HSHS
St. John's
Cancer Institute

2016 ANNUAL REPORT

Commission on Cancer

DIRECTORY

For more information about cancer services and programs at St. John's Hospital, call **(217) 544-6464**. Extensions are below.

St. John's Cancer Services can also be reached by calling (217) 525-5666 or (800) 524-0575, or by visiting www.st-johns.org.

Extension numbers

Executive Director of Cancer Care Services 44960
Nicholas Nehman

Medical Oncology 55640

Radiation Therapy 55666

Day Hospital/Infusion Unit 45395

Oncology Unit Nurse Manager 44863
Shauna Campo, RN

Chief Nursing Officer 44570
Allison Paul, DNP, RN, NEA-RC

Nurse Navigator 45591
Diana Weyhenmeyer, RN, MA, OCN, MSN

Cancer Registry
Angela George, MS, CTR 44692

The Mammography Center 535-3795

Social Work Services 45095

Spiritual Care 55675

CANCER COMMITTEE

HSHS St. John's Cancer Committee monitors the cancer program and recommends changes on various aspects of the expanding program. Representatives from all medical specialties are involved in the treatment and care of St. John's cancer patients.

St. John's cancer program received full approval from the American College of Surgeons Commission on Cancer (ACoS/CoC) in 2013. The three-year approval by the ACoS/CoC, ensures quality care, close to home, for cancer patients.

2016 Cancer Committee Members

Sabha Ganai, MD, PhD — Committee Chair and Cancer Liaison Physician

Sherjeel Sana, MD – Medical Oncologist

Hui Zhang, MD – Medical Oncologist

Onsi Kamel, MD – Pathologist

Simon Bekker, MD – Radiologist

Tamra Davidson, RPh – Pharmacist

Nicholas Nehman – Executive Director of Cancer Services

Diana Weyhenmeyer, RN, MA, OCN, MSN – Community Outreach Coordinator/Nurse Navigator

Shauna Campo, RN – Oncology Nurse Manager

Kathy Chepulis, RHIT – Quality and Risk Management

Lonnie Laughlin, MD – Palliative Care Coordinator

Angela George, MS, CTR – Cancer Registrar and Cancer Conference Coordinator

Mary Wildman – Social Work/Case Management

Nancy Young, RN, BSN, OCN – Nurse Educator

Patricia Fank – Psycho-Oncology

Deborah Durham – Dietitian

Linda Schultz – American Cancer Society

Dan Groepper, CGC – Genetic Counselor

Meckenzie Husske – Rehabilitation Services

Mark Sanders – Research/Clinical Research

Samuel Au, MD, PhD – Radiation Oncologist

WELCOME TO HSHS ST. JOHN'S HOSPITAL

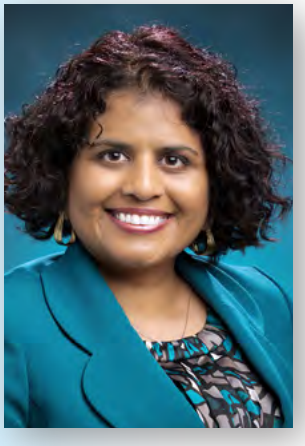
Nicholas Nehman

Executive Director
Orthopedic and
Cancer Care Services
HSHS St. John's Hospital

Cancer is a disease that impacts millions of people every year, and the Cancer Institute at HSHS St. John's Hospital continues to evolve in an effort to better combat the disease. 2015 marked a new chapter in this evolution as St. John's Hospital partnered with the HSHS Medical Group to strengthen oncology services at the hospital and meet community need by welcoming both medical and radiation oncology providers to the group and practice at the hospital.

In addition, 2015 was another year of recognition for our high-quality services and continued support of community and regional events and programs. In particular, St. John's was a recipient of the 2015 Women's Choice Award for Cancer Care and numerous colleagues participated in the American Cancer Society's Relay for Life and Making Strides Against Breast Cancer Walk and the Komen Foundation's Race for the Cure.

Finally, we would like to thank our physician partners and leaders who offer their continued support to our oncology program. Thank you to our caregivers who provide safe, high-quality and patient-centered care. And thank you to our patients and their families for allowing us the honor and privilege of caring for you.



Sabha Ganai, MD, PhD

Assistant Professor of Surgery
SIU School of Medicine
Chair, Cancer Committee
CoC Cancer Liaison Physician
Vice-Chair, Surgery
HSHS St. John's Hospital

CANCER LIAISON PHYSICIAN REPORT: PREVENTION IS THE BEST MEDICINE

HSHS St. John's Hospital is a Commission on Cancer (CoC) Academic Comprehensive Cancer Center and is committed to delivering excellent multidisciplinary cancer care to residents of Springfield and surrounding counties.

