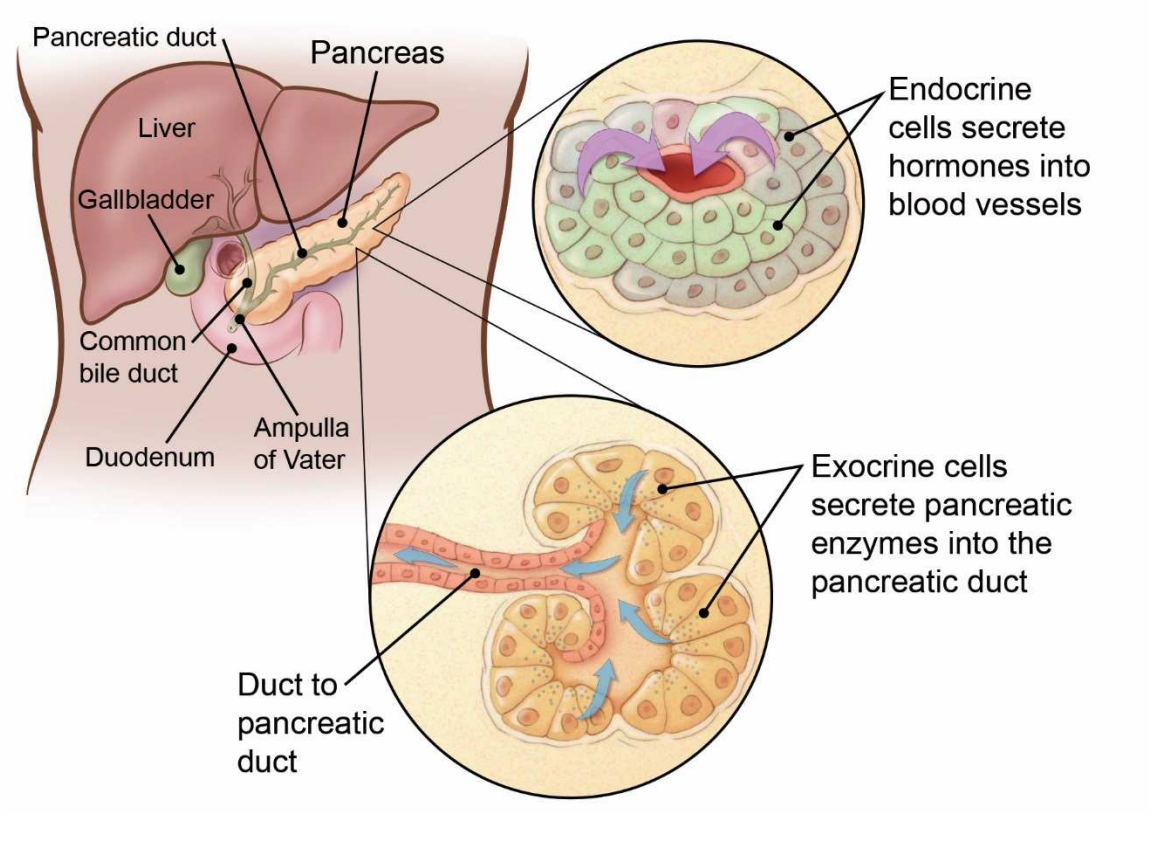
Pancreatic Cancer

What is pancreatic cancer?

Cancer starts when cells in the body begin to grow out of control. Cells in nearly any part of the body can become cancer, and can spread to other areas of the body. To learn more about how cancers start and spread, see *What Is Cancer?*

Pancreatic cancer begins when cells in the pancreas start to grow uncontrollably. The pancreas is an organ located behind the stomach. It is shaped a bit like a fish with a wide head, a tapering body, and a narrow, pointed tail. In adults it is about 6 inches long but less than 2 inches wide. The head of the pancreas is on the right side of the abdomen (belly), behind where the stomach meets the duodenum (the first part of the small intestine). The body of the pancreas is behind the stomach, and the tail of the pancreas is on the left side of the abdomen next to the spleen.



The pancreas has 2 main types of cells:

- **Exocrine cells:** Most of the cells in the pancreas form the exocrine glands and ducts. The exocrine glands make pancreatic enzymes that are released into the intestines to help you digest foods (especially fats). The enzymes are first released into tiny tubes called *ducts*. These merge to form larger ducts, which empty into the pancreatic duct. The pancreatic duct merges with the common bile duct (the duct that carries bile from the liver), and empties into the duodenum (the first part of the small intestine) at the ampulla of Vater.

- **Endocrine cells:** Endocrine cells make up a much smaller percentage of the cells in the pancreas. These cells are in small clusters called *islets* (or *islets of Langerhans*). The islets make important hormones like insulin and glucagon (which help control blood sugar levels), and release them directly into the blood.

Types of pancreatic cancer

The exocrine cells and endocrine cells of the pancreas form different types of tumors. It's very important to distinguish between exocrine and endocrine cancers of the pancreas. They have distinct risk factors and causes, have different signs and symptoms, are diagnosed with different tests, are treated in different ways, and have different outlooks.

Exocrine pancreatic cancers

Exocrine cancers are by far the most common type of pancreas cancer. If you are told you have pancreatic cancer, it is most likely an exocrine pancreatic cancer.

Pancreatic adenocarcinoma: About 95% of cancers of the exocrine pancreas are adenocarcinomas. These cancers usually begin in the ducts of the pancreas. Less often, they develop from the cells that make the pancreatic enzymes, in which case they are called *acinar cell carcinomas*.

Less common types of exocrine cancer: Other, less common exocrine cancers include adenosquamous carcinomas, squamous cell carcinomas, signet ring cell carcinomas, undifferentiated carcinomas, and undifferentiated carcinomas with giant cells.

Ampullary cancer (carcinoma of the ampulla of Vater): This cancer starts in the ampulla of Vater, which is where the bile duct and pancreatic duct come together and empty into the small intestine. Ampullary cancers aren't technically pancreatic cancers, but they are included here because they are treated very similarly.

Ampullary cancers often block the bile duct while they are still small and have not spread far. This blockage causes bile to build up in the body, which leads to yellowing of the skin and eyes (jaundice). Because of this, these cancers are usually found earlier than most pancreatic cancers, and they usually have a better prognosis (outlook).

Pancreatic endocrine tumors (neuroendocrine tumors)

Tumors of the endocrine pancreas are uncommon, making up less than 5% of all pancreatic cancers. As a group, they are often called *pancreatic neuroendocrine tumors (NETs)* or *islet cell tumors*.

Pancreatic NETs can be benign (not cancer) or malignant (cancer). Benign and malignant tumors can look alike under a microscope, so it isn't always clear if a pancreatic NET is cancer. Sometimes it only becomes clear that an NET is cancer when it spreads outside the pancreas.

There are many types of pancreatic NETs.

Functioning NETs: About half of pancreatic NETs make hormones that are released into the blood and cause symptoms. These are called *functioning* tumors. Each one is named for the type of hormone the tumor cells make.

- **Gastrinomas** come from cells that make gastrin. About half of gastrinomas are cancers.
- **Insulinomas** come from cells that make insulin. Most insulinomas are benign (not cancer).
- **Glucagonomas** come from cells that make glucagon. Most glucagonomas are cancers.

- **Somatostatinomas** come from cells that make somatostatin. Most somatostatinomas are cancers.
- **VIPomas** come from cells that make vasoactive intestinal peptide (VIP). Most VIPomas are cancers.
- **PPomas** come from cells that make pancreatic polypeptide. Most PPomas are cancers.

Most functioning NETs are gastrinomas or insulinomas. The other types are rare.

Non-functioning NETs: These tumors don't make enough excess hormones to cause symptoms. They are more likely to be cancer than are functioning tumors. Because they don't make excess hormones that cause symptoms, they can often grow quite large before they are found.

Carcinoid tumors: These NETs are much more common in other parts of the digestive system, although rarely they can start in the pancreas. These tumors often make serotonin (also called *5-HT*) or its precursor, 5-HTP.

The treatment and outlook for pancreatic NETs depend on the specific tumor type and the stage (extent) of the tumor, but the outlook is generally better than that of pancreatic exocrine cancers.

Benign and precancerous growths in the pancreas

Some growths in the pancreas are simply benign (not cancer), while others might become cancer over time if left untreated (known as *precancers*). Because people are getting imaging tests such as CT scans more often than in the past (for a number of reasons), these types of pancreatic growths are now being found more often.

Serous cystic neoplasms (SCNs) (also known as *serous cystadenomas*) are tumors that have sacs (cysts) filled with watery fluid. SCNs are almost always benign, and most don't need to be treated unless they grow large or cause symptoms.

Mucinous cystic neoplasms (MCNs) (also known as *mucinous cystadenomas*) are slow-growing tumors that have cysts filled with a jelly-like substance called *mucin*. These tumors almost always occur in women. While they are not cancer, some of them can progress to cancer over time if not treated, so these tumors are typically removed with surgery.

Intraductal papillary mucinous neoplasms (IPMNs) are benign tumors that grow in the pancreatic ducts. Like MCNs, these tumors make mucin, and over time they sometimes become cancer if not treated. Some IPMNs can just be followed closely over time, but some might need to be removed with surgery if they have certain features, such as if they are in the main pancreatic duct.

Solid pseudopapillary neoplasms (SPNs) are rare, slow-growing tumors that almost always develop in young women. Even though these tumors tend to grow slowly, they

can sometimes spread to other parts of the body, so they are best treated with surgery. The outlook for people with these tumors is usually very good.

Key statistics for pancreatic cancer

How common is pancreatic cancer?

The American Cancer Society's most recent estimates for pancreatic cancer in the United States for 2016 are:

- About 53,070 people (27,670 men and 25,400 women) will be diagnosed with pancreatic cancer.
- About 41,780 people (21,450 men and 20,330 women) will die of pancreatic cancer.

Pancreatic cancer accounts for about 3% of all cancers in the US and about 7% of cancer deaths.

Lifetime risk of pancreatic cancer

The average lifetime risk of pancreatic cancer for both men and women is about 1 in 65 (1.5%). But each person's chances of getting this cancer can be affected by certain risk factors.

For statistics related to survival, see Pancreatic cancer survival rates by stage.

Visit the American Cancer Society's Cancer Statistics Center for more key statistics.

Pancreatic cancer risk factors

A risk factor is anything that affects your chance of getting a disease such as cancer. Different cancers have different risk factors. Some risk factors, like smoking, can be changed. Others, like a person's age or family history, can't be changed.

But having a risk factor, or even several risk factors, does not mean that you will get the disease. And many people who get the disease may have few or no known risk factors.

Several factors can affect a person's chance of getting cancer of the pancreas. Most of these are risk factors for exocrine pancreatic cancer.

Risk factors that can be changed

Tobacco use

Smoking is one of the most important risk factors for pancreatic cancer. The risk of getting pancreatic cancer is about twice as high among smokers compared to those who

have never smoked. About 20% to 30% of pancreatic cancers are thought to be caused by cigarette smoking. Cigar and pipe smoking also increase risk, as does the use of smokeless tobacco products.

Overweight and obesity

Being overweight is a risk factor for pancreatic cancer. Very overweight (obese) people are about 20% more likely to develop pancreatic cancer.

Carrying extra weight around the waistline may be a risk factor even in people who are not very overweight.

Workplace exposure to certain chemicals

Heavy exposure at work to certain chemicals used in the dry cleaning and metal working industries may raise a person's risk of pancreatic cancer.

Risk factors that can't be changed

Age

The risk of developing pancreatic cancer goes up as people age. Almost all patients are older than 45. About two-thirds are at least 65 years old. The average age at the time of diagnosis is 71.

Gender

Men are slightly more likely to develop pancreatic cancer than women. This may be due, at least in part, to higher tobacco use in men, which raises pancreatic cancer risk (see above). The difference in pancreatic cancer risk was larger in the past (when tobacco use was much more common among men than women), but the gap has closed in recent years.

Race

African Americans are slightly more likely to develop pancreatic cancer than whites. The reasons for this aren't clear, but it may be due in part to having higher rates of some other risk factors for pancreatic cancer, such as diabetes, smoking in men, and being overweight in women.

Family history

Pancreatic cancer seems to run in some families. In some of these families, the high risk is due to an inherited syndrome (explained below). In other families, the gene causing the increased risk is not known. Although family history is a risk factor, most people who get pancreatic cancer do not have a family history of it.

