Health & WELL-BEING

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Cancer & Community

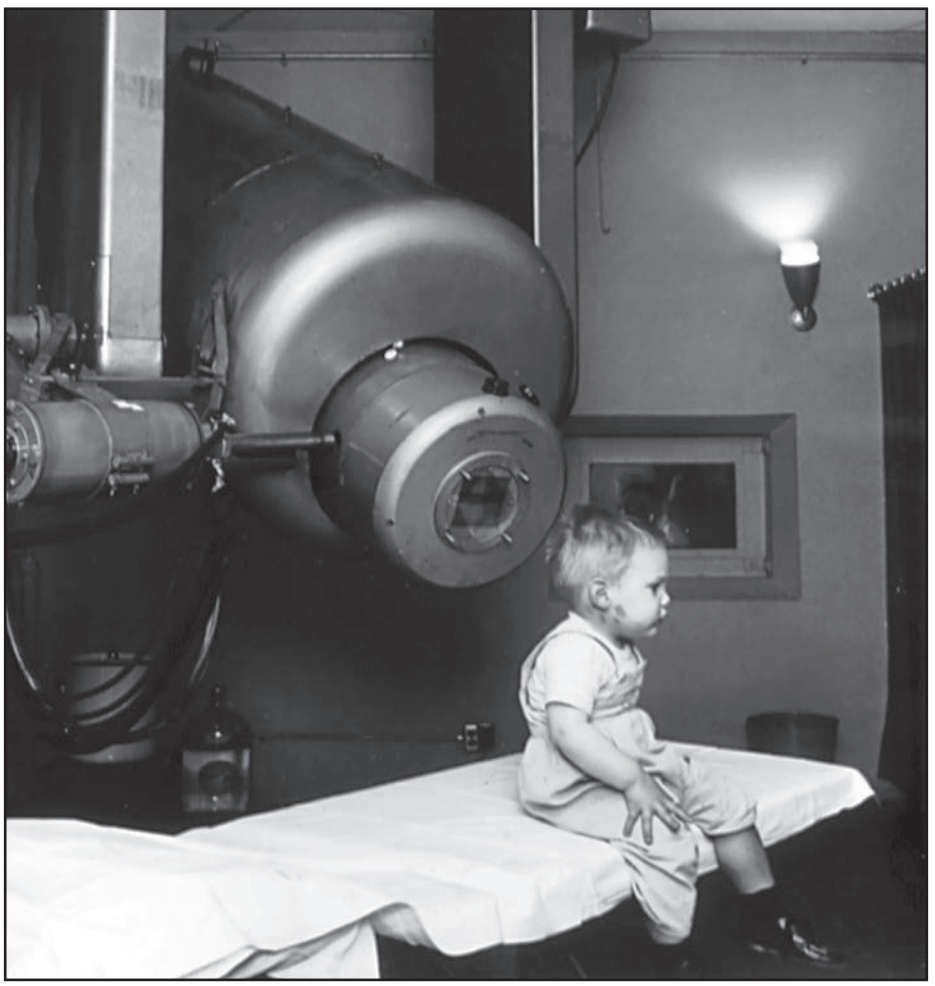
Editor's note: Most people in the United States know someone affected by cancer. For some, it is a constant anxiety as eventually, more likely than not, someone they know will be diagnosed.

But there is hope for all as medical and scientific advances are sharpening our understanding of how cancer works and suggesting new ways we can beat it. And the way doctors and clinicians treat cancer is always changing, as scientists learn more about the nature and development of the disease.

This spring a group of first-year students at Middlebury College undertook a quest to learn about how cancer affects people in Addison County and how treatments are advancing and providing new hope for those afflicted. The students in Chemistry and Biochemistry Assistant Professor Lindsay Repka's "Cancer and Community" first year seminar met with experts including Deb Wesley and Maureen Conrad of Addison County Home Health and Hospice, Middlebury College Anthropology Professor Kristin Bright and others, along with a few local cancer patients. Then they brought together some of what they learned in a package of stories for *Addison Independent* readers.

Here are those stories, which address the history of cancer treatments, newer therapies that build on increased understanding of how cancer functions, how cancer and other disease are stigmatized and how we can relieve that stigma, and how a local community member is facing their cancer diagnoses.

History of cancer informs research



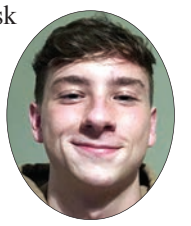
TWO-YEAR-OLD GORDON ISAACS, the first cancer patient treated with a linear accelerator, sits quietly while receiving a dose of radiation therapy for treatment of bilateral retinoblastomas in 1957. After the success of the treatment, doctors expanded the use of radiation therapy for cancer treatment.

Photo courtesy of National Cancer Institute

Current treatments build on past failure & success

By Dylan Schmeling, Landon Rice & Alex Takoudes

Dylan Schmeling



Landon Rice

Alex Takoudes

A New England man told us that one day his wife noticed yellow markings on his face; emergency room doctors identified it as jaundice. The man was immediately admitted to the hospital where he was given a CT scan due to increased risk for patients his age — 78.

Before he knew it, the radiologist was beside the man's bed informing him that the CT scan had identified pancreatic cancer.

His first week in the hospital was the "most chaotic week of his life," he said. There were so many facts to learn about what was going to be done to him and what choices he could make about treatment. At this point, he was faced with three treatment options: surgery,

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Immunotherapy fights cancer at molecular level

By Andrew Planting, Jenny Shan & Ruby Warner

When it comes to treating cancer, we have all heard the terms "chemotherapy" and "radiation therapy" at some point — discussing a close friend's or family member's cancer diagnosis, watching a soapy medical TV drama, reading an article about cancer treatments, you name it. Although chemo and radiation therapies are amazing cancer treatments, they have pitfalls.

We are starting to see cancer treatments that are centered on a more natural, targeted approach, rather than using synthetic chemicals and controlled doses of radiation.

One such treatment is immunotherapy, which uses the body's own immune system to fight cancer.

Three interesting breakthroughs in immunotherapy include CAR-T therapy, PD-L1 inhibitor combination therapy, and ctDNA analysis. These three advances can be thought of,

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Research

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chemotherapy, or a newer option known as immunotherapy.

He felt fortunate to have had his cancer detected in its early stage.

The options this man was offered reflect the current state of the art for cancer treatment, and were built on a history of treatments that have changed over time — and continue to advance.

