapeutic applications.



# Divide and Conquer

## Boosting stem cells to treat diabetes

BY ELLEN GOLDBAUM

**F**or that reason, Emmanuel (Manolis) Tzanakakis, PhD, is striving to boost the numbers of stem cells produced in the laboratory, expanding the pool of cells that eventually can be differentiated into insulin-producing cells.

Tzanakakis, assistant professor in the Department of Chemical and Biological Engineering in the UB School of Engineering and Applied Sciences, has received a \$200,000 James D. Watson Investigator Grant award from the New York State Office of Science, Technology and Academic Research (NYSTAR) to support his studies.

His ultimate goal is to conduct research to develop methods that will allow sufficient quantities of differentiated cells that secrete insulin to be produced from the stem cells. Such cells could be used for diabetes therapies, including transplantation into patients, freeing them from the lifelong necessity of daily insulin injections.

“One of the main obstacles to using stem cells as any kind of human treatment is that you need many more cells than now can be produced in laboratory systems,” says Tzanakakis. “The key questions are, ‘How do you generate large quantities of cells for patients?’ and then ‘How do you get them to differentiate to a specific cell type?’”

Working with adult and embryonic stem cells derived from both mice and humans, Tzanakakis and other groups use bioreactor systems, vessels containing growth media and stem cells, that have the potential to produce high densities of

His ultimate goal is to conduct research to develop methods that will allow sufficient quantities of differentiated cells that secrete insulin to be produced from the stem cells.

undifferentiated cells.

He notes that success will require enhanced understanding of the molecular mechanisms that regulate self-renewal, or regeneration, of stem cells.

“With sound engineering and the


application of biological principles, I believe we can achieve large-scale expansion of stem cell production,” he says.

He also is exploring ways of inducing larger numbers of stem cells to differentiate into those that produce insulin, based on an understanding of how the pancreas develops in the embryo.

“Although we are a long way from generating cells identical to native beta cells, using stem cells, we are trying to coax stem cells into becoming insulin-producing cells,” he says. “To achieve this, cells are treated with growth factors, which are important to the development of the embryonic pancreas effectively mimicking that developmental process, to some extent.”

Before coming to UB in 2004, Tzanakakis held postdoctoral positions at the Diabetes Center in the Department of Medicine at the University of California, San Francisco, and

at the Stem Cell Institute in the Department of Medicine at the University of Minnesota.

He also has received funding for this research from the Juvenile Diabetes Research Foundation. 

# The Scent of Illness

Device to detect disease based on mouth odors

How do you create a sensor that can “sniff” out diseases based on the highly complex odors that come out of our mouths?

You base it on the real thing, according to University at Buffalo researchers.

BY  
ELLEN  
GOLDBAUM

**T**hey are developing a rugged, inexpensive breathalyzer-type device that, just like the nose of a human—or other mammal—will contain thousands of chemical sensors “trained” to recognize complex chemical patterns, some of which are known biomarkers for certain diseases.

“These volatile biomarkers are free for the asking and taking,” says Frank V. Bright, PhD, UB Distinguished Professor in the Department of Chemistry in the College of Arts and Sciences, A. Conger Good-year Professor of Chemistry and principal investigator. “They emanate from us all of the time. They are large in volume, much safer to handle than biofluids and available through totally non-invasive means.”

Called gaseous metabolites, these are the same odors that some animals use to identify their offspring, owners, mates, prey or competitors.

So far, multiple volatile chemicals have been detected by other scientists as biomarkers, correlating their presence and concentration with human diseases ranging from diabetes and AIDS to lung cancer and various mental illnesses.

But current methods of detecting these chemicals in human breath and other odors require cumbersome and elaborate laboratory instruments, such as gas chro-



PHOTO BY ELLEN GOLDBAUM

Rachel M. Bukowski, a doctoral student in chemistry, demonstrates how the device would work.

matographs, which would be prohibitively expensive and inappropriate for clinical, home or remote field settings.

That’s why the UB team is taking a multidisciplinary approach, integrating research in neural networks, pattern analysis, novel sensor technologies, low-power optical detectors and light sources with clinical expertise.

Such a speedy, inexpensive tool for early screening of multiple diseases could improve dramatically the health and longevity of millions of Americans, especially the elderly, and those in lower-income groups, in whom diseases often are diagnosed at later stages, Bright says, in part due to economic issues and poor health-screening tools.