Inherited genetic syndromes

Inherited gene changes (mutations) can be passed from parent to child. These gene changes may cause as many as 10% of pancreatic cancers. Sometimes these changes result in syndromes that include increased risks of other cancers (or other health problems). Examples of genetic syndromes that can cause exocrine pancreatic cancer include:

- **Hereditary breast and ovarian cancer syndrome**, caused by mutations in the *BRCA1* or *BRCA2* genes
- **Familial atypical multiple mole melanoma (FAMMM) syndrome**, caused by mutations in the *p16/CDKN2A* gene
- **Familial pancreatitis**, usually caused by mutations in the *PRSS1* gene
- **Lynch syndrome**, also known as *hereditary non-polyposis colorectal cancer* (HNPCC), most often caused by a defect in the *MLH1* or *MSH2* genes.
- **Peutz-Jeghers syndrome**, caused by defects in the *STK11* gene. This syndrome is also linked with polyps in the digestive tract and several other cancers.
- **Von Hippel-Lindau syndrome**, caused by mutations in the *VHL* gene. It can lead to an increased risk of pancreatic cancer and carcinoma of the ampulla of Vater.

Pancreatic neuroendocrine tumors and cancers can also be caused by genetic syndromes, such as:

- **Neurofibromatosis, type 1**, which is caused by mutations in the *NF1* gene. This syndrome leads to an increased risk of many tumors, including somatostatinomas.
- **Multiple endocrine neoplasia, type I (MEN1)**, caused by mutations in the *MEN1* gene. This syndrome leads to an increased risk of tumors of the parathyroid gland, the pituitary gland, and the islet cells of the pancreas.

Changes in the genes that cause some of these syndromes can be found by genetic testing. For more information on genetic testing, see Can pancreatic cancer be found early?.

Diabetes

Pancreatic cancer is more common in people with diabetes. The reason for this is not known. Most of the risk is found in people with type 2 diabetes. This type of diabetes most often starts in adulthood and is often related to being overweight or obese. It’s not clear if people with type 1 (juvenile) diabetes have a higher risk.

Chronic pancreatitis

Chronic pancreatitis, a long-term inflammation of the pancreas, is linked with an increased risk of pancreatic cancer (especially in smokers), but most people with pancreatitis never develop pancreatic cancer.

Chronic pancreatitis is sometimes due to an inherited gene mutation. People with this inherited (familial) form of pancreatitis have a high lifetime risk of pancreatic cancer.

Cirrhosis of the liver

Cirrhosis is a scarring of the liver. It develops in people with liver damage from things like hepatitis and heavy alcohol use. People with cirrhosis seem to have an increased risk of pancreatic cancer.

Stomach problems

Infection of the stomach with the ulcer-causing bacteria *Helicobacter pylori* (*H. pylori*) may increase the risk of getting pancreatic cancer. Some research has suggested that excess stomach acid might also increase the risk.

Factors with unclear effect on risk

Diet

Some studies have linked pancreatic cancer to diets that are high in red and processed meats (such as sausage and bacon) and low in fruits and vegetables. But not all studies have found such links, and this is still being studied.

Physical inactivity

Some research has suggested that lack of physical activity might increase pancreatic cancer risk. But not all studies have found this.

Coffee

Some older studies have suggested that drinking coffee might increase the risk of pancreatic cancer, but more recent studies have not confirmed this.

Alcohol

Some studies have shown a link between heavy alcohol use and pancreatic cancer. This link is still not certain, but heavy alcohol use can lead to conditions such as chronic pancreatitis and cirrhosis, which are known to increase pancreatic cancer risk.

What causes pancreatic cancer?

Scientists don't know exactly what causes most pancreatic cancers, but they have found several risk factors that can make a person more likely to get this disease. Some of these risk factors affect the DNA of cells in the pancreas, which can result in abnormal cell growth and may cause tumors to form.

DNA is the chemical in our cells that carries our genes, which control how our cells function. We look like our parents because they are the source of our DNA. But DNA affects more than just how we look.

Some genes control when our cells grow, divide into new cells, and die:

- Genes that help cells grow, divide, and stay alive are called *oncogenes*.
- Genes that help keep cell division under control, repair mistakes in DNA, or cause cells to die at the right time are called *tumor suppressor genes*.

Cancers can be caused by DNA changes (gene mutations) that turn on oncogenes or turn off tumor suppressor genes.

Inherited gene mutations

Some people inherit gene changes from their parents that raise their risk of pancreatic cancer. Sometimes these gene changes are part of syndromes that include increased risks of other health problems as well. These syndromes, which cause a small portion of all pancreatic cancers, are discussed in Risk factors for pancreatic cancer.

Acquired gene mutations

Most gene mutations related to cancers of the pancreas occur after a person is born, rather than having been inherited. These *acquired* gene mutations sometimes result from exposure to cancer-causing chemicals (like those found in tobacco smoke). But often what causes these changes is not known. Many gene changes are probably just random events that sometimes happen inside a cell, without having an outside cause.

Some of the DNA changes often seen in sporadic (non-inherited) cases of pancreatic cancer are the same as those seen in inherited cases, while others are different. For example, many sporadic cases of exocrine pancreatic cancer have changes in the *p16* and *TP53* genes, which can also be seen in some genetic syndromes. But many pancreatic cancers also have changes in genes such as *KRAS*, *BRAF*, and *DPC4* (*SMAD4*), which are not part of inherited syndromes. Other gene changes can also be found in pancreatic cancers, although often it's not clear what has caused these changes.

Can pancreatic cancer be prevented?

There is no sure way to prevent pancreatic cancer. Some risk factors such as age, gender, race, and family history can't be controlled. But there are things you can do that might lower your risk.

Don't smoke

Smoking is the most important avoidable risk factor for pancreatic cancer. Quitting smoking helps lower risk. If you smoke and want help quitting, please talk to your doctor or call the American Cancer Society at 1-800-227-2345.

Stay at a healthy weight

Getting to and staying at a healthy weight might also help lower your risk. While the effects of getting physical activity and eating well on pancreatic cancer risk are not as clear, both of these can help you stay at a healthy weight.

The American Cancer Society recommends choosing foods and beverages in amounts that help you get to and stay at a healthy weight. Eat a healthy diet, with an emphasis on plant foods. This includes at least 2½ cups of vegetables and fruits every day. Choose whole-grain breads, pastas, and cereals instead of refined grains, and eat fish, poultry, or beans instead of processed meat and red meat. For more, see the *American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention*.

Limit alcohol use

Heavy alcohol use has been tied to pancreatic cancer in some studies but not in others. This link is still not certain, but heavy alcohol use can lead to conditions such as chronic pancreatitis and cirrhosis, which are known to increase pancreatic cancer risk.

Limit exposure to certain chemicals in the workplace

Avoiding workplace exposure to certain chemicals may reduce your risk for pancreatic cancer.

Can pancreatic cancer be found early?

Pancreatic cancer is hard to find early. The pancreas is deep inside the body, so early tumors can't be seen or felt by health care providers during routine physical exams. Patients usually have no symptoms until the cancer has already spread to other organs.

Screening tests or exams are used to look for a disease in people who have no symptoms (and who have not had that disease before). At this time, no major professional groups recommend routine screening for pancreatic cancer in people who are at average risk.

This is because no screening test has been shown to lower the risk of dying from this cancer.

Sometimes when a person has pancreatic cancer, the levels of certain proteins in the blood go up. These proteins, called *tumor markers*, can be detected with blood tests. The tumor markers CA 19-9 and carcinoembryonic antigen (CEA) are the ones most closely tied to pancreatic cancer. But these proteins don't always go up when a person has pancreatic cancer, and even if they do, the cancer is often already advanced by the time this happens. Sometimes levels of these tumor markers can go up even when a person doesn't have pancreatic cancer. For these reasons, blood tests aren't used to screen for pancreatic cancer, although a doctor might still order these tests if a person has symptoms that might be from pancreatic cancer. These tests are more often used in people already diagnosed with pancreatic cancer to help tell if treatment is working or if the cancer is progressing (see Tests for pancreatic cancer).

Genetic testing for people who might be at increased risk

Some people might be at increased risk of pancreatic cancer because of a family history of the disease (or a family history of certain other cancers). Sometimes this increased risk is due to a specific genetic syndrome.

Some of the gene changes that increase pancreatic cancer risk can be tested for. Knowing if you are at increased risk can help you and your doctor decide if you should have tests to look for pancreatic cancer early, when it might be easier to treat. But determining whether you might be at increased risk is not simple. Talking to someone with experience in hereditary cancer syndromes such as a genetic counselor, geneticist, or an oncologist (doctor who treats people with cancer) is often helpful.

The American Cancer Society strongly recommends that anyone thinking about genetic testing talk with a genetic counselor, nurse, or doctor qualified to interpret and explain the test results before they proceed with testing. It's important to understand what the tests can − and can't − tell you, and what any results might mean, before deciding to be tested.

Genetic tests look for mutations in your genes that cause inherited conditions. The tests are used to look for these inherited conditions, not pancreatic cancer itself. Your risk may be increased if you have one of these conditions, but it doesn't mean that you have (or definitely will get) pancreatic cancer. For more on genetic testing, see *Genetic Testing: What You Need to Know*.

Testing for pancreatic cancer in people at high risk

For people in families at high risk of pancreatic cancer, newer tests for detecting early pancreatic cancer may help. One of these is called *endoscopic ultrasound* (see Tests for pancreatic cancer). This test is not used to screen the general public, but it might be used for someone with a strong family history of pancreatic cancer or with a known genetic

syndrome that increases their risk. Doctors have been able to find early, treatable pancreatic cancers in some members of high-risk families with this test.

Doctors are also studying other new tests to try to find pancreatic cancer early. Interested families at high risk may wish to take part in studies of these new screening tests

Signs and symptoms of pancreatic cancer

The symptoms of exocrine pancreatic cancers and pancreatic neuroendocrine tumors (NETs) are often different, so they are described separately.

Having one or more of the symptoms below does not mean you have pancreatic cancer. In fact, many of these symptoms are more likely to be caused by other conditions. Still, if you have any of these symptoms, it's important to have them checked by a doctor so that the cause can be found and treated, if needed.

Signs and symptoms of exocrine pancreatic cancer

Early pancreatic cancers often do not cause any signs or symptoms. By the time they do cause symptoms, they have often already spread outside the pancreas.

Jaundice and related symptoms

Jaundice is yellowing of the eyes and skin. Most people with pancreatic cancer (and virtually all people with ampullary cancer) will have jaundice as one of their first symptoms.

Jaundice is caused by the buildup of bilirubin, a dark yellow-brown substance made in the liver. Normally, the liver excretes bilirubin as part of a liquid called *bile*. Bile goes through the common bile duct into the intestines, where it helps break down fats. It eventually leaves the body in the stool. When the common bile duct becomes blocked, bile can't reach the intestines, and the level of bilirubin in the body builds up.

Cancers that start in the head of the pancreas are near the common bile duct. These cancers can press on the duct and cause jaundice while they are still fairly small, which can sometimes lead to these tumors being found at an early stage. But cancers that start in the body or tail of the pancreas don't press on the duct until they have spread through the pancreas. By this time, the cancer has often spread beyond the pancreas as well.

When pancreatic cancer spreads, it often goes to the liver. This can also lead to jaundice.

Dark urine: Sometimes, the first sign of jaundice is darker urine. As bilirubin levels in the blood increase, the urine becomes brown in color.

Light-colored or greasy stools: Bilirubin normally helps give stools their brown color. If the bile duct is blocked, stools might be pale or gray. Also, if bile and pancreatic enzymes can't get through to the intestines to help break down fats, the stools can become greasy and might float in the toilet.

Itchy skin: When bilirubin builds up in the skin, it can start to itch as well as turning yellow.

Pancreatic cancer is not the most common cause of jaundice. Other causes, such as gallstones, hepatitis, and other liver and bile duct diseases, are much more common.

Belly or back pain

Pain in the abdomen (belly) or back is common in pancreatic cancer. Cancers that start in the body or tail of the pancreas can grow fairly large and start to press on other nearby organs, causing pain. The cancer may also spread to the nerves surrounding the pancreas, which often causes back pain. Of course, pain in the abdomen or back is fairly common and is most often caused by something other than pancreatic cancer.

Weight loss and poor appetite

Unintended weight loss is very common in people with pancreatic cancer. These people often have little or no appetite.

Nausea and vomiting

If the cancer presses on the far end of the stomach it can partly block it, making it hard for food to get through. This can cause nausea, vomiting, and pain that tend to be worse after eating.

Gallbladder or liver enlargement

If the cancer blocks the bile duct, bile can build up in the gallbladder, making it larger. Sometimes a doctor can feel this (as a large lump under the right ribcage) during a physical exam. It can also be seen on imaging tests.