Treatment of cancer through surgery can range from removing small tumors to entire organs depending on the spread of the cancer. Chemotherapy, introduced by Dr. Sidney Farber's research in the middle of the last century, treats patients with drugs. Radiotherapy (x-rays) can target cancer cells without cutting open the patient or injecting medicine. Finally, immunotherapy and other newer treatment options are changing the reality for cancer patients in a variety of ways.

SURGERY AND BEYOND

Early cancer surgery was championed by William Stewart Halsted, who developed the radical mastectomy in 1894. This surgical practice involved the removal of more and more of women's chests, hoping the excavation of tissue would eliminate the chance of cancer recurrence.

The practice of radical surgery, popularly used on cases of breast cancer, quickly became a prominent method of cancer treatment as many doctors believed it to be most effective in curing the disease. However, cancer patients, disproportionately women, were being mutilated, and data regarding remission rates showed radical surgery had no more benefit compared to more conservative operations.

In the 1950s, American surgeon George Crile faced backlash from the medical community when he suggested that radical surgery catered more to the surgeon's needs rather than the patient's. However, the limitations of surgery and development of other therapies ultimately pushed doctors away from radical operations.

Chemotherapy is perhaps the most widely available treatment for cancer in the present day. It uses chemical agents that kill cancer cells, and was first conceptualized and discovered in the late 1940s by Sidney Farber (after whom the Dana-Farber Cancer Institute is named). The chemicals tend to be highly toxic, meaning that in addition to causing the death of the cancer cells, chemotherapy can negatively affect healthy cells and tissue.

Over time, the use of chemotherapy has shifted to various cocktails as more chemical compounds are discovered and tested. Currently, a patient will often have various options as to the treatment they undergo, depending on the cancer and their condition. Multiple agents are typically given at once, over a period of several months.

While chemotherapy is effective for various, localized and widespread cancers, radiation treatment is particularly effective on localized tumors. Radiotherapy uses very powerful radiation (in the form of X-rays) that is focused on a single point: the tumor. This treatment is mostly used for solid tumors since these are situated in one place, allowing precise targeting. The radiation kills the cancer cells in the tumor, and is often combined with chemotherapy to eliminate the cancer completely.

CHOOSING A TREATMENT

In the case of the anonymous community member we interviewed, surgery was the best option for many reasons. He was lucky enough to have detected the cancer so early that doctors could remove the tumors with a "Whipple Surgery." This surgery is far from a radical surgery and only involves cutting away the portions of the pancreas where tumors have been detected. Two months after his surgery, doctors prescribed four months of chemotherapy to ensure the eradication of the cancer.

The man's treatments involved weekly visits to the hospital, which were eventually downgraded to biweekly visits. We will return to his story after we explain newer treatments for cancer that have emerged.

One example of these newer treatments is immunotherapy. Immunotherapy is an emerging field of cancer treatment that alters the activity of the immune system, therefore slowing or stopping the progression of disease.

In addition to immunotherapy, several other new treatments are being searched for and researched, in the hopes that they can further the progress of the battle against cancer.

THE BENEFITS OF EXERCISE

An example of a newer indirect treatment of cancer is exercise, which can play a role in reducing tumor growth. Recent studies have shown that breast-cancer-bearing mice that are assigned regular exercise had a 24% increase in survival rate compared to a sedentary control group (Hagar et al., 2019). While future research into this correlation is certainly needed, we might see a rise in prescription of exercise for cancer patients

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Learn More About Cancer Treatment

• *"The Emperor of All Maladies" by Siddhartha Mukherjee for an in-depth look at the history of cancer treatment*

• *tinyurl.com/FutureOfCancer for further reading on the future of cancer treatments*

• *tinyurl.com/HypoxiaCancer to learn more about hypoxia and prodrugs*

Researchers finding ways to limit cancer recurrence

By Marco Volpitta & Henry Terry

Advances in medicine enable many people to beat cancer or, at the very least, slow it down. However, beating the disease once doesn't necessarily mean the end of that journey for some cancer patients. Recurrence is a common part of experiencing cancer — some patients are disease-free then get a second diagnosis while others are in remission but then experience progression of the disease again.

But there are many modern treatments that seek to reduce the risk of recurrence and to give patients better chances of long-term survival when fighting cancer.

Doctors must grapple with a multitude of factors when treating any kind of patient. Individual medical histories, the range of possible procedures, and the unpredictable nature of the job itself make for many complicating situations. Because of this, clinicians can find it difficult to prioritize steps relating to cancer recurrence when fighting the disease in the first instance often seems more pressing.

DR. NICHOLAS DEMOSTHENES

Physicians working in the field of anesthesiology, for instance, face this issue frequently. While this may seem bleak, research into specific treatments across the medical field aimed at limiting cancer recurrence, such as Tyrosine Kinase Inhibitors, or TKIs, are gaining popularity and support from the medical community.

Marco Volpitta

ANESTHESIOLOGY

While cancer recurrence may seem like it should be a high priority for clinicians, practice sometimes tells a different story. For example, the field of anesthesiology could play a significant role in the consideration of cancer recurrence.

If you've had surgery, you may be familiar with general anesthesia. The medically induced coma that results from this cocktail of drugs has been the standard of care for many years, but a new class of anesthetics could change this. These newer drugs, known as regional anesthetics, target specific portions of the body as opposed to the system-wide approach of general anesthesia. Anesthesia can suppress the immune system and enable cancer growth. In limiting the affected area of the body by using regional anesthetics, effects on the immune system can be minimized.

Henry Terry

"The use of regional anesthesia has quickly burgeoned into an important adjunctive tool when designing an anesthetic plan," according to University of Pennsylvania anesthesiology resident Dr. Nicholas Demosthenes.

Research is beginning to show that these new types of anesthetics could have an impact on cancer recurrence in the surgeries in which they are used. For example, one 2016 study showed that a regional anesthetic known as propofol limited the spread of cancer in experiments outside of a living organism.

One might think that studies such as this would have an impact on how anesthesiologists tailor their treatment plans, but practice has yet to catch up to the research, Demosthenes said.

"We tend to focus on and prioritize avoiding acute complications like cardiac arrest, stroke and hemodynamic instability over more sub-acute complications like immunosuppression," he said.

While it may take some time before hospitals and anesthesiologists begin considering cancer recurrence the same as they do cardiac arrest, other budding research looks to advance efforts to stem cancer recurrence.