The UB team, members of which have developed some of the world’s most stable and robust sensors, including some that do not need any calibration for more than two years, may be the first to integrate chemists, clinicians, computer scientists and engineers to exploit the full potential of expired gases or odors from human breath or other parts of the body to diagnose diseases.

Based in UB’s Center for Unified Biometrics and Sensors (CUBS), the research, funded by a \$400,000 grant from the John R. Oishei Foundation of Buffalo, is in the emerging field of metabolomics, the real-time study of metabolites, substances produced through metabolism.

The UB device will contain individual chemical sensors, perhaps as many as a million, that collectively will produce a pattern revealing the chemical signature of a patient’s breath, which may be related to a particular disease state.

Metabolomics technology has been identified as a focus for research in the National Institutes of Health Roadmap initiative; within the next two years, NIH plans to establish centers and programs in metabolomics.

While there are other electronic “noses” already on the market, they cannot correlate reliably their read-outs to a particular disease state, Bright says.

“The UB device will be unique because it will be designed to exploit, and in some ways mimic, the concepts of olfaction,” he continues. “Despite the fact that we might encounter numerous really smelly things in our lifetime, it is not as if there are billions of discrete sensors within our noses

that nature designed a priori to respond selectively to every possible smelly odor.

“Rather, there are suites of receptors in our nasal passages and the collective response from all of these receptors to an odor or set of odors can be discriminated,” he explains.

In the same way, the UB device will contain individual chemical sensors, perhaps as many as a million, that collectively will produce a pattern revealing the chemical signature of a patient’s breath, which may be related to a particular disease state.

That pattern will then be used to “train” neural networks, groups of connected artificial neurons capable of learning new information, to discriminate potentially between patients with specific diseases.

“The power of neural networks in this research is that they will pull out the important features and save them so that when they are exposed to a chemical pattern they have ‘seen’ before, the device will elicit the right response,” says Albert H. Titus, PhD, assistant professor of electrical engineering in the UB School of Engineering and Applied Sciences and a co-investigator on the project.

He adds that with neural network processing, the size of the sensor elements can stay very small, each measuring about 10 micrometers in size, a critical element for the inexpensive, low-power device the UB team is designing.

Titus is building novel, complementary metal oxide semiconductor (CMOS) arrays that simultaneously will read the signals produced by each of the sensor elements.

“The issue with this application is, Can you come up with a unique ensemble of sensor elements that exhibit enough diversity to respond to a large variety of small, chemically similar species to give you a chance of realizing the chemical fidelity that you need?” asked Bright.

To achieve that fidelity, he says the

chemical sensors will be made out of xerogels, porous glass-like materials that consist of easily tailored nanoscopic pores, which can be tuned to recognize specific chemicals or classes of chemicals.

Bright’s lab is well-known for its work developing chemical sensors out of xerogels that detect chemicals in blood, urine and other samples.

So far, he and his associates have developed xerogels that can respond to about 100 different chemicals, ranging from small molecules like oxygen and carbon dioxide to mid-sized molecules like steroids and prostaglandins up to big proteins like interleukins.

Bright explains that the envisioned device will work as follows: As the breath sample flows through the breath-testing device, the individual sensing elements will change their color or intensity; those changes will be detected by the CMOS array, producing electrical signals that then can be processed by the neural network.

The ultimate goal is to produce an extremely robust and reliable, low-cost, handheld device encompassing all of the sensing, detection and processing elements.

In addition to Bright and Titus, co-investigators include Alexander N. Cartwright, PhD, professor of electrical engineering, and Venu Govindaraju, PhD, director of CUBS and professor of computer science and engineering, both in the School of Engineering and Applied Sciences, and Wesley L. Hicks, Jr, DDS, MD ’84, professor of otolaryngology in the School of Medicine and Biomedical Sciences and attending head and neck surgeon at Roswell Park Cancer Institute.

“The Oishei Foundation’s generosity will enable our team to have a prototype ready for clinical testing within a year,” says Bright.

The clinical testing will be done at Roswell Park Cancer Institute. **BP**



# Hospital-at-Home Program

Quality care and less cost for older patients

Hospitals are often noisy, disorienting facilities that are full of strangers and home to infections that sometimes spread among patients. It's no surprise, therefore, that being hospitalized can be a traumatic experience, especially for older persons.