Pancreatic cancer can also sometimes enlarge the liver, especially if the cancer has spread to the liver. The doctor might be able to feel this below the right ribcage as well on an exam, or it might be seen on imaging tests.

Blood clots

Sometimes, the first clue that someone has pancreatic cancer is a blood clot in a large vein, often in the leg. This is called a *deep vein thrombosis* or DVT. Symptoms can include pain, swelling, redness, and warmth in the affected leg. Sometimes a piece of the clot can break off and travel to the lungs, which might make it hard to breathe or cause chest pain. A blood clot in the lungs is called a *pulmonary embolism* or PE.

Still, having a blood clot does not usually mean that you have cancer. Most blood clots are caused by other things.

Fatty tissue abnormalities

Some people with pancreatic cancer develop an uneven texture of the fatty tissue underneath the skin. This is caused by the release of the pancreatic enzymes that digest fat.

Diabetes

Rarely, pancreatic cancers cause diabetes (high blood sugar) because they destroy the insulin-making cells. Symptoms can include feeling thirsty and hungry, and having to urinate often. More often, cancer can lead to small changes in blood sugar levels that don't cause symptoms of diabetes but can still be detected with blood tests.

Signs and symptoms of pancreatic neuroendocrine tumors

Pancreatic neuroendocrine tumors (NETs) often release excess hormones into the bloodstream. Different types of tumors make different hormones, which can lead to different symptoms.

Gastrinomas

These tumors make gastrin, a hormone that tells the stomach to make more acid. Too much gastrin causes a condition known as *Zollinger-Ellison syndrome*, in which the stomach makes too much acid. This leads to stomach ulcers, which can cause pain, nausea, and loss of appetite. Severe ulcers can start bleeding. If the bleeding is mild, it can lead to anemia (too few red blood cells), which can cause symptoms like feeling tired and being short of breath. If the bleeding is more severe, it can make stool black and tarry. Severe bleeding can itself be life-threatening.

If the stomach acid reaches the small intestine, it can damage the cells of the intestinal lining and break down digestive enzymes before they have a chance to digest food. This can cause diarrhea and weight loss.

Glucagonomas

These tumors make glucagon, a hormone that increases glucose (sugar) levels in the blood. Most of the symptoms that can be caused by a glucagonoma are mild and are more often caused by something else.

Excess glucagon can raise blood sugar, sometimes leading to diabetes. This can cause symptoms such as feeling thirsty and hungry, and having to urinate often.

People with these tumors can also have problems with diarrhea, weight loss, and malnutrition. The nutrition problems can lead to symptoms like irritation of the tongue (*glossitis*) and the corners of the mouth (*angular cheilitis*).

The symptom that brings most people with glucagonomas to their doctor is a rash called *necrolytic migratory erythema.* This is a red rash with swelling and blisters that often travels from place to place on the skin.

Insulinomas

These tumors make insulin, which lowers blood glucose levels. Too much insulin leads to low blood sugar (*hypoglycemia*), which can cause symptoms like weakness, confusion, sweating, and rapid heartbeat. When blood sugar gets very low, it can lead to a person passing out or even going into a coma and having seizures.

Somatostatinomas

These tumors make somatostatin, which helps regulate other hormones. Symptoms of this type of tumor can include belly pain, nausea, poor appetite, weight loss, diarrhea, symptoms of diabetes (feeling thirsty and hungry, and having to urinate often), and jaundice (yellowing of the skin and eyes).

The early symptoms of a somatostatinoma tend to be mild and are more often caused by other things, so these tumors tend to be diagnosed at an advanced stage. Often, they are not found until they spread to the liver, when they cause problems like jaundice and pain.

VIPomas

These tumors make a substance called *vasoactive intestinal peptide* (VIP). Too much VIP can lead to problems with diarrhea. This may be mild at first, but gets worse over time. By the time they are diagnosed, most people have severe, watery diarrhea.

Other symptoms can include nausea, vomiting, muscle cramps, feeling weak or tired, and flushing (redness and warmth in the face or neck).

People with these tumors also tend to have low levels of acid in their stomachs, which can lead to problems digesting food.

PPomas

These tumors make pancreatic polypeptide (PP), which helps regulate both the exocrine and endocrine pancreas. They can cause problems such as belly pain and an enlarged liver. Some patients also get watery diarrhea.

Carcinoid tumors

These tumors often make serotonin or its precursor, 5-HTP. When a pancreatic tumor makes these substances, they first travel to the liver. The liver breaks these substances down before they can reach the rest of the body and cause problems. Because of this, carcinoid tumors often don’t cause symptoms until they spread outside the pancreas.

When these tumors do spread, it is most often to the liver. There, the cancer cells can release hormones directly into the blood leaving the liver. This can cause the *carcinoid syndrome*, with symptoms including flushing (redness and warmth in the face or neck), diarrhea, wheezing, and a rapid heart rate. These symptoms often occur in episodes, between which the person may feel fine.

Over a long time, the hormone-like substances released by these tumors can damage heart valves, causing shortness of breath, weakness, and a heart murmur (an abnormal heart sound).

Non-functioning neuroendocrine tumors

These tumors don't make excess hormones, so they don't cause symptoms in early stages and often grow quite large before they are found. Most of these are cancers and start to cause problems as they get larger or spread outside the pancreas. Symptoms can be like those from exocrine pancreas cancers, including jaundice (yellowing of the eyes and skin), belly pain, and weight loss.

Symptoms caused by the cancer spreading

When pancreatic NETs spread, most often they go to the liver. This can enlarge the liver, which can cause pain and loss of appetite. It can also affect liver function, sometimes leading to jaundice (yellowing of the skin and eyes) and abnormal lab tests.

These cancers can also spread to other organs and tissues. The symptoms depend on where the cancer is growing. For example, cancer spread to the lungs can cause shortness of breath or a cough. Spread to bones can cause pain in those bones.

Tests for pancreatic cancer

If a person has signs and symptoms that might be caused by pancreatic cancer, certain exams and tests will be done to find the cause. If cancer is found, further tests will be done to help determine the extent (stage) of the cancer.

Medical history and physical exam

Your doctor will ask about your medical history to learn more about your symptoms. The doctor might also ask about possible risk factors, including your family history.

Your doctor will also examine you to look for signs of pancreatic cancer or other health problems. The exam will probably focus mostly on your belly. Pancreatic cancers can sometimes cause the liver or gallbladder to swell, which the doctor might be able to feel during the exam. Your skin and the whites of your eyes will also be checked for jaundice (yellowing).

If the results of the exam are abnormal, your doctor will probably order tests to help find the problem. You might also be referred to a gastroenterologist (a doctor who treats digestive system diseases) for further tests and treatment.

Imaging tests

Imaging tests use x-rays, magnetic fields, sound waves, or radioactive substances to create pictures of the inside of your body. Imaging tests might be done for a number of reasons both before and after a diagnosis of pancreatic cancer, including:

- To look for suspicious areas that might be cancer
- To learn if and how far cancer has spread
- To help determine if treatment is working
- To look for signs of cancer coming back after treatment

Computed tomography (CT) scan

The CT scan makes detailed cross-sectional images of your body. CT scans are often used to diagnose pancreatic cancer because they can show the pancreas fairly clearly. They can also help show if cancer has spread to organs near the pancreas, as well as to lymph nodes and distant organs. A CT scan can help determine if surgery might be a good treatment option.

If your doctor thinks you might have pancreatic cancer, you might get a special type of CT known as a **multiphase CT scan** or a **pancreatic protocol CT scan**. During this test, different sets of CT scans are taken over several minutes after you get an injection of an intravenous (IV) contrast.

CT-guided needle biopsy: CT scans can also be used to guide a biopsy needle into a suspected pancreatic tumor. But if a needle biopsy is needed, most doctors prefer to use endoscopic ultrasound (described below) to guide the needle into place.

Magnetic resonance imaging (MRI)

MRI scans use radio waves and strong magnets instead of x-rays to create detailed images of parts of your body. Most doctors prefer to look at the pancreas with CT scans, but an MRI might also be done.

Special types of MRI scans can also be used in people who might have pancreatic cancer:

- **MR cholangiopancreatography (MRCP)**, which can be used to look at the pancreatic and bile ducts, is described below in the section on cholangiopancreatography.
- **MR angiography (MRA)**, which looks at blood vessels, is mentioned below in the section on angiography.

Ultrasound

Ultrasound tests use sound waves to create images of organs such as the pancreas.

Abdominal ultrasound: For this test, a wand-shaped probe is moved over the skin of the abdomen. It gives off sound waves and detects the echoes as they bounce off organs. If it's not clear what might be causing a person's abdominal symptoms, this might be the first test done because it is easy to do and it doesn't expose a person to radiation. But if signs and symptoms are more likely to be caused by pancreatic cancer, a CT scan is often more useful.

Endoscopic ultrasound (EUS): This test is more accurate than abdominal ultrasound and can be very helpful in diagnosing pancreatic cancer. This test is done with a small ultrasound probe on the tip of an endoscope, which is a thin, flexible tube that doctors use to look inside the digestive tract.

For this test, you will first be sedated (given medicine to make you sleepy). The scope is then passed through your mouth or nose, down through the stomach, and into the first part of the small intestine. It is then pointed toward the pancreas, which is next to the small intestine. The probe on the tip of the endoscope can get very close to the pancreas, so this is a very good way to look at the pancreas. If a tumor is seen, a small, hollow needle can be passed down the endoscope to get biopsy samples of it.

Cholangiopancreatography

This is an imaging test that looks at the pancreatic ducts and bile ducts to see if they are blocked, narrowed, or dilated. These tests can help show if someone might have a pancreatic tumor that is blocking a duct. They can also be used to help plan surgery. The test can be done in different ways, each of which has pros and cons.

Endoscopic retrograde cholangiopancreatography (ERCP): For this test, an endoscope (a thin, flexible tube with a tiny video camera on the end) is passed down the throat, through the esophagus and stomach, and into the first part of the small intestine. This is usually done while you are sedated (given medicine to make you sleepy).

The doctor can see through the endoscope to find the ampulla of Vater (where the common bile duct empties into the small intestine). The doctor guides a catheter (a very small tube) through the tip of the endoscope and into the common bile duct. A small amount of dye (contrast material) is then injected into the common bile duct, and x-rays are taken. This dye outlines the bile and pancreatic ducts. The x-rays can show narrowing or blockage in these ducts that might be due to pancreatic cancer. The doctor doing this test can also put a small brush through the tube to remove cells for a biopsy (see below).

ERCP can also be used to place a stent (small tube) into a bile or pancreatic duct to keep it open if a nearby tumor is pressing on it. This is described in more detail in the section on palliative surgery in Surgery for pancreatic cancer.

Magnetic resonance cholangiopancreatography (MRCP): This is a non-invasive way to look at the pancreatic and bile ducts using the same type of machine used for standard

MRI scans. Unlike ERCP, it does not require an infusion of a contrast dye. Because this test is non-invasive, doctors often use MRCP if the purpose is just to look at the pancreatic and bile ducts. But this test can't be used to get biopsy samples of tumors or to place stents in ducts.

Percutaneous transhepatic cholangiography (PTC): In this procedure, the doctor puts a thin, hollow needle through the skin of the belly and into a bile duct within the liver. A contrast dye is then injected through the needle, and x-rays are taken as it passes through the bile and pancreatic ducts. As with ERCP, this approach can also be used to take fluid or tissue samples or to place a stent into a duct to help keep it open. Because it is more invasive (and might cause more pain), PTC is not usually used unless ERCP has already been tried or can't be done for some reason.

Somatostatin receptor scintigraphy (SRS)

This test, also known as *OctreoScan*, can be very helpful in finding pancreatic neuroendocrine tumors (NETs). A hormone-like substance called *octreotide* that is bound to a radioactive substance is injected into a vein. Octreotide travels through the blood and attaches to the tumor cells of many types of NETs (although it is less helpful for insulinomas).

Several hours after the injection, a special camera can be used to show where the radioactivity is in the body. More scans may be done on the following few days as well.

This scan can also help decide on treatment. NETs that show up on SRS scans will often stop growing if treated with octreotide.

Positron emission tomography (PET) scan

For a PET scan, you are injected with a slightly radioactive form of sugar, which collects mainly in cancer cells. A special camera is then used to create a picture of areas of radioactivity in the body.

This test is sometimes used to look for spread from exocrine pancreatic cancers, but because NETs grow slowly, they do not show up well on PET scans.