TKI DRUGS

Tyrosine kinase inhibitors (TKIs) are a class of cancer drugs that are generally used in cases where standard chemotherapy drugs don't work well. They're commonly used for lung cancer, since chemotherapy usually doesn't stop lung cancer from progressing. In the short term, TKIs tend to be very effective at treating lung cancers, research shows.

In general, TKIs work by inhibiting processes within cancer cells that cause "uncontrolled mitosis," or cellular reproduction. When a cell is preparing to undergo mitosis, it will phosphorylate, or add a phosphorus atom to various molecules within the cell to allow the cell to split in two. One of the main signals to phosphorylate these molecules is given by the epidermal growth factor receptor protein.

In cancer cells, this protein sends out the signal to split far more than in a normal cell, leading to a rapidly expanding

(See TKI drugs, Page 12)

Treatment

(Continued from Page 8)

who are capable. It might also be wise for family members at risk of certain forms of cancer to maintain regular exercise in order to increase their chances of survival if they do get cancer, according to the CDC.

HYPOXIA-ACTIVATED PRODRUGS

Prominent recent work in immunotherapy has targeted the hypoxic environment of cancerous tumors. Hypoxia is the lack of oxygen in the body, which inhibits the productivity of the immune system. Currently, a class of drugs called hypoxia-activated prodrugs (HAPs) is in development and not yet in clinical use. These prodrugs — drugs activated by and inside the body — are triggered under low oxygen conditions. They cause DNA strand breaks and cross-links, consequently killing hypoxic cells.

HAPs are being tested in combination with standard chemotherapy because studies have shown the prodrugs to be ineffective in stopping disease progression when used alone. Chemotherapy is normally inhibited by hypoxia, but is effective when HAPs kill hypoxic cells and normalize the tumoral environment.

NATURALLY OCCURRING CHEMOTHERAPEUTIC AGENTS

Naturally occurring molecules have a long history in cancer treatment and continue to inspire anti-cancer drug development. An East African insect is known to produce a toxin that has anti-cancer properties. The toxin, pederin, has been found in several other organisms, and shows potential in the further development of new cancer treatments. Scientists have found that pederin (and various similar toxins) are produced by bacteria. Researchers have proposed cultivating this bacteria to enable mass production of this chemical, which would increase access to this form of treatment.

Looking at the developments cancer treatment has undergone in the last few decades, it is evident that significant progress has been made, and continues to be made. Nonetheless, as has always been the case, the war against cancer is far from won. With a greater pursuit of treatments, therapies, preventative healthy lifestyles, and a greater understanding of cancer, more people can be spared the ravages of the disease.

Now the results we have been waiting for: What did the next five years look like for the patient that we interviewed?

They were completely normal with no recurrence of the cancer. Considering that there is only a 5% chance of surviving five years after pancreatic cancer, the New England man considers it a miracle that he is still alive.

According to his surgeon, the major contributor to his survival looking back on the experience is likely how early the cancer was detected. The fact that this patient visited the doctor the instant that he showed signs of jaundice might have saved his life.

THE University of Vermont HEALTH NETWORK
Porter Medical Center

Concerned about the cost of your medication's? We can help.

MIDDLEBURY—The COVID-19 pandemic and the ensuing economic turbulence has more people experiencing economic hardships for the first time. The University of Vermont Health Network has assistance available to help patients and communities cover the cost of their health care. Patients should never forgo care for any reason. The impact of delaying care, including routine appointments, can lead to serious health issues.

We know cost can be a barrier for people obtaining the care they need. In addition to the organization's financial assistance policy providing discounted or free care, the Health Assistance Program (HAP) now available at Porter Medical Center provides additional assistance to eligible low- and middle-income families to receive prescription medications at no cost – even if they have insurance.

"These are incredibly difficult times and we want to be clear with our patients and families that we are here for them and will do everything we can to ensure they continue to receive great care," said Porter President Tom Thompson. "We have teams that are specially trained to help patients know and understand the cost of their care, as well as options to assist with paying for care. Please do not delay care, it could have a devastating effect on your life."

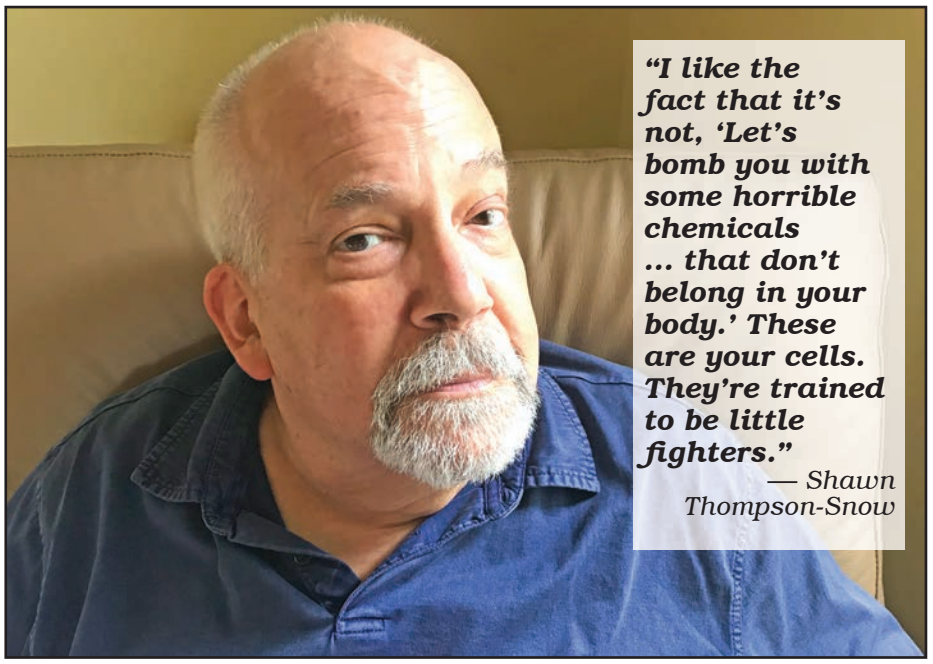
For patients and families that qualify for the Health Assistance Program, all co-pays and costs are waived for both brand-name and generic prescriptions. For example, a family of four with a household income of $100,000 could save up to $600 per month on out-of-pocket costs at the pharmacy.

The program provides medications through UVM Health Network pharmacies, and patients can either pick up their medications or have them mailed to their home. The Health Assistance Program can also provide access to eyeglasses and some medical equipment, as well as assistance with enrolling in state and federal programs such as Vermont Health Connect for those who do not currently have health insurance.