Our patients have access to clinical trials via Southern Illinois University, the Radiation Therapy Oncology Group, the Children's Oncology Group and the University of Chicago Phase II network.

We seek to provide our cancer patients with not only the most innovative therapies and strategies in oncologic care, but also several important quality improvement initiatives for surveillance and cancer therapy through our participation in the American College of Surgeons National Cancer Database (NCDB).

St. John's Cancer Registry collects and monitors data on all patients diagnosed and treated at St. John's. This data is used as part of the NCDB Cancer Quality Improvement Program and demonstrates St. John's has achieved excellent performance in numerous benchmarks for cancer quality when compared against other facilities in Illinois and all CoC programs in the region and nation. Among patients who received part of their cancer care at HSHS St. John's, including diagnosis, only 15.7% received their treatment elsewhere. This reflects the comprehensive breadth of oncology care available to our patients.

Over the last five years of available data from the National Cancer Database (2009 through 2013), 4,574 cancer patients were diagnosed and/or treated at St. John's, with 50.4% male gender. The stage distribution is seen in Figure 1, with a majority of patients being diagnosed with early stage disease. The top five primary cancer sites diagnosed and/or treated at St. John's in 2013 were breast, lung, kidney/renal pelvis, colorectal and bladder cancers, in descending order (Figure 2). Cancers of the breast, lung, kidney/renal pelvis, colon and thyroid were the top five primary cancer sites for women initially diagnosed between January 2009 and December 2013 (Figure 3). Overall, St. John's manages a greater proportion of breast cancer and kidney cancer cases in comparison to national averages for women. In men, cancers of the lung, prostate, kidney/renal pelvis and colon were the top five primary sites between 2009 - 2013 (Figure 4). Overall, St. John's manages a greater proportion of kidney and bladder cancer, but less colorectal, lung and prostate cancers compared to national averages for men.

In preparation for the hospital's participation in the National Colorectal Roundtable and American Cancer Society's 80% by 2018 Campaign, an effort to improve colorectal cancer screening rates to include 80% of adults over the age of 50, this year's annual

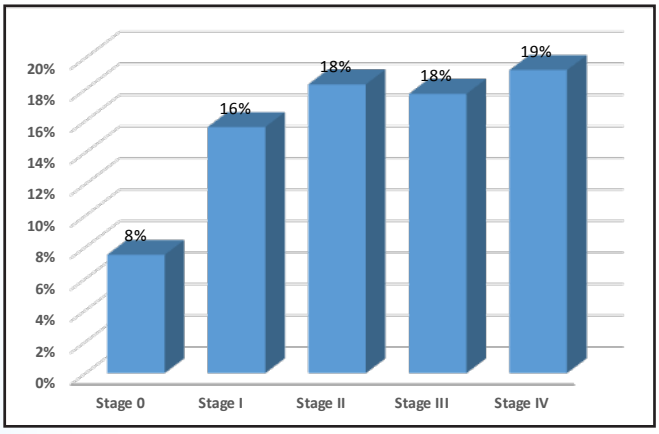


Figure 1:
Stage Distribution of All Cancer Patients Diagnosed and/or Treated at HSHS St. John's Hospital (1/2009 – 12/2013)

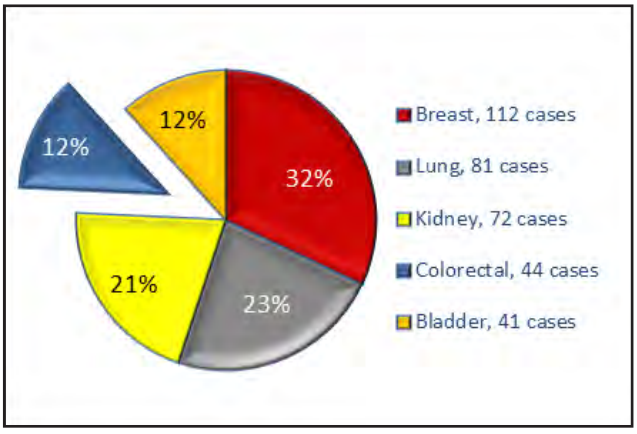


Figure 2:
Incidence of the Five Most Common Cancer Types Diagnosed and/or Treated at HSHS St. John's in 2013.