PET/CT scan: Special machines can do both a PET and CT scan at the same time. This lets the doctor compare areas of higher radioactivity on the PET scan with the more detailed appearance of that area on the CT scan. This test can help determine the stage (extent) of the cancer. It might be especially useful for spotting cancer that has spread beyond the pancreas and wouldn't be treatable by surgery.

Angiography

This is an x-ray test that looks at blood vessels. A small amount of contrast dye is injected into an artery to outline the blood vessels, and then x-rays are taken.

An angiogram can show if blood flow in a particular area is blocked or compressed by a tumor. It can also show abnormal blood vessels (feeding the cancer) in the area. This test can be useful in finding out if a pancreatic cancer has grown through the walls of certain blood vessels. Mainly, it helps surgeons decide if the cancer can be removed completely without damaging vital blood vessels, and it can also help them plan the operation.

Angiography can also be used to look for pancreatic NETs that are too small to be seen on other imaging tests. These tumors cause the body to make more blood vessels to "feed" the tumor, which can often be seen on angiography.

X-ray angiography can be uncomfortable because the doctor has to put a small catheter into the artery leading to the pancreas. Usually the catheter is put into an artery in your inner thigh and threaded up to the pancreas. A local anesthetic is often used to numb the area before inserting the catheter. Once the catheter is in place, the dye is injected to outline all the vessels while the x-rays are being taken.

Angiography can also be done with a CT scanner (CT angiography) or an MRI scanner (MR angiography). These techniques are now used more often because they can give the same information without the need for a catheter in the artery. You might still need an IV line so that a contrast dye can be injected into the bloodstream during the imaging.

Blood tests

Several types of blood tests can be used to help diagnose pancreatic cancer or to help determine treatment options if it is found.

Blood tests for exocrine pancreatic cancers

Liver function tests: Jaundice (yellowing of the skin and eyes) is often one of the first signs of pancreatic cancer, but it can have many causes other than cancer. Doctors often get blood tests to assess liver function in people with jaundice to help determine its cause.

For example, blood tests that look at levels of different kinds of bilirubin (a chemical made by the liver) can help tell whether a patient's jaundice is caused by disease in the liver itself or by a blockage of bile flow (from a gallstone, a tumor, or other disease).

Tumor markers: Tumor markers are substances that can sometimes be found in the blood when a person has cancer. Two tumor markers may be helpful in pancreatic cancer:

- **CA 19-9**
- **Carcinoembryonic antigen (CEA)**, which is not used as often as CA 19-9

Neither of these tumor marker tests is accurate enough to tell for sure if someone has pancreatic cancer. Levels of these tumor markers are not high in all people with pancreatic cancer, and some people who don't have pancreatic cancer might have high levels of these markers for other reasons. Still, these tests can sometimes be helpful, along with other tests, in figuring out if someone has cancer.

In people already known to have pancreatic cancer and who have high CA19-9 or CEA levels, these levels can be measured over time to help tell how well treatment is working. If all of the cancer has been removed, these tests can also be done to look for the cancer coming back.

Other blood tests: Other tests can help evaluate a person's general health (such as kidney and bone marrow function). These tests can help determine if they'll be able to withstand the stress of a major operation.

Blood tests for pancreatic neuroendocrine tumors

Blood tests looking at the levels of certain pancreatic hormones can often help diagnose pancreatic neuroendocrine tumors (NETs). Tests might be done to check blood levels of:

- Hormones made by different types of NET cells, such as insulin, gastrin, glucagon, somatostatin, pancreatic polypeptide, and VIP (vasoactive intestinal peptide)
- Chromogranin A (CgA)
- Glucose and C-peptide (for insulinomas)

Carcinoid tumors: For carcinoids, a blood test may be done to look for serotonin, which is made by many of these tumors. The urine might also be tested for serotonin and for related chemicals such as 5-HIAA and 5-HTP.

Other common tests to look for carcinoids include blood tests for chromogranin A (CgA), neuron-specific enolase (NSE), substance P, and gastrin.

Depending on where the tumor might be located and the patient's symptoms, doctors might do other blood tests as well.

Biopsy

A person's medical history, physical exam, and imaging test results may strongly suggest pancreatic cancer, but usually the only way to be sure is to remove a small sample of tumor and look at it under the microscope. This procedure is called a *biopsy*. Biopsies can be done in different ways.

Percutaneous (through the skin) biopsy: For this test, a doctor inserts a thin, hollow needle through the skin over the abdomen and into the pancreas to remove a small piece of a tumor. This is known as a *fine needle aspiration* (FNA). The doctor guides the needle into place using images from ultrasound or CT scans.

Endoscopic biopsy: Doctors can also biopsy a tumor during an endoscopy. The doctor passes an endoscope (a thin, flexible, tube with a small video camera on the end) down the throat and into the small intestine near the pancreas. At this point, the doctor can either use endoscopic ultrasound (EUS) to pass a needle into the tumor or endoscopic retrograde cholangiopancreatography (ERCP) to remove cells from the bile or pancreatic ducts. These tests are described in more detail above. You will be sedated (made sleepy)

for these tests, but general anesthesia (being put into a deep sleep) is not usually needed. Major side effects from these types of biopsies are rare.

Surgical biopsy: Surgical biopsies are now done less often than in the past. They can be useful if the surgeon is concerned the cancer has spread beyond the pancreas and wants to look at (and possibly biopsy) other organs in the abdomen.

The most common way to do a surgical biopsy is to use *laparoscopy* (sometimes called *keyhole surgery*). You will be sedated or asleep for this procedure. The surgeon makes several small incisions (cuts) in the abdomen and inserts long, thin instruments. One of these has a small video camera on the end to let the surgeon see inside the abdomen. The surgeon can look at the pancreas and other organs for tumors and take biopsy samples of abnormal areas.

In the past, surgeons often used a *laparotomy* (a large incision through the skin into the wall of the abdomen) to examine internal organs and take biopsies. But this type of surgery requires a longer recovery and is now rarely used.

Some people might not need a biopsy

Rarely, the doctor might not do a biopsy on someone who has a tumor in the pancreas if imaging tests show the tumor is very likely to be cancer and if it looks like surgery can remove all of it. Instead, the doctor will proceed with surgery, at which time the tumor cells can be looked at to confirm the diagnosis. During surgery, if the doctor finds that the cancer has spread too far to be removed completely, only a sample of the cancer may be removed to confirm the diagnosis, and the rest of the planned operation will be stopped.

If treatment (such as chemotherapy or radiation) is planned before surgery, a biopsy is needed first to be sure of the diagnosis.

See *Testing Biopsy and Cytology Specimens for Cancer* to learn more about different types of biopsies, how the biopsy samples are tested in the lab, and what the results will tell you.

Pancreatic cancer stages

What is the stage of a cancer?

The stage of a pancreatic cancer is the extent of the disease at the time of diagnosis. It is one of the most important factors in choosing treatment options and predicting a patient’s outlook. Pancreatic cancer is staged based on the results of exams, imaging tests, endoscopies, and biopsies, which are described in Tests for pancreatic cancer.

The American Joint Committee on Cancer (AJCC) TNM staging system

A staging system is a standard way for doctors to sum up how large a cancer is and how far it has spread. The system used most often to stage cancers of the pancreas is the American Joint Committee on Cancer (AJCC) TNM system, which is based on 3 key pieces of information:

- **T** describes the size of the main (primary) **tumor** and whether it has grown outside the pancreas and into nearby organs.
- **N** describes the spread to nearby (regional) lymph **nodes**, which are bean-sized collections of immune system cells to which cancers often spread first.
- **M** indicates whether the cancer has **metastasized** (spread) to other organs of the body. (The most common sites of pancreatic cancer spread are the liver, lungs, and the peritoneum, which is the lining that covers the organs in the abdomen.)

Numbers or letters appear after T, N, and M to provide more details about each of these factors. Higher numbers mean the cancer is more advanced.

T categories

TX: The main tumor cannot be assessed.

T0: No evidence of a primary tumor.

Tis: Carcinoma in situ (the tumor is confined to the top layers of pancreatic duct cells). (Very few pancreatic tumors are found at this stage.)

T1: The cancer has not grown outside the pancreas and is 2 centimeters (cm) (about ¾ inch) or less across.

T2: The cancer has not grown outside the pancreas but is larger than 2 cm across.

T3: The cancer has grown outside the pancreas into nearby surrounding structures but not into major blood vessels or nerves.

T4: The cancer has grown beyond the pancreas into nearby large blood vessels or nerves.

N categories

NX: Nearby (regional) lymph nodes cannot be assessed.

N0: The cancer has not spread to nearby lymph nodes.

N1: The cancer has spread to nearby lymph nodes.

M categories

M0: The cancer has not spread to distant lymph nodes (other than those near the pancreas) or to distant organs such as the liver, lungs, brain, etc.

M1: The cancer has spread to distant lymph nodes or to distant organs.

Stages of pancreatic cancer

Once the T, N, and M categories have been determined, this information is combined to assign an overall stage of 0, I, II, III, or IV (sometimes followed by a letter).

Stage	Stage grouping	Stage description
0	Tis, N0, M0	The tumor is confined to the top layers of pancreatic duct cells and has not invaded deeper tissues. It has not spread outside of the pancreas. These tumors are sometimes referred to as pancreatic carcinoma in situ or pancreatic intraepithelial neoplasia III (PanIn III).
IA	T1, N0, M0	The tumor is confined to the pancreas and is 2 cm across or smaller (T1). The cancer has not spread to nearby lymph nodes (N0) or distant sites (M0).
IB	T2, N0, M0	The tumor is confined to the pancreas and is larger than 2 cm across (T2). The cancer has not spread to nearby lymph nodes (N0) or distant sites (M0).
IIA	T3, N0, M0	The tumor is growing outside the pancreas but not into major blood vessels or nerves (T3). The cancer has not spread to nearby lymph nodes (N0) or distant sites (M0).
IIB	T1-T3, N1, M0	The tumor is either confined to the pancreas or growing outside the pancreas but not into major blood vessels or nerves (T1-T3). The cancer has spread to nearby lymph nodes (N1) but not to distant sites (M0).
III	T4, Any N, M0	The tumor is growing outside the pancreas and into nearby major blood vessels or nerves (T4). The cancer may or may not have spread to nearby lymph nodes (Any N). It has not

		spread to distant sites (M0).
IV	Any T, Any N, M1	The cancer has spread to distant sites (M1).

Other prognostic factors

Although not formally part of the TNM system, other factors are also important in determining a person's prognosis (outlook).

Tumor grade

The grade of the cancer (how abnormal the cells look under the microscope) uses a scale from G1 to G3 (or sometimes G1 to G4), with G1 cancers looking the most like normal cells and having the best outlook.

The details of grading are a little different for pancreatic neuroendocrine tumors (NETs), where measures of how many of the cells are in the process of dividing is an important part of grading. This is determined by counting mitoses (cells that have started to split into two new cells) under a microscope and with a Ki-67 test that recognizes cells that are almost ready to start splitting. Based on these tests, NETs are divided into 2 groups:

- **Well-differentiated NETs** (which includes low-grade [G1] and intermediate-grade [G2] tumors) have 20 or fewer mitoses and a Ki-67 index of 20% or lower.
- **Poorly differentiated tumors** (high-grade [G3] tumors) have more than 20 mitoses or a Ki-67 index of more than 20%. These are also called *neuroendocrine carcinomas*, and they often grow and spread quickly.

Extent of resection

For patients who have surgery, another important factor is the *extent of the resection* — whether or not all of the tumor is removed:

- **R0:** All of the cancer is thought to have been removed. (There are no visible or microscopic signs suggesting that cancer was left behind.)
- **R1:** All visible tumor was removed, but lab tests of the removed specimen show that some small areas of cancer were probably left behind.
- **R2:** Some visible tumor could not be removed.

Resectable versus unresectable pancreatic cancer

The AJCC staging system gives a detailed summary of how far the cancer has spread. But for treatment purposes, doctors use a simpler staging system, which divides cancers into groups based on whether or not they can be removed (resected) with surgery:

- Resectable
- Borderline resectable
- Unresectable (either locally advanced or metastatic)

These terms are used more often to describe exocrine pancreatic cancers than pancreatic neuroendocrine tumors.

Resectable

If the cancer is only in the pancreas (or has spread just beyond it) and the surgeon believes the entire tumor can be removed, it is called *resectable*. (In general, this would include most stage IA, IB, and IIA cancers in the TNM system.)

It's important to note that some cancers might appear to be resectable based on imaging tests such as CT scans, but once surgery is started it might become clear that not all of the cancer can be removed. If this happens, only a sample of the cancer may be removed to confirm the diagnosis (if a biopsy hasn't been done already), and the rest of the planned operation will be stopped to help avoid the risk of major side effects.