"We want our patients to know they can get the care they need – including their medications – regardless of their ability to pay" said Erin Armstrong, UVM Health Network's Community Benefits Manager. "Our Health Assistance Program can help with co-pay assistance so patients can continue to receive the medications they need to maintain their health. Please reach out for help if you need it. We're here for you." The Health Assistance Program at Porter Medical Center is made possible by the 340B Drug pricing program that allows safety net health care providers to purchase drugs at discounted prices.

Patients should call 802-847-6984 or toll-free 1-888-739-5183 or email HealthAssistanceProgram@UVMHealth.org for assistance. Additional information about UVM Health Network assistance programs is available at UVMHealth.org/medcenter/HAP.

www.portermedical.org



SHAWN THOMPSON-SNOW

Immunotherapy

(Continued from Page 7)

respectively, as individualized soldier cells, a chemotherapy and immunotherapy crossover, and a tool for early cancer detection.

On April 17, 2012, at the Children's Hospital of Philadelphia, an 8-year-old girl was at a crossroads. Emily Whitehead had struggled for three years with leukemia, a type of cancer resulting from DNA mutations in the bone marrow. Her chemotherapy treatment hadn't shown promising results, and in a last-ditch effort, Emily's family accepted a new therapy — CAR-T. Fortunately, Emily's response was a wild success, showing complete remission after just three weeks, thus making her the first child cured by CAR-T therapy.

Jenny Shan

Chimeric antigen receptor T cell, or CAR-T cell therapy, is a new immunotherapy recently introduced as a treatment for hematologic cancers, or blood-related cancers, such as leukemia. CAR-T cell therapy uses the patient's own T cells, a type of white blood cell with a key role in the immune system, to target invasive molecules called antigens and trigger an immune response. In this therapy, T cells are extracted from the patient and modified to produce a synthetic CAR protein that has been engineered to seek out a specific antigen on malignant cells and selectively kill those malignant cells.

Ruby Warner

Currently, CAR-T cell therapy produces the most successful results for acute lymphoblastic leukemia, as demonstrated through Emily's miraculous recovery. Clinical trials from as early as 2012 have demonstrated 70-90% of participants reaching complete remission, which the National Cancer Institute defines as the "disappearance of all signs of cancer in response to treatment." This does not always mean that the patient is free of cancer, but it is an extremely positive response.

Even in its infancy, CAR-T cell therapy is gaining recognition in communities around the country, including in Vermont. Shawn Thompson-Snow, a local retired drug, alcohol and mental health counselor, was diagnosed with Multiple Myeloma (MM), a cancer originating in the bone marrow, in the fall of 2019.

The Addison County resident has maintained an optimistic attitude toward his diagnosis, and the recent FDA approval of CAR-T cell therapy for MM makes him a possible recipient in the future. Although Thompson-Snow has gone through and benefited from more traditional chemotherapy and radiation treatments, he is drawn to the more natural technique of CAR-T cell therapy.

"I like the fact that it's not, 'Let's bomb you with some horrible chemicals ... that don't belong in your body,'" he said. "These are your cells. They're trained to be little fighters."

While a few complications of his MM need to be alleviated before he can be approved for the therapy, Thompson-Snow is extremely optimistic that CAR-T cell therapy will be a promising treatment for MM in general.

ANOTHER NEW THERAPY

When fighting a battle, masses of soldiers are critical in order to overwhelm your enemy. CAR-T therapy creates the soldiers necessary for the battle against cancer, but masses aren't the only factor that come into play during this fight. A therapy that prevents cancer from employing one of its growth strategies can also give the patient the upper hand.

The following therapy works on a cellular level and is rather technical.

A strategy used by cancerous cells to invade a human body is to hijack the joining of molecules, or ligation, between a protein and its ligand (the binding molecule). The protein is called programmed death-1 (PD-1) and its ligand is called programmed death ligand-1 (PD-L1). PD-1 is located on the surface of T cells. When ligated, PD-1 and its ligand

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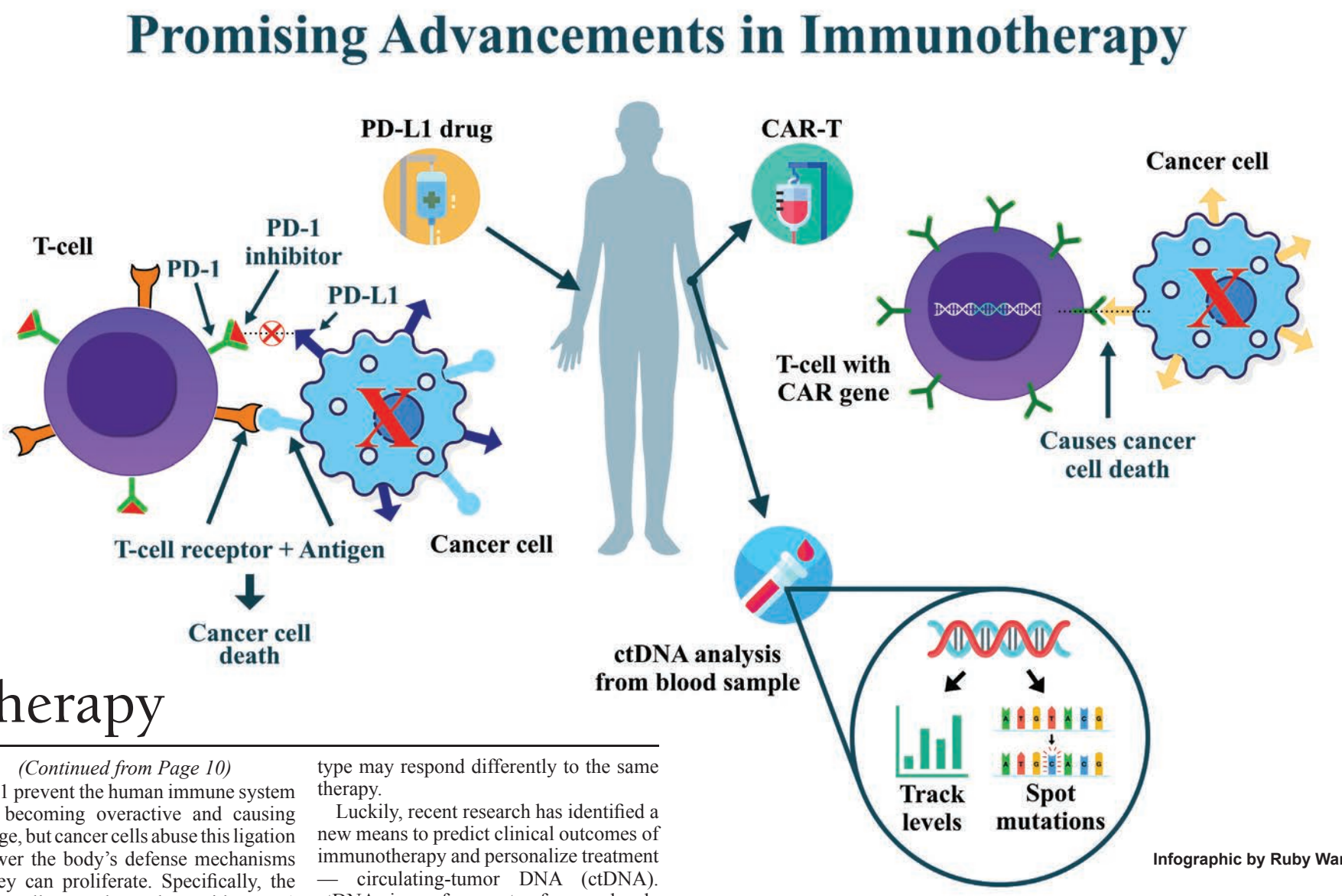