BY  
LOIS  
BAKER

and review of medical records, a study coordinator collected information on the seriousness of illness, health status, medications used, laboratory results, type and course of treatment, complications, and outcomes, and determined if the care met treatment standards.

In addition, a family member or person who knew the patient well was interviewed to determine if they knew whether the patient had experienced dementia. Patients and family members were contacted two weeks after discharge to obtain information on the patient's ability to function and satisfaction with care.

In the second, or intervention, phase, which included 30 participants in Buffalo, patients who came to the hospital for admission for the target illnesses were evaluated in the emergency department and given the option of being admitted or taking part in the Hospital-at-Home project. Sixty-percent of eligible patients opted for Hospital at Home. They

were taken home by ambulance, and met there by a nurse. Hospital-equivalent treatment—medications, electrocardiograms, X-rays, intravenous fluids and medications, oxygen and respirators—was provided in the home setting.

The nurse stayed with the patient for 8 to 24 hours initially, depending on the protocol of the project site, and then visited at least once a day until "discharge." The Hospital-at-Home physician made daily visits and was available 24 hours a day for emergencies. When the patient was ready for discharge, care reverted to the primary care physician.



home-hospital program," he adds.

The program was carried out in two consecutive 11-month phases. All patient participants came to a hospital suffering from one of four target illnesses: community-acquired pneumonia, exacerbation of chronic heart failure, exacerbation of chronic obstructive pulmonary disease or cellulitis.

The first phase, which included 60 patients in Buffalo, took place in participating hospitals. In this phase, 282 persons who met the study criteria, consented to participate and to allow a review of their records served as the "hospital observation comparison group." Through interviews

In hopeful contrast, a study published in the December 6, 2005 issue of *Annals of Internal Medicine* has shown that for older persons with certain acute conditions, hospital-level care can be provided at home for less money and with fewer clinical complications than in-hospital care.

In addition, patients recovered sooner when "hospitalized" at home, the study found, and they and their families were more satisfied with the overall experience.

The program, called Hospital at Home, was carried out by collaborators at UB, Yale University and Oregon Health and Science University; it was overseen by Bruce Leff, MD, from The Johns Hopkins University.

In Buffalo, the program was a collaboration among four institutions: UB, Kaleida Health, Independent Health and Univera.

"The success of our collaboration provides a model for establishing home-hospital programs in communities with multiple competing health-care organizations," says Bruce Naughton, MD '79, UB associate professor of medicine and director of the Division of Geriatrics, who was principal investigator in Buffalo.

"Work is continuing in Buffalo with the goal of establishing a sustainable

"Our experience with home-hospital and similar programs gives Western New York the opportunity to develop innovative health-care services for its aging population."

—Bruce Naughton, MD '79

Extensive evaluation of the process of care and treatment outcomes in both settings showed that, in addition to the fact that the majority of patients chose Hospital at Home when given the choice, care in that setting was timely and of high quality. The analysis showed that substituting at-home care entirely for hospital care resulted in fewer important clinical complications including delirium, greater satisfaction and lower total costs.

Naughton notes that this home treatment program differs from other community-based treatment plans in several respects: extensive physician involvement and one-on-one nursing care (for an average of nearly 17 hours per patient); intensive medical services, including providing oxygen and intravenous therapy, which were excluded in previous studies of in-home care; and in-depth analysis of a wide range of outcomes, including clinical, patient and family satisfaction, patient function, delirium experiences and costs.

"Our experience with home-hospital and similar programs gives Western New York the opportunity to develop innovative health-care services for its aging population," says Naughton. "There are alternatives to hospitalization for older adults that can increase patient safety and reduce costs." **BP**

**Editor's Note**

*Hospital at Home was funded by the John A. Hartford Foundation. Although the program has concluded, a scaled-down version, called Rapid Response for Congestive Heart Failure, is currently in operation, according to Bruce Naughton, MD. Rapid Response is designed to respond at home in less than 30 minutes to acute flare-ups that would otherwise require emergency department visits and, potentially, hospitalization. The program accepts Medicare and is funded on a traditional fee structure.*

# Study Tracks Nurses' Career Changes

Looking for reasons behind critical shortage of nurses

BY  
LOIS  
BAKER

Carol S. Brewer, PhD, associate professor of nursing at UB and a specialist in nursing labor issues, has received \$440,000 to study the reasons behind the critical shortage of nurses across the United States through research funded by the Robert Wood Johnson Foundation.