Borderline resectable

This term is used to describe some cancers that might have just reached nearby blood vessels, but which the doctors feel might still be removed completely with surgery. This would include some stage III cancers in the TNM system.

Unresectable

These cancers can't be removed entirely by surgery.

Locally advanced: If the cancer has not yet spread to distant organs but it still can't be removed completely with surgery, it is called *locally advanced.* Often the reason the cancer can't be removed is because it has grown into or surrounded nearby major blood vessels. (In general, this would include stage IIB and most III cancers in the TNM system.)

Surgery to try to remove these tumors would be very unlikely to be helpful and could still have major side effects. Some type of surgery might still be done, but it would be a less extensive operation with the goal of preventing or relieving symptoms or problems like a blocked bile duct or intestinal tract, instead of trying to cure the cancer.

Metastatic: If the cancer has spread to distant organs, it is called *metastatic*. These cancers can't be removed completely. Surgery might still be done, but the goal would be to prevent or relieve symptoms, not to try to cure the cancer.

Pancreatic cancer survival rates, by stage

Survival rates tell you what portion of people with the same type and stage of cancer are still alive a certain amount of time (usually 5 years) after they were diagnosed. They can't tell you how long you will live, but they may help give you a better understanding about how likely it is that your treatment will be successful. Some people will want to know the survival rates for their cancer, and some people won't. If you don't want to know, you don't have to.

What is a 5-year survival rate?

Statistics on the outlook for a certain type and stage of cancer are often given as 5-year survival rates, but many people live longer – often much longer – than 5 years. The 5-year survival rate is the percentage of people who live at least 5 years after being diagnosed with cancer. For example, a 5-year survival rate of 70% means that an estimated 70 out of 100 people who have that cancer are still alive 5 years after being diagnosed. Keep in mind, however, that many of these people live much longer than 5 years after diagnosis.

But remember, the 5-year relative survival rates are estimates – your outlook can vary based on a number of factors specific to you.

Cancer survival rates don't tell the whole story

Survival rates are often based on previous outcomes of large numbers of people who had the disease, but they can't predict what will happen in any particular person's case. There are a number of limitations to remember:

- The numbers below are among the most current available. But to get 5-year survival rates, doctors have to look at people who were treated at least 5 years ago. As treatments are improving over time, people who are now being diagnosed with pancreatic cancer may have a better outlook than these statistics show.
- These statistics are based on the stage of the cancer when it was first diagnosed. They do not apply to cancers that later come back or spread, for example.
- The outlook for people with pancreatic cancer varies by the stage (extent) of the cancer – in general, the survival rates are higher for people with earlier stage cancers. But many other factors can affect a person's outlook, such as age and overall health, and how well the cancer responds to treatment. The outlook for each person is specific to their circumstances.

Your doctor can tell you how these numbers may apply to you, as he or she is familiar with your particular situation.

Survival rates for exocrine pancreatic cancer

The numbers below come from the National Cancer Data Base and are based on people diagnosed with exocrine pancreatic cancer between 1992 and 1998. In general, people who can be treated with surgery tend to live longer than those not treated with surgery.

- The 5-year survival rate for people with stage IA pancreatic cancer is about 14%. For stage IB cancer, the 5-year survival rate is about 12%.
- For stage IIA pancreatic cancer, the 5-year survival rate is about 7%. For stage IIB cancer, the 5-year survival rate is about 5%.
- The 5-year survival rate for stage III pancreatic cancer is about 3%.
- Stage IV pancreatic cancer has a 5-year survival rate of about 1%. Still, there are often treatment options available for people with this stage of cancer.

Remember, these survival rates are only estimates – they can't predict what will happen to any individual person. We understand that these statistics can be confusing and may lead you to have more questions. Talk to your doctor to better understand your specific situation.

Survival rates for neuroendocrine pancreatic tumors (treated with surgery)

For pancreatic neuroendocrine tumors (NETs), survival statistics by stage are only available for patients treated with surgery. These numbers come from the National Cancer Data Base and are based on patients diagnosed between 1985 and 2004.

- The 5-year survival rate for people with stage I pancreatic NETs is about 61%.
- For stage II pancreatic NETs, the 5-year survival rate is about 52%.
- The 5-year relative survival rate for stage III pancreatic NETs is about 41%.
- Stage IV pancreatic NETs have a 5-year survival rate of about 16%. Still, there are often treatment options available for people with these cancers.

In this database, the overall 5-year survival rate for people who did *not* have their tumors removed by surgery was 16%.

Pancreatic cancer treatment

If you've been diagnosed with pancreatic cancer, your cancer care team will discuss your treatment options with you. It's important that you think carefully about your choices. You will want to weigh the benefits of each treatment option against the possible risks and side effects.

Which treatments are used for pancreatic cancer?

Depending on the type and stage of the cancer and other factors, treatment options for people with pancreatic cancer can include:

- Surgery
- Ablation or embolization treatments
- Radiation therapy
- Chemotherapy and other drugs

Pain control is also an important part of treatment for many patients.

Sometimes, the best option might include more than one type of treatment. To learn about the most common approaches to treating these cancers, see Treating pancreatic cancer, based on the extent of the cancer.

For **pancreatic neuroendocrine tumors (NETs)**, treatment options might include surgery, ablation or embolization treatments, radiation therapy, or different types of medicines. For more on how these tumors are treated, see Treating pancreatic neuroendocrine tumors, based on the extent of the tumor.

Which doctors treat pancreatic cancer?

Depending on your options, you can have different types of doctors on your treatment team. The doctors on your cancer treatment team might include:

- A **surgeon**: a doctor who uses surgery to treat cancers or other problems
- An **endocrinologist**: a doctor who treats diseases in glands that secrete hormones
- A **radiation oncologist**: a doctor who uses radiation to treat cancer
- A **medical oncologist**: a doctor who uses chemotherapy and other medicines to treat cancer

Many other specialists might be part of your treatment team as well, including physician assistants (PAs), nurse practitioners (NPs), nurses, psychologists, social workers, nutritionists, and other health professionals. See *Health Professionals Associated With Cancer Care* for more on this.

Making treatment decisions

It's important to discuss all of your treatment options, including their goals and possible side effects, with your doctors to help make the decision that best fits your needs. Some important things to consider include:

- Your age and expected life span
- Any other serious health conditions you have
- The stage (extent) of your cancer
- Whether or not surgery can remove (resect) the cancer
- The likelihood that treatment will cure the cancer (or help in some other way)
- Your feelings about the possible side effects from treatment

You may feel that you must make a decision quickly, but it's important to give yourself time to absorb the information you have just learned. It's also very important to ask questions if there is anything you're not sure about. See What should you ask your health care team about pancreatic cancer? for ideas.

Getting a second opinion

If time allows, you may also want to get a second opinion from another doctor or medical team. This can give you more information and help you feel more certain about the treatment plan you choose. If you aren't sure where to go for a second opinion, ask your doctor for help.

Thinking about taking part in a clinical trial

Clinical trials are carefully controlled research studies that are done to get a closer look at promising new treatments or procedures. Clinical trials are one way to get state-of-the art cancer treatment. Sometimes they may be the only way to get access to newer treatments. They are also the best way for doctors to learn better methods to treat cancer. Still, they are not right for everyone.

If you would like to learn more about clinical trials that might be right for you, start by asking your doctor if your clinic or hospital conducts clinical trials. You can also call our clinical trials matching service at 1-800-303-5691 for a list of studies that might meet your medical needs, or see the Clinical Trials section of our website to learn more.

Considering complementary and alternative methods

You may hear about complementary or alternative methods that your doctor hasn't mentioned to treat your cancer or relieve symptoms. These methods can include vitamins, herbs, and special diets, or other methods such as acupuncture or massage, to name a few.

Complementary methods refer to treatments that are used *along with* your regular medical care. *Alternative treatments* are used *instead of* a doctor's medical treatment. Although some of these methods might be helpful in relieving symptoms or helping you feel better, many have not been proven to work. Some might even be dangerous.

As you consider your options, look for "red flags" that might suggest fraud. Does the method promise to cure all or most cancers? Are you told not to have regular medical treatments? Is the treatment a "secret" that requires you to visit certain providers or travel to another country?

Be sure to talk to your cancer care team about any method you are thinking about using. They can help you learn what is known (or not known) about the method, which can help you make an informed decision. See the Complementary and Alternative Medicine section of our website to learn more.

Choosing to stop treatment or choosing no treatment at all

For some people, when treatments have been tried and are no longer controlling the cancer, it could be time to weigh the benefits and risks of continuing to try new treatments. Whether or not you continue treatment, there are still things you can do to help maintain or improve your quality of life. Learn more in *If Cancer Treatments Stop Working.*

Some people, especially if the cancer is advanced, might not want to be treated at all. There are many reasons you might decide not to get cancer treatment, but it's important to talk this through with your doctors before you make this decision. Remember that even if you choose not to treat the cancer, you can still get help for pain or other symptoms.

Help getting through treatment

Your cancer care team will be your first source of information and support, but there are other resources for help when you need it. Hospital- or clinic-based support services are an important part of your care. These might include nursing or social work services, financial aid, nutritional advice, rehab, or spiritual help.

The American Cancer Society also has programs and services – including rides to treatment, lodging, support groups, and more – to help you get through treatment. Call our National Cancer Information Center at 1-800-227-2345 and speak with one of our trained specialists on call 24 hours a day, every day.

The treatment information in this document is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.

Surgery for pancreatic cancer

Two general types of surgery can be used for pancreatic cancer:

- **Potentially curative surgery** is used when the results of exams and tests suggest that it's possible to remove (resect) all the cancer.
- **Palliative surgery** may be done if imaging tests show that the cancer is too widespread to be removed completely. This surgery is done to relieve symptoms or to prevent certain complications like a blocked bile duct or intestine, but the goal is not to try to cure the cancer.

Staging laparoscopy

To determine which type of surgery might be best, it's important to know the stage (extent) of the cancer. But it can be hard to stage pancreatic cancer accurately just using imaging tests. Sometimes laparoscopy is done first to help determine the extent of the cancer and if it can be resected.

For this procedure, the surgeon makes a few small incisions (cuts) in the abdomen and inserts long, thin instruments. One of these has a small video camera on the end so the surgeon can see inside the abdomen. The surgeon can look at the pancreas and other organs for tumors and take biopsy samples of abnormal areas to learn how far the cancer has spread.

Potentially curative surgery

Studies have shown that removing only part of a pancreatic cancer doesn't help patients live longer, so potentially curative surgery is only done if the surgeon thinks all of the cancer can be removed.

This is very complex surgery, and it can also be very hard for patients. It can cause complications and can take weeks to months to recover from. If you are thinking about having this type of surgery, it's important to weigh the potential benefits and risks carefully.

Fewer than 1 in 5 pancreatic cancers appear to be confined to the pancreas at the time they are found. Even then, not all of these cancers turn out to be truly resectable once the surgery is started. Sometimes once the surgeon starts the operation it becomes clear that the cancer has grown too far to be removed completely. If this happens, the operation may be stopped, or the surgeon might continue with a smaller operation with a goal of relieving or preventing symptoms (see "Palliative surgery"). This is because the planned operation would be very unlikely to cure the cancer and could still lead to major side effects. It would also lengthen the recovery time, which could delay other treatments.

Surgery offers the only realistic chance to cure exocrine pancreatic cancer, but it doesn't always lead to a cure. Even if all visible cancer is removed, often some cancer cells have

already spread to other parts of the body. These cells can eventually grow into new tumors, which can be very hard to treat.

Long-term success rates for surgery on pancreatic neuroendocrine tumors (NETs) are often much better. These tumors are more likely to be cured with surgery.

Curative surgery is done mainly to treat cancers in the head of the pancreas. Because these cancers are near the bile duct, they often cause jaundice, which sometimes allows them to be found early enough to be removed. Surgeries for other parts of the pancreas are mentioned below, but these are only done when it's possible to remove all of the cancer.

Three procedures can be used to remove tumors of the pancreas:

Whipple procedure (pancreaticoduodenectomy)

This is the most common operation to remove a cancer of the exocrine pancreas. It also sometimes is used to treat pancreatic NETs.

During this operation, the surgeon removes the head of the pancreas and sometimes the body of the pancreas as well. Nearby structures such as part of the small intestine, part of the bile duct, the gallbladder, lymph nodes near the pancreas, and sometimes part of the stomach are also removed. The remaining bile duct and pancreas are then attached to the small intestine so that bile and digestive enzymes can still enter the small intestine. The pieces of the small intestine (or the stomach and small intestine) are then reattached as well so that food can pass through the digestive tract.