Infographic by Ruby Warner

Therapy

(Continued from Page 10)

PD-L1 prevent the human immune system from becoming overactive and causing damage, but cancer cells abuse this ligation to lower the body's defense mechanisms so they can proliferate. Specifically, the cancer cells coat themselves with PD-L1 and ligate to PD-1 on T cells, inactivating the T cells.

PD-L1 inhibitor immunotherapies prevent cancerous cells from using this strategy by stopping PD-L1 from binding to PD-1. Standalone PD-L1 inhibitor therapies have shown positive outcomes in some cases, but in the context of particularly tricky cancers (e.g., pancreatic cancer), they have fallen short. Combination therapies involving a PD-L1 inhibitor in conjunction with chemotherapy have shown promising results in cases where standalone therapies have fallen through.

A 2019 study conducted by researchers from Massachusetts General Hospital, Harvard Medical School and Northeastern University used a PD-L1 inhibitor and gemcitabine, a chemotherapy agent responsible for preventing the division of cancerous cells. The results were very exciting, demonstrating a 90% reduction in tumor volume and greatly increased survival rates in mice receiving the therapy. As encouraging as these results are, some of the experiments demonstrated inconclusive results, prompting the need for further research before researchers can declare this PD-L1 inhibitor combination therapy a viable counter to one of cancer's potent attacks.

EFFECTIVENESS

As with all battles, victory doesn't come without its fair share of challenges. Though immunotherapy can be a great benefit to many patients, there is a significant variability in clinical benefit of immunotherapy. Even patients with similarly progressed cancers of the same type may respond differently to the same therapy.

Luckily, recent research has identified a new means to predict clinical outcomes of immunotherapy and personalize treatment — circulating-tumor DNA (ctDNA). ctDNA is a fragment of a molecule released by tumor cells that can then be tracked in the patient. The information coded in ctDNA will hopefully provide doctors with valuable insight regarding a specific patient's response to treatment. By analyzing ctDNA in patient's blood samples, researchers can now know the genetic mutations on cancer cells and thus predict clinical outcomes and therapy resistance.

While masses of fighters (T cells) and clever strategies (PD-L1 inhibitors) help win battles, so does reconnaissance (ctDNA tracking). Early cancer detection is especially meaningful because treatment is more effective and success more attainable when the cancer is less complex and invasive. Using ctDNA, doctors can potentially detect cancer at a rather early stage from just a single drop of blood. What's more, ctDNA from blood samples could be more representative than a tumor biopsy for a disseminated disease that has extended beyond localized tissues and organs.

While ctDNA is excellent at identifying certain types of cancers, such as bladder and breast, further research is needed in order to use ctDNA for detection of other, more obscure, cancers.

Cancer research has been at the forefront of the scientific community for centuries. Technological advances such as CAR-T, PD-L1 therapy, and ctDNA analysis have made it possible to diagnose cancers and treat them with targeted therapies.

The continual discovery of new treatments will give us the upper hand we need in the fight against cancer.

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Addison Wellness would like you to say 'hello' our two newest members of the team!

Leila Kiernan, PT, DPT joined Addison Wellness in October after graduating from Northeastern University in May of 2020.

In May of 2021, we welcomed **Jodi Eddy, PT,** who relocated from the Nashua NH area. Jodi has 23 years of experience in orthopedic physical therapy and was a UVM classmate of Tracy and Matt. We are stoked to have both Jodi and Leila join the Addison Wellness Family!

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Better understanding nets better cancer treatments

By Clara Sandberg & Spencer Kiley

In December of 1971, Richard Nixon signed the National Cancer Act, which dedicated $1.5 billion over the ensuing several years to cancer research. It was a pivotal moment of the "War on Cancer," a movement that emerged in the 1960s that brought a new sense of urgency to cancer research.


Clara Sandberg

Many thought that the discovery of chemotherapy's potential to cure cancer was the final frontier in fighting the disease, but they lacked a thorough understanding of cancer as a disease, which meant they had no way of predicting what chemicals might be effective in different cancers. This led to an era defined by trial and error when treating cancer patients could seem like just another experiment.


Spencer Kiley

Fifty years on, as the urgency of that era has somewhat faded, understanding of normal cells and cancer cells has advanced significantly, enabling clinicians to prescribe individualized treatment based on different cancers or even different stages of the same cancer. Cancer researchers have not found the "magic bullet" they have been hunting for as long as the disease has been killing people. But they have found that the lives of most cancer patients can be extended at least a little bit and often they can have a comfortable and peaceful death.

This is all possible because of the thorough understanding of cancer that has been developed, allowing researchers to continue to build on this knowledge to advance existing treatments and come up with new ones.

BREAKING DNA DOUBLE STRANDS

Radiation therapy has been a fundamental tool of cancer treatment beginning more than a hundred years ago, but even it has advanced with understanding of the disease. It kills cancer by breaking the double strands in the cell's DNA, and though all cells have mechanisms to repair this type of damage, they rely on specific components that stop the cell's progress in the cell cycle, which can only work for so long. If the damage is not fixed in time, "apoptosis" occurs, which is when a cell is killed intentionally by the body.