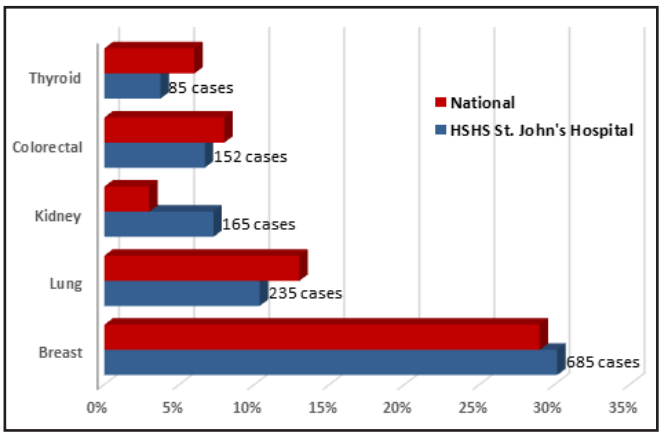


Figure 3:
2009 - 2013 Percentage Incidence Female Cases: Comparison of top 5 primary sites in females at St. John's with national data (Siegel et al, 2016).

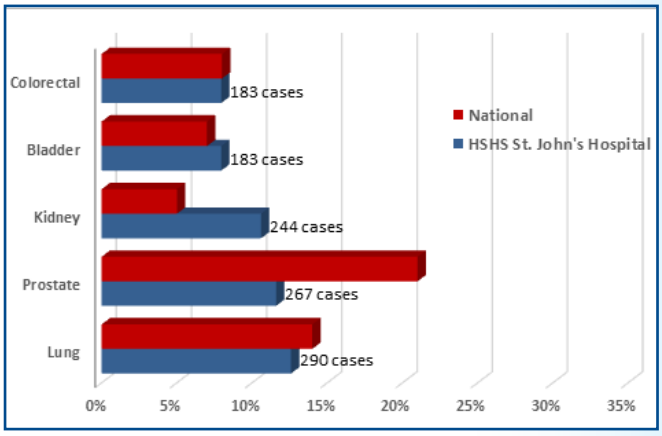


Figure 4:
2009 - 2013 Percentage Incidence Male Cases: Comparison of top 5 primary sites in males at St. John's with national data (Siegel et al, 2016).

report includes a special focus on colon and rectal cancers. Colorectal cancer is the third most commonly diagnosed cancer for both men and women in the United States, affecting an estimated 134,490 people in the U.S. and 5,580 new cases in Illinois in 2016 [1].

Unfortunately, colorectal cancer also is the third cause of cancer mortality, with an estimate of 49,190 patients nationally and 2,030 people in Illinois dying from the disease in 2016 [1]. This is particularly disturbing because colorectal cancer can be prevented through screening measures ranging from colonoscopy to Fecal Immunohistochemical Testing ("FIT") for normal risk adults over age 50. In fact, colonoscopy is the only screening tool that is considered both primary and secondary prevention. While it can diagnose the presence of colorectal cancers, it can also prevent cancers by early removal of precancerous polyps. FIT testing is a newer noninvasive modality that allows screening to occur on a yearly basis rather than once every ten years. New data has shown that while United States colorectal cancer mortality declined by 48% between 1970 and 2011, central and southern Illinois are part of a "hotspot" where colorectal cancer deaths are much higher than the national average. [2] Many of these counties have screening rates below expected. The good news is that clinicians at St. John's are working to address these disparities in our surrounding counties.

Among patients with colorectal cancer managed at St. John's, 39% travelled between 25 - 100 miles to establish care, which is twice the national average of patients dealing with similar driving distances. This is reflective of St. John's important role as a regional cancer center.

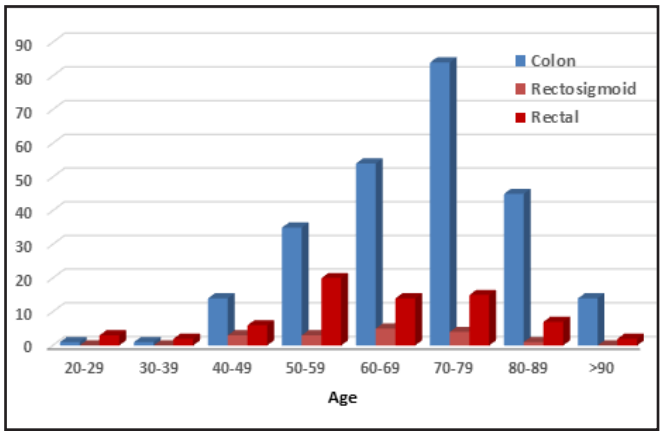


Figure 5:
Histogram of age distributions by site for colorectal cancer diagnosed and/or treated between 1/2009 and 12/2013 at HSHS St. John's Hospital.