Most often, this operation is done through a large incision (cut) down the middle of the belly. Some doctors at major cancer centers also do the operation laparoscopically, which is sometimes known as *keyhole surgery* (see What's new in pancreatic cancer research?).

A Whipple procedure is a complex operation that requires a surgeon with a lot of skill and experience. It carries a relatively high risk of complications that can sometimes be life threatening. When the operation is done in small hospitals or by doctors with less experience, as many as 15% of patients may die as a result of surgical complications. In contrast, when the operation is done in cancer centers by surgeons experienced in the procedure, less than 5% of patients die as a direct result of surgery.

To have the best outcome, it's important to be treated by a surgeon who does many of these operations and to have the surgery at a hospital where many of them are done. In general, people having this type of surgery do better when it is at a hospital that does at least 15 to 20 Whipple procedures per year.

Still, even under the best circumstances, many patients have complications from the surgery. These can include:

- Leaking from the various connections among organs that the surgeon has to make
- Infections

- Bleeding
- Trouble with the stomach emptying itself after eating
- Trouble digesting some foods (which might require taking pancreatic enzymes in pill form to help with digestion)
- Weight loss
- Changes in bowel habits
- Diabetes

Distal pancreatectomy

In this operation, the surgeon removes only the tail of the pancreas or the tail and a portion of the body of the pancreas. The spleen is usually removed as well. This operation is used more often to treat pancreatic NETs found in the tail and body of the pancreas. It is seldom used to treat cancers of the exocrine pancreas because these tumors have usually already spread by the time they are found.

The spleen helps the body fight infections, so if it's removed you'll be at increased risk of infection with certain bacteria. To help with this, doctors recommend that patients get certain vaccines before this surgery.

Total pancreatectomy

This operation removes the entire pancreas, as well as the gallbladder, part of the stomach and small intestine, and the spleen. This surgery might be an option if the cancer has spread throughout the pancreas but can still be removed. But this type of surgery is used less often than the other operations because there doesn't seem to be a major advantage in removing the whole pancreas, and it can have major side effects.

It's possible to live without a pancreas. But when the entire pancreas is removed, people are left without the cells that make insulin and other hormones that help maintain blood sugar levels. These people develop diabetes, which can be hard to manage because they are totally dependent on insulin shots. People who have had this surgery also need to take pancreatic enzyme pills to help them digest certain foods.

Before you have this operation, your doctor will recommend that you get certain vaccines because the spleen will be removed.

Palliative surgery

If the cancer has spread too far to be removed completely, any surgery being considered would be palliative (intended to relieve or prevent symptoms). Because pancreatic cancer can progress quickly, most doctors don't advise major surgery for palliation, especially for people who are in poor health.

Sometimes surgery might be started with the hope it will cure the patient, but once it begins the surgeon discovers this is not possible. In this case, the surgeon might do a less extensive, palliative operation known as *bypass surgery* instead to help prevent or relieve symptoms.

Cancers growing in the head of the pancreas can block the common bile duct as it passes through this part of the pancreas. This can cause pain and digestive problems because bile can't get into the intestine. The bile chemicals will also build up in the body, which can cause jaundice, nausea, vomiting, and other problems.

There are 2 main options for relieving bile duct blockage.

Stent placement

The most common approach to relieving a blocked bile duct does not involve actual surgery. Instead, a stent (small tube, usually made of metal) is placed inside the duct to keep it open. This is usually done through an endoscope (a long, flexible tube) while you are sedated. Often this is part of an endoscopic retrograde cholangiopancreatography (ERCP). The doctor passes the endoscope down the throat and all the way into the small intestine. The doctor can then insert the stent into the bile duct through the endoscope. The stent can also be put in place through the skin during a percutaneous transhepatic cholangiography (PTC). (These tests are described in Tests for pancreatic cancer.)

The stent helps keep the bile duct open even if the surrounding cancer presses on it. But after several months, the stent may become clogged and may need to be cleared or replaced. Larger stents can also be used to keep parts of the small intestine open if they are in danger of being blocked by the cancer.

A bile duct stent can also be put in to help relieve jaundice before curative surgery is done (which would typically be a couple of weeks later). This can help lower the risk of complications from surgery.

Bypass surgery

In people who are healthy enough, another option for relieving a blocked bile duct is surgery to reroute the flow of bile from the common bile duct directly into the small intestine, bypassing the pancreas. This typically requires a large incision in the abdomen, and it can take weeks to recover from this. Sometimes surgery can be done through several small cuts in the abdomen using special long surgical tools. (This is known as *laparoscopic* or *keyhole surgery*.)

Having a stent placed is often easier and the recovery is much shorter, which is why this is done more often than bypass surgery. But surgery can have some advantages, such as:

- It can often give longer-lasting relief than a stent, which might need to be cleaned out or replaced.
- It might be an option if a stent can't be placed for some reason.

- During surgery, the surgeon may be able to cut some of the nerves around the pancreas or inject them with alcohol. This may reduce or get rid of any pain caused by the cancer. (Pancreatic cancer often causes pain if it reaches these nerves.)

Sometimes, the end of the stomach is disconnected from the duodenum (the first part of the small intestine) and attached farther down the small intestine during this surgery as well. (This is known as a *gastric bypass*.) This is done because over time the cancer might grow large enough to block the duodenum, which can cause pain and vomiting and often requires urgent surgery. Bypassing the duodenum before this happens can sometimes help avoid this.

Bypass surgery can still be a major operation, so it's important that you are healthy enough to withstand it and that you talk with your doctor about the possible benefits and risks before you have the surgery.

Surgery to treat pancreatic neuroendocrine tumors

Along with the operations described above, sometimes a less extensive procedure can be used to remove pancreatic NETs.

Enucleation (removing just the tumor)

Sometimes if a pancreatic NET is small, just the tumor itself is removed. This is called *enucleation*. This operation may be done using a laparoscope, so that only a few small incisions are needed.

This operation may be all that is needed to treat an insulinoma, since this type of tumor is often benign. Small gastrinomas and some other pancreatic NETs may also be treated with enucleation, but sometimes the duodenum (the first part of the small intestine) is removed as well.

The lymph nodes around the pancreas might also be removed so that they can be checked for cancer cells.

Whipple procedure or distal pancreatectomy

For larger gastrinomas and other types of pancreatic NETs, a pancreaticoduodenectomy (Whipple procedure) or a distal pancreatectomy is often needed, depending on the location of the tumor. These operations are described above.

The lymph nodes around the pancreas are often removed as well so that they can be checked for cancer cells.

Surgery for cancer that has spread

Surgery may be used to remove metastases if a pancreatic NET has spread to the liver (the most common site of spread) or the lungs. Removing metastases can improve

symptoms and prolong life in patients with pancreatic NETs. In rare cases, a liver transplant might be used to treat pancreatic NETs that have spread to the liver.

For more about surgery as a treatment for cancer, see the website section on Surgery Used to Treat Cancer.

Ablation or embolization treatments for pancreatic cancer

These treatments are different ways of destroying tumors, rather than removing them with surgery.

When might one of these treatments be used?

Ablation or embolization can sometimes be used to help treat pancreatic cancer that has spread to other organs, especially the liver. But these treatments are very unlikely to cure cancers on their own. They are more likely to be used to help prevent or relieve cancer symptoms, and are often used along with other types of treatment.

- **Pancreatic neuroendocrine tumors (NETs):** When NETs have spread to other sites, these treatments can often improve symptoms and help people live longer.
- **Exocrine pancreas cancers:** These treatments are used much less often for exocrine cancers (which account for most pancreatic cancers), but they might sometimes be used when there are only a few areas of spread to treat.

Ablative treatments

Ablation refers to treatments that destroy tumors, usually with extreme heat or cold. Typically, with this type of treatment you will not need to stay in the hospital. There are different kinds of ablative treatments:

Radiofrequency ablation (RFA): This procedure uses high-energy radio waves for treatment. The doctor puts a thin, needle-like probe through the skin and into the tumor. An electric current then passes through the tip of the probe, which heats the tumor and destroys the cancer cells. This treatment is used mainly for small tumors.

Microwave thermotherapy: This procedure is similar to RFA, except microwaves are used to heat and destroy the tumor.

Cryosurgery (also known as cryotherapy or cryoablation): This procedure destroys a tumor by freezing it. A thin metal probe is guided into the tumor, and very cold gasses pass through the probe to freeze the tumor, killing the cancer cells. This method can be used to treat larger tumors than the other ablation techniques, but it sometimes requires general anesthesia (where you are in a deep sleep and not able to feel pain).

Side effects of ablation treatments

Possible side effects after ablation therapy include abdominal pain, infection, and bleeding inside the body. Serious complications are uncommon, but they are possible.

Embolization

During embolization, the doctor injects substances into an artery to try to block the blood flow to cancer cells, causing them to die. This can sometimes be used for tumors in the liver that are too large to be treated with ablation. This type of treatment typically does not require a hospital stay.

There are 3 main types of embolization:

Arterial embolization: This is also known as trans-arterial embolization (or TAE). In this procedure a catheter (a thin, flexible tube) is put into an artery through a small cut in the inner thigh and threaded up into the artery feeding the tumor. A dye is usually injected into the blood at this time to help the doctor monitor the path of the catheter with angiography, a special type of x-ray. Once the catheter is in place, small particles are injected into the artery to plug it up.

Chemoembolization: This approach, also known as trans-arterial chemoembolization (or TACE) combines embolization with chemotherapy. Most often, this is done by using tiny beads that give off a chemotherapy drug for the embolization. TACE can also be done by giving chemotherapy through the catheter directly into the artery, then plugging up the artery.

Radioembolization: This technique combines embolization with radiation therapy. In the United States, this is done by injecting small radioactive beads (called *microspheres*) into the artery. Once infused, the beads lodge in the blood vessels near the tumor, where they give off small amounts of radiation to the tumor site for several days. The radiation travels a very short distance, so its effects are limited mainly to the tumor.

Side effects of embolization

Possible complications after embolization include abdominal pain, fever, nausea, infection, and blood clots in nearby blood vessels. Serious complications are not common, but they can happen.

Radiation therapy for pancreatic cancer

Radiation therapy uses high-energy x-rays (or particles) to kill cancer cells.

When might radiation therapy be used?

Radiation therapy can be helpful in treating some **exocrine pancreatic cancers** (the most common type of pancreatic cancer). It can be used in different situations to treat these cancers:

- Radiation might be given after surgery (known as *adjuvant* treatment) to try to lower the chance of the cancer coming back. The radiation is typically given along with chemotherapy, which is together known as *chemoradiation* or *chemoradiotherapy.*
- For borderline resectable tumors, radiation might be given (along with chemotherapy) before surgery to try to shrink the tumor and make it easier to remove.
- Radiation therapy (combined with chemotherapy) may be used as part of the main treatment in people whose cancers have grown beyond the pancreas and can't be removed by surgery (locally advanced/unresectable cancers).
- Radiation is sometimes used to help relieve symptoms such as pain in people with advanced cancers or in people who aren't healthy enough for other treatments like surgery.

Pancreatic neuroendocrine tumors (NETs) don't respond well to radiation, so it's not often used to treat these tumors. Radiation is sometimes used to treat pancreatic NETs that have spread to the bone and are causing pain. It may also be used in the form of radioembolization to treat NETs that have spread to the liver, which was discussed in Ablation or embolization treatments for pancreatic cancer.

How is radiation therapy given?

The type of radiation most often used to treat pancreatic cancer, known as *external beam radiation therapy*, focuses radiation from a source outside of the body on the cancer.

Before your treatment starts, your radiation team will take careful measurements to find the correct angles for aiming the radiation beams and the proper dose of radiation. This planning session, called *simulation*, usually includes getting imaging tests such as CT or MRI scans.

The treatment is much like getting an x-ray, but the radiation is stronger. The procedure itself is painless. Each treatment lasts only a few minutes, although the setup time – getting you into place for treatment – usually takes longer. Most often, radiation treatments are given 5 days a week for several weeks.

Possible side effects

Some of the more common side effects of radiation therapy include:

- Skin changes in areas getting radiation, ranging from redness to blistering and peeling
- Nausea and vomiting

- Diarrhea
- Fatigue
- Loss of appetite
- Weight loss

Radiation can also lower blood counts, which can increase the risk of serious infection.

Usually these effects go away within a few weeks after the treatment is complete. Ask your doctor what side effects to expect and how to prevent or relieve them.

To learn more about radiation therapy, see the Radiation Therapy section of our website.