The most common type of radiation involves continuous irradiation of the cancer for a few minutes at a time. However, research has shown that exposure to extremely short bursts of radiation in a very large dose can create double strand breaks that are more complex, with more damage condensed in a small area. This increased complexity of the breaks can lead to a significantly longer repair process. When testing the two types of radiation treatment, researchers found that 24 hours after exposure the cells exposed to ultrashort radiation had up to 2.9 times more double strand breaks than the cells exposed to continuous radiation (Babayan et al. 2020).

Along with this, drugs have emerged

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TKI drugs

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cluster of cells. Most TKIs used to treat lung cancer target the epidermal growth factor receptor protein, known as EGFR. The TKI chemically binds to the protein in a way that makes the protein unable to signal the cell to begin mitosis.

However, lung cancers generally acquire resistance to TKIs within a few years, meaning that the cancer stops being affected by the drug. For EGFR-targeting TKIs, this resistance occurs because the EGFR protein mutates and the TKIs can no longer bind and inhibit the protein's function. The most common mutant is EGFR-T790M. After the initially used TKI stops working, secondary TKI and chemotherapy treatments are much less effective. Because of this, research into TKIs that can stem cancer recurrence is ongoing. For example, researchers have developed TKIs that are able to bind to and inhibit the EGFR-T790M mutant.

Anesthesia can suppress the immune system and enable cancer growth, so by using regional anesthetics, effects on the immune system can be minimized.

The new TKIs under development will give doctors a new set of drugs that can be used to improve medical outcomes and extend patients' lives.

Cancer remains one of modern medicine's least treatable diseases, and one of the most pervasive in our society today. Unlike most other diseases, it also has the potential to return after remission, or even after a patient has been declared cancer free.

Researchers are constantly working on developing more effective methods to prevent recurrence, like regional anesthesia and TKI drugs that are not affected by common resistance-inducing mutations.

Through life-saving innovation and development, cancer recurrence can be better understood, treated, and hopefully prevented altogether.

Understanding

(Continued from Page 12)

that can inhibit double strand break repair, whether that is through the prevention of cell cycle arrest or by targeting other necessary components of the repair process, which in tandem with the advances in radiation, could lead to radiation therapy that can kill cancer much more efficiently than it can now.

Though these concepts are in varying stages in the process to become an established treatment, they show that improving our fundamental understanding of cancer and how treatments affect cells can lead to improvements to even our most basic treatment methods.

However, the most innovative discoveries lie in revolutionary treatments that attempt to cure cancer in a whole new way, and they have the potential to change the way cancer is treated forever.

Cancer treatments mostly consist of killing off the entire cancer cell, but a developing new treatment, CRISPR-Cas gene editing, focuses only on one segment of DNA rather than the whole cell. CRISPR-Cas gene editing works in the patient at the cellular level to cleave out unwanted DNA sequences and replace them with a non-functioning segment.

For cancer treatment, researchers can use CRISPR-Cas gene editing to cleave out mutant segments of DNA that are causing the cancer cells to continuously replicate.

Essentially, researchers use two molecules to accomplish this: a guide RNA and a Cas protein.

The guide RNA consists of complementary base pairs that match up with the unwanted DNA. The guide RNA locates and binds to the segment of DNA that needs to be cut out and indicates its location to the Cas protein. Next, the Cas protein cleaves the DNA. The native biological machinery then takes over, eliminating the unwanted segment of DNA, and replacing it with a non-functioning segment of DNA.

For cancer treatment, researchers can use this system to cleave out mutant segments of DNA that are causing the cancer cells to continuously replicate.

Researchers have had some success with mice when they used a CRISPR-Cas system to edit out a mutated gene in pancreatic cancer (Zhao et al.). This mutated gene's name is KRAS-G12D. Researchers have learned that KRAS-G12D is specifically important for cancer's ability to progress and grow rapidly inside of the patient. So, by editing out KRAS-G12D and replacing it with non-functioning DNA, the hope is that the patient's cancer growth will slow and eventually stop. So far, editing KRAS-G12D showed some slower tumor progression, but not an elimination of the cancer in the mice. Even though there was not complete destruction of the cancer, the slower progression shows signs of hope for the future of CRISPR-Cas systems in cancer treatment.

How can these new cancer treatments be used in the future? Although both improvements in radiation treatments and use of new CRISPR-Cas gene editing systems are in the early stages of development, this research could be the new face of cancer treatment through more clinical trials and testing.

Now that there's a better understanding of cancer cells, there's a better idea of the weaknesses of those cells. Researchers can be more specific in targeting components of cancer cells, even editing the DNA itself. These targeting treatments could minimize or even eliminate the need for more invasive treatments, such as chemotherapy or surgery.

Overall, if these systems show success in human trials, they will change the way we think about cancer treatments in the future.

Illness, stigma and a path forward

By Liz Bowen, Agnes Roche & Claire Shapiro

"Men and women, but men in particular, are squeamish even thinking about damage to sexual function. ... that plays a huge role in the fact that so few people understand anything about it until it starts to impact their life."

We got this message from an Addison County resident recently diagnosed with prostate cancer, which can cause sexual dysfunction.

Approximately one in six individuals with a prostate — likely more — will have prostate cancer at some point in their life. This could, and likely will, be you or someone close to you: a friend, a sibling, a spouse, a parent. And yet so many people have a limited understanding of the disease. Conversation around prostate cancer can be difficult for many to engage in because it involves discussion of sexual

(See Forward, Page 17)

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Mom was right: Eat your veggies!

By DORI OWCZARZAK, MS, RD, LDN
Penn State University Extension

If you could add one vegetable to the list accepted by everyone at the dinner table, which one would you choose? Do the vegetables served at your family meals reflect the likes and dislikes of your partner? If so, you are not alone. The simple exercise of making a list of the vegetables you enjoy but your family does not quickly exposes why so many of us default to a short list. Potatoes, corn, peas, carrots, green beans, lettuce and sometimes broccoli or cauliflower are vegetables often accepted by everyone.

Eating more vegetables, especially deep orange, cruciferous, and dark leafy greens, can help lower chronic disease risk. When it comes to vegetables in short supply in American diets, these three groups of vegetables with great health benefits come to mind:

• Deep orange (carrots, sweet potatoes, pumpkin and winter squash, such as butternut squash).

• Cruciferous (broccoli, cauliflower, cabbage, Brussels sprouts).

• Dark leafy greens (mild: dark

(See Veggies, Page 15)

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A quarter of runners 1st hit the roads during pandemic

A new report finds that more than a quarter of people who consider themselves runners first hit the roads during the COVID-19 pandemic.