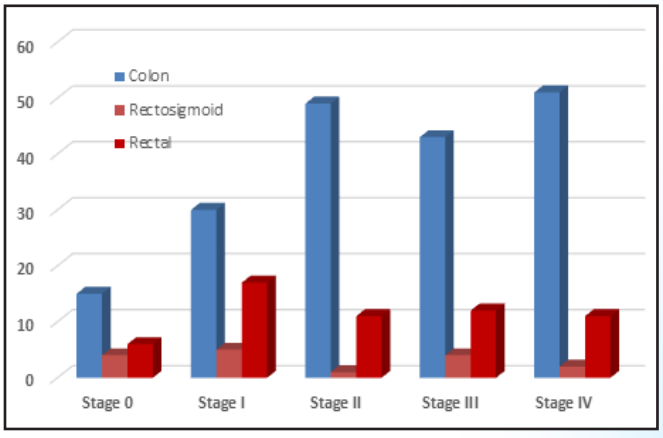
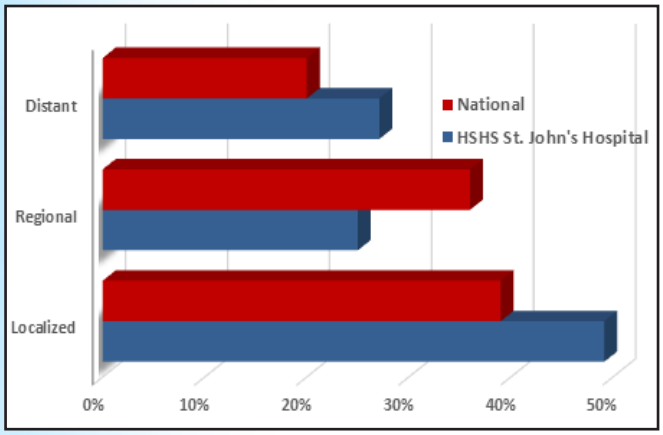


Figure 6:
Histogram of stage distributions by site for colorectal cancer diagnosed and/or treated between 1/2009 and 12/2013 at HSHS St. John's Hospital.

Figure 7:
2009 - 2013 Percentage Incidence of Colorectal Cases by Extent of Disease at Diagnosis: Comparison of St. John's cases with known stage with national data (Siegel et al., 2016).



Colorectal cancer risk can otherwise be modified by diet, weight control, physical activity and limiting processed meat intake. Genetics can also increase the risk of cancer, as will be discussed by Dan Groepper in this Annual Report. From January 2009 to December 2013, a total of 250 colon cancers (74.6%), 16 rectosigmoid junction cancers (4.8%) and 69 rectal cancers (20.6%) were diagnosed at St. John's, with 45% of incident cases in women and 55% in men. The age distribution of colon cancers demonstrated a peak in patients in their seventies, while rectal cancers were more likely seen in patients in their 50s (Figure 5). The stage distribution of patients presenting with colon cancer showed a greater proportion of late stage disease in comparison to those with rectal cancer at St. John's (Figure 6). When comparing colorectal incidence with national numbers, there is a higher proportion of localized disease at St. John's (Stages I-II), but there is also a higher than expected proportion of patients presenting with distant, metastatic disease (Stage IV; Figure 7). This has important survival implications where the United States five-year survival is 90% for localized (Stages I-II), 71% for regional disease (Stage III) and only 13% for distant disease (Stage IV), even with the best therapies. [1] Ideally, by promoting colorectal screening practices in our communities, we can further decrease the proportion of late stage diagnosis of colorectal cancer and thus improve cancer outcomes through prevention and early detection.

1. *Siegel RL, Miller KD, Jemal A. Cancer Statistics, 2016. CA Cancer J Clin 2016; 66: 7-30.*
2. *Siegel RL, Sahar L, Robbins A, et al. Where can colorectal cancer screening interventions have the most impact? Cancer Epidemiol Biomarkers Prev 2014; 24: 1151-1156.*

V. Presad Poola, MD
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Colorectal Surgery
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SIU School of Medicine

ROBOTIC ASSISTED MINIMALLY INVASIVE SURGERY FOR COLON AND RECTAL CANCER

Minimally invasive techniques (laparoscopic) when utilized appropriately are advantageous for colon or rectal cancer patients resulting in less post-operative pain and a shorter hospital stay. Due to many limitations (unstable two dimensional camera platforms, rigid straight instruments, limited degree of freedom) most rectal cancer patients do not benefit from laparoscopic surgery.