Chemotherapy and other drugs for pancreatic cancer

Chemotherapy (chemo) uses anti-cancer drugs injected into a vein or taken by mouth. These drugs enter the bloodstream and reach all areas of the body, making this treatment potentially useful for cancers that have spread beyond the organ they started in.

When might chemotherapy be used?

Chemo is often part of the treatment for exocrine pancreatic cancer (the most common type of pancreatic cancer), but for pancreatic neuroendocrine tumors (NETs), other types of medicines are used more often.

Chemo may be used at any stage of pancreatic cancer:

- Chemo can be given before surgery (sometimes along with radiation) to try to shrink the tumor. This is known as *neoadjuvant* treatment.
- Chemo can be used after surgery (sometimes along with radiation) to try to kill any cancer cells that have been left behind (but can’t be seen). This type of treatment, called *adjuvant* treatment, might lower the chance that the cancer will come back later.
- Chemo is commonly used when the cancer is advanced and can’t be removed completely with surgery, or if surgery isn’t an option for some other reason.

When chemo is given along with radiation, it is known as *chemoradiation* or *chemoradiotherapy*. It can help the radiation work better, but can also have more severe side effects.

Which chemo drugs are used to treat pancreatic cancer?

Many different chemo drugs can be used to treat pancreatic cancer, including:

- Gemcitabine (Gemzar)
- 5-fluorouracil (5-FU)
- Irinotecan (Camptosar)
- Oxaliplatin (Eloxatin)
- Albumin-bound paclitaxel (Abraxane)
- Capecitabine (Xeloda)
- Cisplatin
- Paclitaxel (Taxol)
- Docetaxel (Taxotere)
- Irinotecan liposome (Onivyde)

In people who are healthy enough, 2 or more drugs are usually given together. For people who are not healthy enough for combined treatments, a single drug (usually gemcitabine, 5-FU, or capecitabine) can be used.

Doctors give chemo in cycles, with each period of treatment followed by a rest period to allow the body time to recover. Each chemo cycle typically lasts for a few weeks.

Possible side effects

Chemo drugs can cause side effects. These depend on the type and dose of drugs given and how long treatment lasts. Common short-term side effects include:

- Nausea and vomiting
- Loss of appetite
- Hair loss
- Mouth sores
- Diarrhea or constipation
- Increased chance of infection (from a shortage of white blood cells)
- Bleeding or bruising after minor cuts or injuries (from a shortage of platelets)
- Fatigue and shortness of breath (from too few red blood cells)

Some chemo drugs can cause other side effects. For example:

- Drugs such as cisplatin, oxaliplatin, and paclitaxel can damage nerves, which can lead to symptoms of numbness, tingling, or even pain in the hands and feet (called

peripheral neuropathy). For a day or so after treatment, oxaliplatin can cause nerve pain that gets worse with exposure to cold, including when swallowing cold foods or liquids.

- Cisplatin can damage the kidneys. Doctors try to prevent this by giving the patient lots of fluid before and after the drug is given.

If you will be getting chemo, ask your cancer care team about the drugs being used and what side effects to expect. Most side effects go away once treatment is stopped

Be sure to tell your doctor or nurse if you do have side effects, as there are often ways to help with them. For example, drugs can be given to prevent or reduce nausea and vomiting.

To learn more about chemo, see the Chemotherapy section of our website.

Targeted therapy for pancreatic cancer

As researchers have learned more about the changes in pancreatic cancer cells that help them grow, they have developed newer drugs to specifically target these changes. These targeted drugs work differently from standard chemo drugs. Sometimes they work when standard chemo drugs don't, and they often have different (and less severe) side effects. (See What's new in pancreatic cancer research? for more information.)

Erlotinib (Tarceva) is a drug that targets a protein on cancer cells called *EGFR*, which normally helps the cells grow. In people with advanced pancreatic cancer, this drug can be given along with the chemo drug gemcitabine. Some people may benefit more from this combination than others. Common side effects of erlotinib include an acne-like rash on the face and neck, diarrhea, loss of appetite, and feeling tired.

Drugs used to treat pancreatic neuroendocrine tumors

The drugs used to treat pancreatic neuroendocrine tumors (NETs) tend to be different from those used to treat exocrine pancreatic cancer (the most common type of pancreatic cancer. These drugs are used mainly when the tumor can't be removed with surgery.

Somatostatin analogs

Drugs that are similar to somatostatin, a natural hormone in the body, can be very helpful for some patients with pancreatic NETs. These drugs stop tumors from releasing hormones into the bloodstream, which can often relieve symptoms and help patients feel better. They also seem to help slow the growth of some tumors.

These drugs can be expected to help anyone with a tumor that can be seen on somatostatin receptor scintigraphy (see "Imaging tests" in Tests for pancreatic cancer).

They can help reduce diarrhea in patients with VIPomas, glucagonomas, and somatostatinomas, and can also help the rash of glucagonomas.

The somatostatin analogs currently available include:

- **Octreotide (Sandostatin):** The standard version of octreotide is short-acting and is injected 2 to 4 times a day. There is also a long-acting form of the drug (called Sandostatin LAR Depot) that only needs to be given once a month, which may help patients more than the short-acting version.
- **Lanreotide (Somatuline Depot):** This is a newer somatostatin analog, which is injected under the skin about once a month. It has been shown to help slow the growth of pancreatic NETs.
- **Pasireotide (Signifor, Signifor LAR):** Another newer somatostatin, this drug is injected either twice a day or about once a month. Pasireotide is being studied for use in pancreatic NETs, although the other drugs are used more often.

Possible side effects

The main side effects of these drugs are pain at the site of the injection, and rarely, stomach cramps, nausea, vomiting, headaches, dizziness, and fatigue. These drugs can also cause sludge to build up in the gallbladder, which can lead to gallstones. They can also make the body resistant to the action of insulin, which can raise blood sugar levels and make pre-existing diabetes harder to control. These drugs are not often used to treat insulinomas, because the effects on the release of other hormones can cause worse problems with blood sugars.

Chemotherapy for pancreatic neuroendocrine tumors

Chemotherapy (chemo) uses anti-cancer drugs injected into a vein or taken by mouth. Chemo is most often used to treat NETs that are large or growing quickly and are causing symptoms. When chemo is used it often includes a combination of 2 or more drugs.

The most commonly used drugs for pancreatic NETs include:

- Doxorubicin (Adriamycin) or liposomal doxorubicin (Doxil)
- Streptozocin
- Fluorouracil (5-FU)
- Dacarbazine (DTIC)
- Temozolomide (Temodar)
- Capecitabine (Xeloda)
- Oxaliplatin (Eloxatin)

For poorly differentiated (high-grade) NETs (sometimes called *neuroendocrine carcinomas*), a combination of a platinum drug (either cisplatin or carboplatin) plus etoposide is often used.

To learn more about chemo (including possible side effects), see the Chemotherapy section of our website.

Targeted therapy for pancreatic neuroendocrine tumors

Targeted drugs work differently from standard chemo drugs. They attack specific changes in tumor cells that help them grow. Some targeted drugs can be helpful in treating advanced pancreatic NETs.

Sunitinib (Sutent) attacks new blood vessel growth and other targets that help cancer cells grow. In advanced pancreatic NETs, it has been shown to slow tumor growth and help patients live longer. This drug is taken as pills once a day. The most common side effects are nausea, diarrhea, changes in skin or hair color, mouth sores, weakness, and low blood cell counts. Other possible effects include tiredness, high blood pressure, heart problems, bleeding, hand-foot syndrome (redness, pain, and skin peeling of the palms of the hands and the soles of the feet), and low thyroid hormone levels.

Everolimus (Afinitor) works by blocking a cell protein known as *mTOR*, which normally helps cells grow and divide. This drug has been shown to slow tumor growth, but it's not yet clear if it helps patients live longer. Everolimus is a pill taken once a day. Common side effects of this drug include mouth sores, infections, nausea, loss of appetite, diarrhea, skin rash, feeling tired or weak, fluid buildup (usually in the legs), and increases in blood sugar and cholesterol levels. A less common but serious side effect is damage to the lungs, which can cause shortness of breath or other problems.

Other drugs that treat pancreatic neuroendocrine tumors

Other types of drugs are sometimes useful in treating people with pancreatic NETs as well.

Diazoxide: This drug can block insulin release from the pancreas. It can be used to prevent low blood sugar (hypoglycemia) in patients with insulinomas. This drug is often used before surgery, to make the operation safer for the patient.

Proton pump inhibitors: These drugs block acid secretion from the stomach. They are often very helpful in preventing ulcers in patients with gastrinomas, although they might need to be taken in higher than usual doses. Examples of these drugs include omeprazole (Prilosec), esomeprazole (Nexium), and lansoprazole (Prevacid).

Pain control in pancreatic cancer

Pain can be a major problem for people with pancreatic cancer. These cancers can invade and press on nerves near the pancreas, which can cause pain in the abdomen (belly) or back.

Treatment is available to help relieve this pain. If you are having any pain, please be sure to tell your doctor or nurse. Pain is easier to control if the treatment is started when you first have it. You and your doctor or nurse can talk about the best ways to treat your pain. A pain specialist can also help develop a treatment plan.

There are proven ways to relieve pain from pancreatic cancer.

Pain medicines

For most patients, morphine or similar drugs (opioids) can help control the pain. Many people are worried about these drugs because they fear becoming addicted, but studies have shown that the risk of this is low if the patient takes the drug for pain as directed by the doctor.

Pain medicines work best when they are taken on a regular schedule. They do not work as well if they are only used when the pain becomes severe. Several long-acting forms of morphine and other opioids are in pill form and only need be taken once or twice a day. There is even a long-acting form of the drug fentanyl that is applied as a patch every 3 days.

Common side effects of these drugs are nausea and feeling sleepy, which often get better over time. Constipation is a common side effect that does not get better on its own, so it needs to be treated. Most people need to take laxatives daily.

Other treatments

Sometimes certain procedures might be needed to treat pain. For example, cutting or injecting alcohol into some of the nerves near the pancreas that carry pain sensations can often improve pain and allow you to use lower doses of pain medicines. If you are having surgery for some reason (such as to remove the cancer or relieve bile duct blockage), this can be done as part of the same operation.

This can also be done as a separate procedure. For example, the doctor might do a *nerve block* by injecting the nerves near the pancreas with either an anesthetic or a medicine that destroys the nerves. This can be done either by passing a needle through the skin or by using an endoscope (a long, flexible tube that is passed down the throat and past the stomach).

Treating the cancer with chemotherapy and/or radiation therapy can also sometimes relieve pain by shrinking the size of the cancer.

For more information on pain and what can be done about it, see our *Guide to Controlling Cancer Pain*.

Treating pancreatic cancer, based on extent of the cancer

Treating exocrine pancreatic cancer, the most common type of pancreatic cancer, is different from treating pancreatic neuroendocrine tumors (NETs), which is discussed elsewhere.

Most of the time, pancreatic cancer is treated based on its stage – how far it has spread in the body. But other factors, such as your overall health, can also affect treatment options. Talk to your doctor if you have any questions about the treatment plan he or she recommends.

It can be hard to stage pancreatic cancer accurately using imaging tests. Doctors do their best to figure out before treatment if there is a good chance the cancer is resectable – that is, if it can be removed completely. But sometimes cancers turn out to have spread farther than was first thought.

Treating resectable cancer

Surgeons usually consider pancreatic cancer to be resectable if it looks like it is still just in the pancreas or doesn't extend far beyond the pancreas, and has not grown into nearby large blood vessels. A person must also be healthy enough to withstand surgery to remove the cancer, which is a major operation.

If imaging tests show a reasonable chance of removing the cancer completely, surgery is the preferred treatment if possible, as it offers the only realistic chance for cure. Based on where the cancer started, usually either a Whipple procedure (pancreaticoduodenectomy) or a distal pancreatectomy is used.

Sometimes even when a cancer is thought to be resectable, it becomes clear during the surgery that not all of it can be removed. If this happens, continuing the operation might do more harm than good. The surgery might be stopped, or the surgeon might continue with a smaller operation with a goal of relieving or preventing problems such as bile duct blockage.

Even when the surgeon thinks all of the cancer has been removed, the cancer might still come back. Giving chemotherapy (chemo), either alone or with radiation therapy (chemoradiation), after surgery (known as *adjuvant treatment*) might help some patients live longer. The chemo drugs most often used are gemcitabine (Gemzar) or 5-FU.

Treating borderline resectable cancer

A small number of pancreatic cancers have reached nearby blood vessels but have not grown deeply into them or surrounded them. These cancers might still be removable by surgery, but the odds of removing all of the cancer are lower, so they are considered *borderline resectable*.