RunRepeat surveyed 3,961 current runners to investigate how many began during the pandemic. The firm, which performs independent running shoe analysis, wanted to learn about athletes' motivations for running, whether they'll participate in races, and how they differ from those that began before COVID.

A May 21 write-up tabulating the runner responses showed that:

• 28.76% of current runners started running during the pandemic.

• These new-pandemic runners are 19.82% less likely to participate in in-person races over the next 12 months.

• New runners are more than twice as likely as pre-pandemic runners to prefer virtual races.

• Motives for running are changing — physical health is the primary motivation for 72% of new-pandemic runners, up 18.03% from runners who began running before the pandemic.

"New runners are running for their health, all while being less likely to choose any of the other options as a primary source of motivation," said Nick Rizzo, research director for RunRepeat.

Rizzo said that, specifically, these new runners are:

• 34.27% less likely to run for competition or achievement.

• 31.44% less likely to run for social interaction.

• 14.81% less likely to run for mental or emotional health.

• 3% less likely to run for their confidence or self-esteem.

"With more than a quarter of runners having begun during the pandemic, the 'average runner' has changed," Rizzo said. "From their motivations to their race participation and preferences. Focusing much more on the physical health benefits of cardio and being much more highly in favor of virtual races."

To see the report head online to runrepeat.com/new-pandemic-runners.

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Veggies

(Continued from Page 14)

lettuces, kale, Swiss chard, spinach; or savory: mustard, turnip, beet and collard).

WHY EAT DEEP ORANGE VEGETABLES?

According to the Penn State Extension Totally Veggies program, free radicals are molecules the body produces during the digestion of food as a result of an unhealthy diet, or exposure to tobacco smoke, pollution or chemicals. Because free radicals result in disease such as heart disease, cancer, and eye problems, we need a way to neutralize them. Fortunately, antioxidants neutralize free radicals, thus reducing the risk of disease. Deep orange vegetables are a great source of three antioxidants: vitamins A and C, and carotenoids.

You can see how the process works by cutting an apple and dipping the slices in lemon juice. Although oxidation would cause the apple to become brown, the vitamin C in the juice acts as an antioxidant, keeping the apple white. Think of the browning on the apple as free radical damage. The effects of antioxidants are the main reason we are advised to eat more vegetables.

WHY EAT CRUCIFEROUS VEGETABLES?

Cruciferous vegetables naturally produce bitter, sulfur-containing compounds to protect themselves against insect predators.

These bitter sulfur-containing compounds, called phytochemicals, are what give the cruciferous vegetables their stronger flavors and smells, and surprisingly, also help protect us from common cancers when we eat them.

WHY EAT DARK LEAFY GREENS?

Macular degeneration, the leading cause of vision loss among Americans age 60 and older, is an age-related disease that can blur sharp central vision needed for driving and reading. Dark leafy greens contain lutein, a carotenoid thought to be important for eye health. In the body, lutein concentrates in the macula, a small area in the retina responsible for central vision. Eating dark green leafy vegetables is the most effective way to guard eye health.

The most protective vegetables might be unfamiliar to you, or not served due to family norms that discourage experimentation with foods. If your family evening meals focus on meat and potatoes, what would it look like to introduce new vegetables? Might you want to try the vegetables first, and then offer a tasting to your family along with a familiar meal? Do this once a week, and then when you find a vegetable that two or more enjoy, serve it again.

Don't allow one person's dislikes to veto a new vegetable or recipe. The idea that everyone must like what is served is common in families, but this limits your ability to introduce new foods. You may be very surprised at what your family members like and will eat. If there is a vegetable that your partner does not like, let it go unsaid so that it does not affect the willingness of others at the table to try and enjoy it. If parents model vegetable eating for children, the eating habits can transfer to the children. Children who are involved with food preparation and choosing recipes are more open to trying new vegetables.

Vegetables are low in calories and filling; therefore, eating more vegetables results in eating less of the other foods offered at a meal. This might be as simple as serving a salad first at dinner, and then watching how it decreases the amount of the main dish that is eaten.

Ideas for introducing more vegetables into family meals include using salads, soups and side dishes, and including vegetables in mixed dishes for family dinners. Sometimes a vegetable prepared one way is undesirable, but the same vegetables prepared another way might become a new family favorite. When you find ways that your family enjoys them, vegetables offer exciting colors, flavors and texture, plus they contain vitamins, minerals and fiber, providing protection against many chronic diseases.

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Donor blood helps cancer patients after pandemic delays

VERMONT — The American Red Cross and the American Cancer Society have teamed up this June to encourage people across the country for a campaign called "Give Blood to Give Time," which will help ensure loved ones have the strength and support they need as they undergo cancer treatment.

According to the American Cancer Society, many patient visits and procedures were delayed or canceled early in the pandemic to reduce the risk of exposure to COVID-19. With procedures resuming, blood donations are critical for cancer treatments. Unfortunately, the Red Cross is seeing fewer blood and platelet donors give as the nation begins to climb out of this pandemic. This downturn comes at a time when the Red Cross continues to see strong demand for blood products including platelets by hospitals, causing concern for the sufficiency of the blood supply this month and throughout the summer.

Platelets, the clotting portion of blood primarily given to cancer patients during treatment, must be transfused within five days of donation and, therefore, are always in great demand.

"Many cancer patients, especially those going through chemotherapy, will have a need for blood products during treatment," said Dr. Baia Lasky, medical director for the Red Cross. "When someone donates blood or platelets, they may not only help prevent life-threatening bleeding that can cause stroke or relieve some symptoms, like shortness of breath and headaches, but also give patients and their families the time and hope they need to fight back."

> *"Many cancer patients, especially those going through chemotherapy, will have a need for blood products during treatment."*
>
> *— Dr. Baia Lasky, Red Cross medical director*

Some types of chemotherapy can damage bone marrow, reducing red blood cell and platelet production. Other times, the cancer itself or surgical procedures cause the need for blood products. About six blood products are needed every minute to help someone going through cancer treatment. Yet only 3% of people in the U.S. give blood. It is vital that more people donate blood and platelets regularly to meet that need.

To schedule a blood or platelet donation appointment, visit GiveBloodToGiveTime.org. As a special thank-you, those who come to donate through June 13 will receive a limited edition Red Cross T-shirt, while supplies last.