However, at HSHS St John's Hospital, robotic-assisted minimally invasive operations using free-moving multi-joint forceps, high-quality three-dimensional imaging with a stable camera, and greatly improved ergonomics, enable complex rectal cancer operations to be performed very safely. The benefits of robotic-assisted minimally invasive operations include:

- Reduced pain and discomfort
- Faster recovery time and return to normal activities
- Smaller incisions, resulting in reduced risk of infection
- Reduced blood loss and fewer transfusions
- Shorter hospitalization
- Minimal scarring

Colorectal surgeons in Springfield will continue to perform laparoscopic colectomy for most colon cancer patients. A multidisciplinary team comprised of a colorectal surgeon, gastroenterologist, medical oncologist and radiation oncologist, in collaboration with SIU School of Medicine and St John's, can provide the highest quality care to colon and rectal cancer patients.

Hui Zhang, MD
Medical Oncologist
HSHS St. John's Hospital

COLORECTAL CANCER

Colorectal cancer (CRC) is the third most commonly diagnosed cancer in males and the second in females, with 1.4 million new cases and almost 694,000 deaths estimated to have occurred in the world in 2012 [1- 2]. There are approximately 140,000 cases diagnosed in the United States every year. The incidence of CRC is higher in the developed countries than in developing countries [1-2].

CRC is both sporadic and familial. Age is a major risk factor for sporadic CRC. In the U.S., the lifetime incidence of CRC in patients at average risk is about 5 percent, with 90 percent of cases occurring after age 50. Males have a higher incidence than females and African Americans have a higher risk than Caucasians [1-4].

There are several common inherited forms of CRC, such as hereditary nonpolyposis colorectal cancer (HNPCC), familial polyposis, Peutz-Jeghers syndrome and juvenile polyposis. These are caused by different gene mutations and tend to develop at young age among several members of a family and increase the risk of other cancers such as ovarian, pancreatic, breast, gastric, genitourinary and small bowel cancers [5].

Scientific studies in the past decades demonstrated that physical inactivity, an unhealthy diet, consuming low fiber or high fatty foods, smoking and obesity are risk factors of CRC [5]. In contrast, vitamin D, calcium and aspirin intake seem to decrease the risk [5-6].

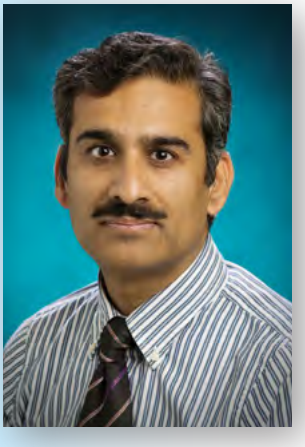
The majority of early stage colorectal cancers are curable. How to detect the pre-cancer disease or early stage of cancer is the key to decreasing cancer-related mortality. For example, surgery alone is curative for more than 85 percent of patients with stage I or early stage II disease. For patients with stage III disease (with positive lymph node involvement), the five-year survival rate drops to 30 percent to 50 percent [4-10].

There are several screening tests for CRC, such as digital rectal examination, fecal occult blood test, sigmoidoscopy and colonoscopy. Recently, the American Cancer Society and several other societies released guidelines and added two new tests: stool DNA and CT colonography. For the general population, both men and women are recommended to start one of screening tests at age of 50, however, patients with an inherited disease, such as HNPCC, usually start screening tests earlier and should discuss with their physician [5].

For patients with advanced colorectal cancer, chemotherapy will help to reduce the recurrent rate, prolong life span significantly and minimize symptoms caused by cancer itself.

In recent years, the use of either EGFR or VGFR inhibitors or antibodies, combined with chemotherapy for patients with an extensive stage of colorectal cancer, significantly increase the response rate, disease-free survival and overall survival rates, as compared with chemotherapy alone [5-11].