Her award is part of a \$1.9 million grant to Christine T. Kovner of the New York University College of Nursing, on which Brewer is co-principal investigator.

"The results of this partnership will be of significance to the health-care community in helping to find solutions to a critical national shortage of nurses," says Mecca Cranley, PhD, dean of the UB School of Nursing. "In the face of this continuing problem, exploring the conditions that influence new nurses to remain in, or leave, their positions will be

particularly useful." The five-year national study will survey 5,000 recent graduates of registered nurse (RN) programs periodically over the first four years of their careers to track the underlying reasons for their work decisions.

"This research will allow us to track changes over the first few years of a new RN's career, during which time many seem to leave hospitals," says Brewer, who has published articles on nursing labor issues in professional journals since 1998.

"It is important for us to know whether new nurses are leaving particular settings, or leaving the profession altogether," she notes. "The answers will point to very different solutions to a nursing shortage. New graduates of nursing programs who become registered nurses are essential to balancing the overall supply and demand for these professionals." **BP**

"This research will allow us to track changes over the first few years of a new RN's career, during which many seem to leave hospitals."

—Carol S. Brewer, PhD

# The Long View on Supplements

Mixed results for colorectal cancer and hip fractures in women

BY  
LOIS  
BAKER

Daily calcium and vitamin D supplements do not lower the risk of colorectal cancer in postmenopausal women as previous studies had suggested. They do, however, provide a modest benefit in preserving bone mass and preventing hip fractures, particularly in older women, although they have no effect on other types of fractures.

These findings from the national Women's Health Initiative (WHI) clinical trial appeared in two reports in the February 16, 2006 issue of the *New England Journal of Medicine*.

Jean Wactawski-Wende, PhD, associate professor of social and preventive medicine in the UB School of Public Health and Health Professions, is first author on the colorectal cancer study and a coauthor on the hip-fracture study.

"There has been a public perception that calcium and vitamin D supplements can prevent colorectal cancer, and observational studies have suggested that those who have higher intakes have less disease," says Wactawski-Wende. "Unfortunately, this long-term clinical trial, in which some of the women were followed for more than nine years, does not support this assumption.

"Results on the effect of calcium and vitamin D supplementation on bone frac-

tures showed a significant positive effect on bone density, as well as a nonsignificant 12 percent decrease in risk of hip fractures over all," she says.

"Further analyses showed that the group who took most of the recommended supplements over the course of the trial had a 29 percent reduction in risk of hip fracture, and women over age 60 had a 21 percent reduction in risk of hip fracture.

"Overall, the most important message from these studies is that all women should have an adequate intake of calcium and vitamin D to preserve their bone density," says Wactawski-Wende.

"For women over 60, this may be especially important. Although women should consider taking calcium and vitamin D supplements along with adequate dietary intake to protect their bones, they should not expect these supplements to provide protection against colorectal cancer."

A total of 36,282 postmenopausal women, including 963 from Western New York, took part in the WHI calcium/vitamin D trial. Half were assigned randomly to receive 1,000 mg of calcium carbonate combined with 400 international units of vitamin D<sub>3</sub> daily, while the other half took matching placebos. Participants were followed for 6 to 10 years.

Colorectal cancer is the third most common cancer in U.S. women and the third leading cause of cancer deaths in women, according to the American Cancer Society. Observational studies had suggested that both higher intakes of calcium, as well as vitamin D intake, may decrease the risk of colorectal cancer, although there was little clinical trial data available.

Results of the colon-cancer analysis showed that over an average of seven years, a total of 322 women in the study were diagnosed with invasive colorectal

cancer. There was no statistically significant difference between the supplement and comparison groups in the number of colorectal cancer cases or in the characteristics or severity of tumors.

There also was no difference between groups in the number of polyps reported by the participants. When the investigators analyzed only the data obtained from partic-

on colorectal cancer did not change.

Wactawski-Wende also notes that the average follow-up of seven years may not have been long enough to find an effect. "Colorectal cancer is thought to take 10 to 20 years to develop. Although we saw no evidence of a trend toward protection in the later years of follow-up, we'll continue to follow these women for five more years,

supplements can help keep bones strong. The fracture analyses showed that 374 women had hip fractures, for a rate of 14 per 10,000 women per year in the supplement group, compared to 16 per 10,000 per year in the placebo group.