"The need for blood in cancer treatments is an important and untold story," said Howard Byck, senior vice president of corporate and sports alliances, American Cancer Society. "The American Cancer Society is excited to be working with the Red Cross on Give Blood to Give Time. Through this partnership, we want people to know there are multiple ways they can help and make a meaningful difference in the lives of patients and their families."

THE RED CROSS and American Cancer Society are encouraging healthy people to donate blood this month in order to restock supplies of blood and plasma for use by patients undergoing cancer treatment.

CASE STUDY

In August 2016, Myel Bowers-Smith received an unexpected and life-changing medical diagnosis. What she thought was an infection from a mosquito bite was actually stage 4 inflammatory breast cancer. The cancer was a very rare and aggressive breast carcinoma that spread from her breast to her lymph nodes on the left side of her body. "I just knew something wasn't right with my body," she said.

Bowers-Smith was determined to keep a positive attitude even when her treatments left her feeling sick for days at a time, unable to eat and extremely fatigued. "I received five different chemotherapy treatments and steroids. I also received multiple plasma and platelet transfusions. I would be in the hospital bed for hours receiving treatments," she said.

After months of treatment, Bowers-Smith was told her cancer was in remission in February 2017. "I was more than excited because I survived. I won, and it was time to get my life back! This couldn't defeat me," she said.

Bowers-Smith recognizes the role of blood products in her recovery and now encourages others to give. "Everyone needs someone, and this is your time to help someone who needs your blood or platelets. Be a blessing," she said. "Eligible donors, you have something good – which is your blood. A pint of blood can help save lives, and you never know if you or someone you love would need donated blood or platelet products."

HEALTH INSIGHTS FOR DONORS

The Red Cross is testing blood, platelet and plasma donations for COVID-19 antibodies through July 24. The test may indicate if the donor's immune system has produced antibodies to this coronavirus, regardless of whether they developed symptoms. Testing may also identify the presence of antibodies developed after receiving a COVID-19 vaccine. The Red Cross is not testing donors to diagnose illness, referred to as a diagnostic test. To protect the health and safety of Red Cross staff and donors, it is important that individuals who do not feel well or believe they may be ill with COVID-19 postpone donation.

> *The next local blood drive is planned for Saturday, June 12, 9 a.m.- 1:30 p.m. at the Middlebury Parks & Recreation gym at 154 Creek Road in Middlebury.*

At a time when health information has never been more important, the Red Cross is also screening all blood, platelet and plasma donations from self-identified African American donors for the sickle cell trait. This additional screening will provide Black donors with an additional health insight and help the Red Cross identify compatible blood types more quickly to help patients with sickle cell disease. Blood transfusion is an essential treatment for those with sickle cell disease, and blood donations from individuals of the same race, ethnicity and blood type have a unique ability to help patients fighting sickle cell disease.

Donors can expect to receive antibody test and sickle cell trait screening results, if applicable, within one to two weeks through the Red Cross Blood Donor App and the online donor portal at RedCrossBlood.org.

The next local blood drive is planned for Saturday, June 12, 9 a.m.- 1:30 p.m. at the Middlebury Parks & Recreation gym at 154 Creek Road in Middlebury.

Stigma

(Continued from Page 13)

activity and the possibility of impotence, both highly stigmatized topics.

Stigma, the negative perception of people deemed different or disadvantaged, often prevents individuals with a variety of illnesses from getting treatment and living fulfilling lives. Diagnoses of cancers, mental illness and HIV, for instance, can sometimes bring social stigma on individuals, this limiting an entire population's willingness to seek healthcare and reducing their access to care and to their networks of support.

Liz Bowen

Mental illness affects at least one in five Americans. As one of the most common health challenges in this country, the stigma that exists around mental health poses a significant barrier to care for a large portion of the population. The shame and guilt associated with this affliction may lead to fear and exclusion, coercive and withheld treatment, and treatment avoidance by patients. Segregated institutions for the mentally ill in the mid-20th century with experimental and sometimes cruel treatments are examples of the effect of stigma around mental illness.

Agnes Roche

Stigma surrounding HIV poses similar social difficulties. People living with HIV/AIDS are often unable to disclose their HIV status to those around them due to fears of social rejection because of their disease. HIV/AIDS disproportionately affects members of the LGBTQ community in the United States, and many associate HIV with drug use and homosexuality, two things looked down upon within many communities and by prominent institutions such as the Catholic Church. Combined with the fact that people with HIV are disproportionately shaped by social determinants of health (lack of education, minimal healthcare and poverty, for example), this stigma adds another dimension of difficulty to daily life and a patient's ability to find community support.

Due to stigma, mental illness and HIV, patients experience barriers to care that do not exist in other illnesses in which shame and guilt are less common. It is important to destigmatize these illnesses in order to advocate for the general health and well-being of those diagnosed with alienating illnesses such as prostate cancer.

While stigma presents a barrier to healthcare for many individuals, there is hope. Researchers Patrick W. Corrigan and Amy C. Watson, prominent members of the field of social psychology, have developed a three-step process for combating mental health stigma on a societal level. This framework can likely be applied to many different stigmatized ailments.

Claire Shapiro

The framework includes protest, education and contact. Protest aims to draw attention to and stop negative or misleading depictions of mental illness, such as the perception of mental illness as a character flaw. Once protest has stopped negative portrayals, education of the general public and increasing contact with people who suffer from mental illness serve as progressive efforts, creating positive dialogue around mental illness.

This process was seen in the progressive destigmatization of breast cancer experienced in American society in the late 20th century. Protest was undertaken by women who challenged the paternalistic and authoritative treatment of female breast cancer patients in writing memoirs. Efforts at disseminating information were spearheaded by books, namely one titled "Our Bodies, Ourselves," that centered on educating women about their anatomy and health. And public announcements by prominent women served a nationwide effort to forge contact between the public and public figures who had breast cancer, such as First Lady Betty Ford, helping give humanity to the illness.

Public announcements by prominent women served a nationwide effort to forge contact between the public and public figures who had breast cancer, such as First Lady Betty Ford, helping give humanity to the illness.

The efficacy of the framework developed by Corrigan and Watson to destigmatize breast cancer decades ago reveals its potential for success with destigmatizing other forms of cancer and other illnesses.

This outline presents medical professionals and public health experts with a promising roadmap for destigmatizing some of the most socially difficult illnesses in the United States. It also shows individuals and communities the importance of changing our attitudes toward currently stigmatized health challenges.

It is these changes that will help make our families, friends, neighbors and coworkers feel more supported and get treatment more smoothly when on their healthcare journeys.

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