1. *Torre LA, Bray F, Siegel RL, et al. Global cancer statistics, 2012. CA Cancer J Clin 2015; 65:87.*
2. *Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. CA Cancer J Clin 2015; 65:5.*
3. *Center MM, Jemal A, Ward E. International trends in colorectal cancer incidence rates. Cancer Epidemiol Biomarkers Prev 2009; 18:1688. Eddy DM. Screening for colorectal cancer. Ann Intern Med 1990; 113:373.*
4. *http://www.cancervic.org.au/downloads/cec/cancer-in-vic/CCV-Statistics-trends.pdf (Accessed on January 03, 2012).*
5. *American Society of Clinical Oncology- SEP 2013, chapter 9; 225-236*
6. *Davis DM, Marcet JE, Frattini JC, et al. Is it time to lower the recommended screening age for colorectal cancer? J Am Coll Surg 2011; 213:352.*
7. *Singh KE, Taylor TH, Pan CG, et al. Colorectal Cancer Incidence Among Young Adults in California. J Adolesc Young Adult Oncol 2014; 3:176.*
8. *Tawadros PS, Paquette IM, Hanly AM, et al. Adenocarcinoma of the rectum in patients under age 40 is increasing: impact of signet-ring cell histology. Dis Colon Rectum 2015; 58:474.*
9. *Jemal A, Siegel R, Xu J, Ward E. Cancer statistics, 2010. CA Cancer J Clin 2010; 60:277.*
10. *Lehnert T, Methner M, Pollok A, et al. Multivisceral resection for locally advanced primary colon and rectal cancer: an analysis of prognostic factors in 201 patients. Ann Surg 2002; 235:217.*
11. *Primrose J, Falk S, Finch-Jones M, et al. Systemic chemotherapy with or without cetuximab in patients with resectable colorectal liver metastasis: the New EPOC randomised controlled trial. Lancet Oncol 2014; 15:601.*



Sherjeel Sana, MD
Medical Oncologist
SIU School of Medicine

CHALLENGES AND ADVANCEMENTS IN THE TREATMENT OF COLORECTAL CANCERS

Colorectal cancer is one of the three most common and deadliest cancers in males and females worldwide. Despite a drop in mortality of colon cancer, which we largely attribute to screening, we are still far short of our goal of screening the eligible population for colon cancer. Screening colonoscopy is the most cost effective tool, yet less than 30 percent of our population 50 years or older is being screened with this modality. The major reason for this failure is because the medical community has been unsuccessful in advocating for and delivering the message to the target patient population.

To fill this huge disconnect Simmons Cancer Institute, in collaboration with St. John's Hospital and Memorial Medical Center, has pledged to screen at least 50 percent of the over 50 population this year and 80 percent by the end of 2018.

Achieving the above milestones is the first step in decreasing the incidence of invasive colorectal cancer, but there would still be a large number of people at risk of dying. To this end we must continue to pursue research in treating advanced colorectal cancer.

The major advances in the treatment of colorectal cancer have happened in the last few years. We are not only able to cure most early stage cancers, but are also able to extend life significantly in patients with metastatic cancer due to better understanding of the biology of this disease. A big leap in this direction has been the discovery and role of RAS mutations and targeted drugs. This knowledge has transformed the treatment of metastatic colorectal cancer and extended the overall survival from six months to more than two years.

A summary of recent advances in treatment we offer our patients, in addition to combination chemotherapies in metastatic colorectal cancers, include Bevacizumab. Bevacizumab is an antibody against vascular endothelial growth factor (VEGF), which is a molecule necessary in the process of angiogenesis. The addition of Bevacizumab to standard chemotherapy for metastatic colorectal cancer improves survival in the range of two to four months over chemotherapy alone. There are usually few side effects, but potential problems include hypertension, protein in urine, renal impairment and delayed wound healing.

Cetuximab and Panitumumab are two monoclonal antibodies targeting the epidermal growth factor receptor (EGFR) are active in the treatment of metastatic colorectal cancers that carries no mutations in the RAS genes. It has shown benefit both as single agent as well as in combination with first line chemotherapies.

Regorafenib is another approved oral agent pill which inhibits the blood vessel growth (Inhibitor of VEGF receptors) for the treatment of patients with mCRC who have been previously treated with chemotherapies, Bevacizumab and K-RAS wild type, an anti-EGFR therapy. It improves survival in the range of two months in previously heavily treated patients.

(TAS-102) is the second oral cytotoxic agent after capecitabine (oral from of 5 FU chemotherapeutic agent) approved in March of 2015. It is a combination of trifluridine and tipiracil which works in concert to damage tumor DNA by causing strand breaks. A recent Phase 3 trial (RECOURSE) has established the benefit of this pill in patients who failed first line chemotherapy combinations and K-RAS wild type.

FAMILIAL CANCER – BEYOND THE SYNDROMES

In various contexts, a detailed family history proves a valuable source of information to guide medical management. Relatives with diabetes, heart disease, autoimmune disorders and many other conditions intuitively put other family members at a higher than average risk for recurrence. This pattern applies to colorectal cancers, as well.

A patient who has one or more first-degree relatives with colorectal cancer faces at least a doubling of their lifetime risk for this cancer. As the number of affected individuals in the family increases, the risks to relatives increase too. It is believed this phenomenon is partially due to shared DNA, but shared environmental factors like diet also play a role.