Osteoporosis, a skeletal disorder characterized by weakened bones leading to an increased risk of fracture, is a major

“Although women should consider taking calcium and vitamin D supplements along with adequate dietary intake to protect their bones, they should not expect these supplements to provide protection against colorectal cancer.”

ipants who had the best compliance in taking their study pills, there was still no benefit seen from calcium/vitamin D supplementation on colorectal cancer. The supplements were generally well tolerated; however, participants in the supplement group had a higher risk of developing kidney stones.

To determine if baseline vitamin D level might have some effect on the outcome, researchers measured blood levels of vitamin D in a subgroup of participants at the start of the study. The effect of the intervention on colorectal cancer did not differ by baseline blood levels of vitamin D.

In assessing the colon cancer findings, Wactawski-Wende notes that participants already had relatively high personal intakes of both calcium and vitamin D at the start of the study—about twice the national average. These initial high levels may have prevented the intervention supplements from affecting colon-cancer rates further, she says. However, even when looking at those participants with the lowest personal intakes of calcium, the findings



STEPHANIE CARTER

cause of disability, loss of independence and death, according to the National Institutes of Health. It contributes to an estimated 300,000 hip fractures in the U.S. each year. Four out of 10 women over 50 will experience a fracture at the hip, spine or wrist in their lifetime. Ten million people in the U.S. are estimated to have osteoporosis and 34 million more have low bone mass, placing them at greater risk for fracture.

which may allow us to identify any later effects of the intervention."

Overall, there were fewer deaths in the supplement group than in the placebo group, 744 compared to 807, hinting that calcium and vitamin D supplements may have a positive effect on mortality, says Wactawski-Wende. Analyses that will take a closer look at mortality are planned.

## Hip Fracture Outcomes

Results of the effect of calcium and vitamin D supplementation on hip fractures supported conventional wisdom that these

"There are serious health consequences following hip fracture. Prevention of hip fracture is a key," says Wactawski-Wende. "Achieving adequate intake of calcium and vitamin D is one important factor in maintaining bone density and preventing hip fracture.

"Use of calcium with vitamin D supplements along with a diet rich in calcium and vitamin D may result in important benefits to bone density and hip fracture prevention," she says. "However, results of the WHI calcium plus vitamin D study do not support their use for colorectal cancer prevention." **BP**

“Overall, the most important message from these studies,” says Wactawski-Wende, “is that all women should have an adequate intake of calcium and vitamin D to preserve their bone density.”

# At the Heart of a Low-fat Diet

New clues to the role of fat in disease prevention in women

BY  
LOIS  
BAKER



JEFF KOEBEL

The nearly decade-long dietary modification trial of the national Women's Health Initiative (WHI), which tested the effect of a diet low in total fat and high in fruits, vegetables and whole grains, showed that such a diet had no statistically significant effect on rates of breast cancer, colon cancer, heart disease and stroke.

**R**esults of the three arms of the trial were published February 8, 2006 in three papers in the *Journal of the American Medical Association*.

The University at Buffalo is one of the 40 WHI clinical trial sites. This dietary modification arm of the WHI included 1,138 Western New Yorkers among the 48,835 postmenopausal women who participated across the U.S.

Jean Wactawski-Wende, PhD, UB associate professor of social and preventive medicine, is a coauthor on the papers reporting the breast and colon cancer results. Maurizio Trevisan, MD,

professor and dean of the UB School of Public Health and Health Professions, is also a coauthor on the heart disease paper.

"The women achieved a remarkable change in dietary fat, but not as much as planned," says Wactawski-Wende. "There is no question that a diet low in fat and high in fruits, vegetables and grains is very healthy. This trial tested the diet's effects on specific conditions. The fact that it showed little effect on those specific conditions does not mean that anyone

should abandon a proven healthy diet."

Results showed the dietary change group went from 38 percent to 24 percent of calories from total fat in the first year, to 29 percent in the sixth year. The comparison group, in which women followed their regular diets, averaged 35 percent of calories from fat at year one and 37 percent at year six.

Women in both groups started at 35 to 38 percent of calories from fat. The low-fat diet group also increased their consumption of vegetables, fruits, and grains.

"If we had achieved what we planned, 20 percent of calories from fat, the changes may have reached statistical

significance," Wactawski-Wende adds.

"This study has shown us once again that it is very hard to change behavior. However, those who made those greatest reductions in total dietary fat had the greatest benefits."