A genetic syndrome is identified in some families with multiple cases of colorectal cancer. For example, Lynch syndrome, familial adenomatous polyposis syndrome, Peutz-Jeghers syndrome, MUTYH-associated polyposis and juvenile polyposis syndrome account for 5 percent to 10 percent of all colorectal cancer diagnoses. Lynch syndrome is the most common and universal colorectal and endometrial tumor testing so testing for it now acts as a screening tool for patients affected by cancer whose family history may not be informative.

The discovery of any one of these syndromes in a family anchors recurrence risk assessment. Without this type of hereditary diagnosis however, many patients are left with the uncertainty of family history alone. The National Comprehensive Cancer Network (NCCN) provides guidelines for patients who only have a family history of colorectal cancer. Based on the number of affected relatives and their age at diagnosis, the age at first colonoscopy may be reduced and frequency of studies may be increased. For instance, a patient whose father had colorectal cancer at age 51 years is recommended colonoscopy at age 41 years with a repeat scan every 5 years. Without this history, colonoscopies would start at age 50 years with repetition every 10 years unless there are remarkable findings.

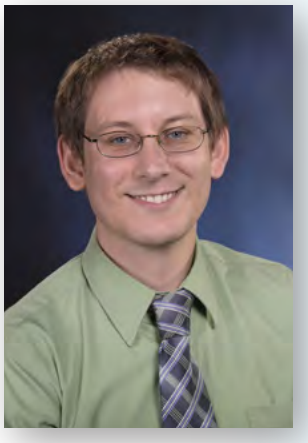
Colonoscopy effectively screens for and prevents colon cancers from occurring. Everyone is at risk for colorectal cancer and therefore colonoscopy is recommended at some point for everyone. This procedure has the greatest benefit when considered with specific risk factors like a positive family history. Awareness of family history plays a critical role in minimizing the burden of this disease for all people.

Genes and the family – colorectal cancer

A very anxious Jessica arrived in my office for genetic counseling. She asked, "Am I going to get colon cancer, too? I searched Google and think I have Lynch syndrome." Upon exploring these concerns, she explained her older sister, Pam, was recently diagnosed with colon cancer at 40 years of age. Additionally, their father and paternal aunt had colon cancer in their 50s. Jessica, now 28 years old, was concerned about what this history meant for her and her young children.

During her visit, I clarified that colorectal cancers often occur sporadically or by chance. In fact, the average American currently has a 4 percent to 5 percent lifetime risk to develop this form of cancer. Only 5 percent to 10 percent of individuals with colorectal cancer have a recognized inherited syndrome. Collection of family history helps determine whose cancer is sporadic versus hereditary. Lynch syndrome is a hereditary cancer syndrome characterized by a strong family history of colorectal, endometrial and various other gastrointestinal/gynecological cancers. An individual with Lynch syndrome may have lifetime chances of 75 percent to 80 percent for colon cancer and 20 percent to 60 percent for endometrial cancer.

We also discussed genetic testing as a tool to understand whether Jessica and her relatives have a hereditary cancer condition, like Lynch syndrome. Jessica is not a good candidate for this testing because she is healthy. A normal genetic test result for her would not help us learn why her relatives have cancer. They may have an inherited condition besides Lynch syndrome.



Daniel Groepper, MS, CGC
Genetic Counselor
SIU School of Medicine

Following our consultation, I began working with Jessica, Pam and Pam's oncologist to gather more information. Because Pam had surgery at HSHS St. John's Hospital, I knew her tumor was tested for markers of Lynch syndrome. In the past two years, St. John's pathology department began universal screening for these tumor markers because some people with colon or endometrial cancer have Lynch syndrome without a strong family history of cancer. Pam's colon tumor showed signs of Lynch syndrome, but her genetics referral was postponed during her treatments. I eventually met Pam for consultation and reviewed some of the same information discussed with Jessica. Pam elected to have genetic testing which revealed an MLH1 gene mutation. Endometrial cancer risk management was initiated for Pam. Inexpensive site-specific MLH1 testing subsequently ordered for Jessica showed normal (negative) results.

At our final visit, I confirmed for Jessica that Lynch syndrome is present in her family, most likely her father is affected, but like many hereditary cancer syndromes, there is a 50 percent chance of not inheriting the condition. Because she did not inherit Lynch syndrome, she cannot pass it on to her children. Finally, this normal testing does not eliminate her cancer risks. She still has the same chances to develop cancer as the average individual.

Samuel P. Au, MD
Radiation Oncologist
HSHS Medical Group

RADIATION THERAPY FOR COLORECTAL CANCERS

During radiation therapy, the colorectum, or the large bowel, is divided into the colon and rectum [2]. Tumor progressions differ tremendously in these two areas. The transverse colon, cecum and the sigmoid loop are mobile structures that lie free in the peritoneal cavity and are completely covered with serosa, the visceral peritoneum. The posterior aspect of the ascending and descending colon and both flexures are frequently without serosa. The anterior surface of the proximal third of the rectum is covered with serosa. Pattern of tumor recurrence and its natural progression often depends on the tumor location, in reference of the peritoneal reflection. If the tumor is completely above the peritoneal reflection, it is treated as colon cancer. If any portion is at or below the reflection it is treated as rectal cancer.

After the initial mucosal growth, there are several directions in which colorectal cancer may progress.

- **Direct extensions:** The tumor penetrates through the bowel wall and extracolonic tissues, and then directly invades adjacent organs.
- **Perineural invasion:** Tumor invades and grows along the perineural route, which may extend as far as 10 cm from the primary tumor.
- **Lymphatic invasion:** Tumor invades into the lymphatic vessels and metastases into the regional lymph nodes.
- **Vascular Invasion:** The liver is the primary site of hematogenous metastases, followed by the lung. In about 40 percent of autopsy studies, liver is the only site involved [3].

With all stages combined, the most common failure site in colon cancer after the initial treatment is abdominal rather than local. When local failure occurs, it usually does not produce the same degree of debilitating symptoms as in rectal cancer.

Radiation therapy is an effective locoregional modality. It synergizes and complements with surgery, a localized modality, and chemotherapy or targeted therapy, a systemic modality. Over the years, because of technological advancements in diagnostics and image processing, highly precise image-guided radiation treatment is feasible to the deep-situated tumor with minimal side effects.

Sterotactic Body Radiotherapy for liver and lung metastases

Radiation therapy is seldom recommended in the definitive treatment of colon cancers. In selected cases of tumor penetrating and fixing to a neighboring structure or for a patient with recurrent disease, perioperative radiation with external beam or brachytherapy can be considered.

Approximately 50 percent of colon cancer patients develop metastatic liver disease [4]. Metastatic disease most frequently develops metachronously after treatment for locoregional colorectal cancer, with the liver the most common site of involvement [5]. About 30 percent of colorectal cancer patients present with synchronous liver metastases. Clinical studies have shown resection of liver metastases offered a five-year, disease-free survival rate of approximately 20 percent [6], and a recent meta-analysis reported a median survival of 38 percent [7] of these cases. Retrospective meta-analysis has shown that patients with solitary liver metastases have a five-year overall survival rate as high as 71% following resection [8].

Most of the benefit of liver metastases resection also applies for lung metastases [9]. Resectable primary colon tumor with resectable synchronous metastases can be treated with a staged or simultaneous resection.

For patients who are not candidates for such surgery, or who decline, radiation therapy in the form of the non-invasive stereotactic body radiotherapy (SBRT) is usually offered. It is a treatment utilizing all the latest imaging technology to

deliver stereotactically the dose to the target tumor. Radiation is channeled with high-precision image-guidance, 3-dimensional conformal photon beams to the liver and lung metastases. But unlike surgery, it is entirely non-invasive. It typically involves 3 to 5 daily treatments, each lasting for about 30 minutes. It offers high tumor control rates, with very minimal side-effects. It utilizes multiple high energy photon beams. The sizes, the shapes and the intensity across the beams are optimized to match the size, the shape and the thickness of the tumor to be treated.

SBRT is currently being routinely offered for brain metastases, especially in those unresectable cases.

Radiation therapy for rectal cancers

For early stage of rectal cancer, the incidence of local failure after surgery is less than 10 percent. Post-operative radiation therapy is therefore not recommended. The failure rate markedly increases to 15 percent to 35 percent in the more advanced transmural and lymph node involved cases [10].

Local failure in general is severely debilitating and salvage is often of limited success. Intractable pain and loss of bowel and bladder function happens frequently. The ability of radiation therapy to decrease local failure, besides improving survival, is by itself an important endpoint.

Radiation therapy plays an important role as part of the overall definitive treatment of rectal cancers. For the resectable cases, it is offered pre-operatively to improve complete resections and enhance the likelihood of sphincter preservation. For the locally advanced or unresectable cases, pre-operative radiation therapy, preferable with chemotherapy, is used to down-size the tumor to facilitate complete surgical excision [11], and is currently the standard of multi-disciplinary care. In cases of a locoregional disease without prior radiation, post-operative radiation therapy in conjunction of chemotherapy is recommended to improve tumor control and survival [12].

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