"On the issue of breast cancer, results indicated that women who started with the highest fat intake and had greater changes in fat intake showed stronger evidence that they could be reducing their risk," she continues.

Overall results showed that the intervention group achieved a nine-percent reduction in risk of breast cancer, compared to the comparison group.

"This means that, out of 10,000 women, 42 women in the dietary change group and 45 in the comparison group developed breast cancer each year," explains Wactawski-Wende. "This difference was not large enough to be statistically significant—meaning it could have been due to chance. Longer follow-up may be needed to show the effects of diet on cancer risk over time."

There was no overall benefit on heart disease. Noting that the study focused on total fat intake rather than the type of fat, Trevisan says that for heart disease, specific types of fat, such as saturated fat and trans-fats may be more important than total fat.

"In women who achieved the greatest reduction in saturated fat in this study, we saw the greatest benefit on heart disease and certain blood markers," he says.

The study also found that women following this low-fat and somewhat higher carbohydrate diet did not increase their body weight, triglycerides or indicators of increased risk of diabetes, such as blood glucose or insulin levels.

No effect on colorectal cancer was seen but there was a reduction in the number of colon polyps reported.

Women who took part in the dietary modification trial were assigned randomly to the comparison group and the intervention group. The comparison group maintained their usual diet, while the intervention group was asked to decrease fat intake to 20 percent of total calories, increase fruits

“ Noting that the study focused on total fat intake rather than the type of fat, Trevisan says that for heart disease, specific types of fat, such as saturated fat and trans-fats may be more important than total fat. ”

and vegetables combined to five or more servings per day, and increase grains to six or more servings per day.

Both groups were tracked for an average of 8.1 years.

The WHI diet proved to be safe, the results showed, and is consistent with cur-

rent U.S. Dietary guidelines. An ongoing five-year follow-up study may help researchers understand the longer term effects of this low fat dietary intervention, the authors note. **BP**

## Antioxidant Supplements during Radiation

BY  
LOIS  
BAKER

Study seeks to determine their efficacy in cancer therapy

**O**ne of the first studies to determine whether antioxidant vitamin and mineral supplements should be taken during radiation therapy is under way in the UB School of Nursing.

The research, funded by a two-year, \$236,500 grant from the National Cancer Institute, could settle a controversy between two opposing cancer-therapy camps, says Jean Brown, PhD, UB professor of nursing, nutrition and rehabilitation science and principal investigator on the study.

"Radiation therapy is designed to destroy tumor cells, while antioxidants are supposed to help repair cell damage," says Brown. "So one side is saying 'If we're

trying to kill cells, we don't want repair.' The other side is saying 'Antioxidants might help prevent damage to normal cells and reduce radiation's side effects.'

"For example, radiation therapy for lung cancer affects the esophagus and makes swallowing difficult. It's possible antioxidants might either ameliorate the soreness or help patients recover more quickly.

"We just don't know," says Brown. "There is considerable in vitro evidence that antioxidants are beneficial during cancer treatment, but studies testing the effects in cancer patients are very limited."

Finding the answer is important, says Brown, because many people take multivitamins. A study at Houston's M.D. Anderson Cancer Center found that 77

percent of patients were taking supplements, she notes.

The UB study will involve 60 prostate-cancer patients who are receiving radiation therapy. Prostate cancer patients were

chosen because the PSA test provides a measure of the extent of tumor response to therapy.

"The study will provide pilot and feasibility evidence for a larger-scale clinical trial," says Brown. "In the meantime, it will help health-care providers and cancer patients make more informed decisions on the use of multivitamins and antioxidants during radiation."

In addition to Brown, who is a fellow in the American Academy of Nursing, the study team is composed of Richard Brown, PhD, and Kate Rittenhouse-Olson, PhD, from UB's Department of Biotechnical and Clinical Laboratory Sciences in the School of Medicine and Biological Sciences; and Peter Horvath, PhD, of the Nutrition Program and Gregory Wilding, PhD, of the Department of Biostatistical Sciences, both in the School of Public Health and Health Professions.

Thomas O'Connor, MD, UB clinical associate professor of radiation oncology, and Marylin Dodd, PhD, from the University of California, San Francisco, are serving as study consultants. **BP**

“ We just don't know. There is considerable in vitro evidence that antioxidants are beneficial during cancer treatment, but studies testing the effects in cancer patients are very limited. ”

—Jean Brown, PhD