These cancers are often treated first with neoadjuvant chemotherapy (sometimes along with radiation therapy) to try to shrink the cancer and make it easier to remove. Imaging tests (and sometimes laparoscopy) are then done to make sure the cancer hasn't grown too much to be removed. As long as it hasn't, surgery is then done to remove it. This might be followed by more chemotherapy.

Another option might be to have surgery first, followed by adjuvant chemotherapy (and possibly radiation). If, during the surgery, it becomes clear that not all of the cancer can be removed, continuing the operation might do more harm than good. The surgery might be stopped, or the surgeon might continue with a smaller operation with a goal of relieving or preventing problems such as bile duct blockage.

Treating locally advanced (unresectable) cancer

Locally advanced cancers have grown too far into nearby blood vessels or other tissues to be removed completely by surgery, but have not spread to the liver or distant organs and tissues. Surgery to try to remove these cancers does not help people live longer. Therefore, if surgery is done, it is to relieve bile duct blockage or to bypass a blocked intestine caused by the cancer pressing on other organs.

Chemotherapy, sometimes followed by chemoradiation, is the standard treatment option for locally advanced cancers. This may help some people live longer even if the cancer doesn't shrink. Giving chemo and radiation therapy together may work better to shrink the cancer, but this combination has more side effects and can be harder on patients than either treatment alone.

Treating metastatic (widespread) cancer

Pancreatic cancers often first spread within the abdomen (belly) and to the liver. They can also spread to the lungs, bone, brain, and other organs.

These cancers have spread too much to be removed by surgery. Even when imaging tests show that the spread is only to one other part of the body, it has to be assumed that small groups of cancer cells (too small to be seen on imaging tests) have already reached other organs of the body.

Chemotherapy is the main treatment for these cancers. It can sometimes shrink or slow the growth of these cancers for a time and might help people live longer, but it is not expected to cure the cancer.

Gemcitabine is the drug used most often. It can be used alone (especially for people in poor health), or it can be combined with other drugs like albumin-bound paclitaxel (Abraxane), erlotinib (Tarceva), or capecitabine (Xeloda).

Another option, especially for people who are otherwise in good health, is a combination of chemo drugs called FOLFIRINOX. This consists of 4 drugs: 5-FU, leucovorin, irinotecan (Camptosar), and oxaliplatin (Eloxatin). This treatment might help people live longer than getting gemcitabine alone, but it can also have more severe side effects.

Other treatments might also be used to help prevent or relieve symptoms from these cancers. For example, radiation therapy or some type of nerve block might be used to help relieve cancer pain, or a stent might be placed during an endoscopy to help keep the bile duct open.

Because the treatments now available don't work well for many people, you may want to think about taking part in a clinical trial of new drugs or combinations of drugs.

Treating pancreatic cancer that progresses or recurs

If cancer continues to grow during treatment (progresses) or comes back (recurs), your treatment options will depend on where and how much the cancer has spread, what treatments you have already had, and on your health and desire for more treatment. It's important that you understand the goal of any further treatment, as well as the likelihood of benefits and risks.

When pancreatic cancer recurs, it most often shows up first in the liver, but it may also spread to the lungs, bone, or other organs. This is usually treated with chemotherapy if you are healthy enough to get it. If you have had chemo before and it kept the cancer away for some time, the same chemo might be helpful again. Otherwise, different chemo drugs might be tried. Other treatments such as radiation therapy or stent placement might be used to help prevent or relieve symptoms from the cancer.

If the cancer progresses while you are getting chemotherapy, another type of chemotherapy might be tried if you are healthy enough.

At some point, it might become clear that standard treatments are no longer controlling the cancer. If you want to continue getting treatment, you might think about taking part in a clinical trial of a newer pancreatic cancer treatment. While these are not always the best option for every person, they may benefit you, as well as future patients.

Treating cancer of the ampulla of Vater

The ampulla of Vater is the area where the pancreatic duct and the common bile duct empty into the duodenum (the first part of the small intestine). Cancer at this site (known as *ampullary cancer*) can start in the pancreatic duct, the duodenum, or the common bile duct. In many patients, ampullary cancer can't be distinguished from pancreatic cancer until surgery has been done.

These cancers often cause early symptoms such as jaundice, so they are often found while they are still resectable. Surgery with the Whipple procedure is often successful in treating these early stage cancers. Adjuvant chemoradiotherapy is often recommended after surgery.

More advanced ampullary cancers are treated like pancreatic cancer.

The treatment information in this document is not official policy of the American Cancer Society and is not intended as medical advice to replace the expertise and judgment of your cancer care team. It is intended to help you and your family make informed decisions, together with your doctor. Your doctor may have reasons for suggesting a treatment plan different from these general treatment options. Don't hesitate to ask him or her questions about your treatment options.

Treating pancreatic neuroendocrine tumors, based on extent of the tumor

Treatment of pancreatic neuroendocrine tumors (NETs) depends to a large extent on whether they can be removed (resected) completely or not. But other factors, such as your overall health, can also affect treatment options. Talk to your doctor if you have any questions about the treatment plan he or she recommends.

Sometimes it can be hard to determine cancer is resectable – that is, if it can be removed completely – using just imaging tests. A staging laparoscopy might be done before surgery to help determine if the tumor can be removed. But even then, cancers sometimes turn out to have spread farther than was first thought.

Pancreatic NETs are more likely to be resectable than exocrine pancreas cancers (the most common type of pancreatic cancer). Most NETs that have not spread to distant parts of the body are resectable. Even some NETs that have spread might be resectable if they have not spread too far (such as only to a small extent in the liver).

Treating resectable tumors

If the tumor is resectable, it will be removed by surgery. The procedure used depends on the type of tumor, its size, and its location in the pancreas. Surgery can range from as little as enucleation (removing just the tumor) to as much as a Whipple procedure (pancreaticoduodenectomy). Lymph nodes are often removed to check for tumor spread.

Before any surgery, medicines are often given to control any symptoms caused by the tumor. For example, drugs to block stomach acid (like proton pump inhibitors) are used for gastrinomas. Often, people with insulinomas are treated with diazoxide to keep blood sugar from getting too low. If the tumor was visible on somatostatin receptor scintigraphy (OctreoScan), a somatostatin analog such as octreotide (Somatostatin) may be used to control any symptoms.

Surgery alone is all that is needed for many pancreatic NETs, but after surgery, close monitoring is important to look for signs that the cancer may have come back or spread.

Treating unresectable tumors

These tumors can't be removed completely with surgery. Pancreatic NETs are often slow growing, so lab and imaging tests are used to monitor the tumor(s) and look for signs of growth.

People with NETs that have spread outside the pancreas often have symptoms like diarrhea or hormone problems. These can often be helped with medicines like octreotide, lanreotide, diazoxide, and proton pump inhibitors. Some of these might also slow the growth of the tumor.

If further treatment is needed, chemotherapy or targeted drugs (such as sunitinib or everolimus) might be used, but this is usually delayed until a person is having symptoms that can't be controlled with other drugs or has signs of tumor growth on scans. Surgery or ablative techniques might also be used to treat cancer spread to the liver.

For people with poorly differentiated tumors (neuroendocrine carcinomas), chemotherapy is typically the first treatment.

If treatment is no longer working at some point, you might want to think about taking part in a clinical trial testing a newer treatment. While these are not always the best option for every person, they may benefit you as well as future patients.

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What should you ask your health care team about pancreatic cancer?

It's important to have honest, open discussions with your cancer care team. You should feel free to ask any question, no matter how minor it might seem. For instance, consider these questions:

When you're told you have pancreatic cancer

- What kind of pancreatic cancer do I have?
- Has my cancer spread beyond where it started?
- What is the stage of my cancer? Is it resectable (removable by surgery)?
- Do I need any other tests before we can decide on treatment?
- Will I need to see other doctors?

- If I'm concerned about the costs and insurance coverage for my diagnosis and treatment, who can help me?

When deciding on a treatment plan

- How much experience do you have treating this type of cancer?
- What are my treatment choices?
- What do you recommend and why?
- What is the goal of each treatment?
- Should I get a second opinion? How do I do that? Can you recommend a doctor or cancer center?
- How is treatment likely to help me?
- What risks or side effects might I expect? How long are they likely to last?
- Should I think about taking part in a clinical trial?
- How soon do I need to start treatment?
- What should I do to be ready for treatment?
- How long will treatment last? What will it be like? Where will it be done?
- What risks or side effects should I expect? How long are they likely to last?
- Will treatment affect how I eat?
- Will treatment affect my daily activities?
- What would my options be if the treatment doesn't work or if the cancer comes back?

During treatment

Once treatment begins, you'll need to know what to expect and what to look for. Not all of these questions may apply to you, but getting answers to the ones that do may be helpful.

- How will we know if the treatment is working?
- Is there anything I can do to help manage side effects?
- What symptoms or side effects should I tell you about right away?
- How can I reach you on nights, holidays, or weekends?
- Do I need to change what I eat during treatment?

- Are there any limits on what I can do?
- Should I exercise? What should I do, and how often?
- Can you suggest a mental health professional I can see if I start to feel overwhelmed, depressed, or distressed?

After treatment

- Are there any limits on what I can do?
- What symptoms should I watch for?
- What kind of exercise should I do now?
- What type of follow-up will I need after treatment?
- How often will I need to have follow-up exams and tests?
- How will we know if the cancer has come back? What should I watch for?
- What will my options be if the cancer comes back?

Along with these sample questions, be sure to write down some of your own. Keep in mind that doctors aren't the only ones who can give you information. Other health care professionals, such as nurses and social workers, can answer some of your questions. To find out more about speaking with your health care team, see *Talking With Your Doctor*.

Living as a pancreatic cancer survivor

For some people with pancreatic cancer, treatment can remove or destroy the cancer. Completing treatment can be both stressful and exciting. You may be relieved to finish treatment, but find it hard not to worry about cancer coming back. This is very common if you've had cancer.

For most people with pancreatic exocrine cancer (and some people with pancreatic neuroendocrine tumors), the cancer might never go away completely, or it might come back in another part of the body. These people may get regular treatments with chemotherapy, radiation therapy, or other therapies to help keep the cancer under control for as long as possible. Learning to live with cancer that does not go away can be difficult and very stressful.

Follow-up care

If you have completed treatment, your doctors will still want to watch you closely. It's very important to go to all of your follow-up appointments. During these visits, your doctors will ask questions about any problems you are having and may do exams and lab or imaging tests to look for signs of cancer or treatment side effects.

Some treatment side effects might last a long time or might not even show up until years after you have finished treatment. Your doctor visits are a good time to ask questions and talk about any changes or problems you notice or concerns you have.

Doctor visits and tests

Your schedule of doctor visits, exams, and tests will depend on the original extent of your cancer, how it was treated, and other factors. Tests might include blood tests for tumor markers (such as CA 19-9) or imaging tests (such as CT scans). Be sure to follow your doctor's advice about follow-up tests.

Ask your doctor for a survivorship care plan

Talk with your doctor about developing a survivorship care plan for you. This plan might include:

- A suggested schedule for follow-up exams and tests
- A list of possible late- or long-term side effects from your treatment, including what to watch for and when you should contact your doctor
- A schedule for other tests you might need, such as tests to look for long-term health effects from your cancer or its treatment
- Diet and physical activity suggestions

Keeping health insurance and copies of your medical records

Even if you've finished treatment, it's very important to keep health insurance. Tests and doctor visits cost a lot, and even though no one wants to think of their cancer coming back, this could happen.

At some point after your cancer treatment, you might find yourself seeing a new doctor who doesn't know about your medical history. It's important to keep copies of your medical records to give your new doctor the details of your diagnosis and treatment. Learn more in *Keeping Copies of Important Medical Records*.

Help with nutrition and pain

Pancreatic cancer often causes weight loss and weakness from poor nutrition. These symptoms might be caused by treatment or by the cancer itself. A team of doctors and nutritionists can work with you to provide nutritional supplements and information about your individual nutritional needs. This can help you keep up your weight and nutritional intake. Many patients need to take pancreatic enzymes in pill form to help digest food so that it can be absorbed. For serious nutrition problems, the doctor might need to put a feeding tube into the stomach to improve nutrition and energy levels. This is usually

temporary. For more information and nutrition tips for during and after cancer treatment, see *Nutrition for the Person With Cancer During Treatment: A Guide for Patients and Families*.

There are many ways to control pain caused by pancreatic cancer. If you have pain, tell your cancer care team right away, so they can give you prompt and effective pain management. For more information, see the Pain section of our website.

Can I lower the risk of my cancer progressing or coming back?

If you have (or have had) pancreatic cancer, you probably want to know if there are things you can do that might lower your risk of the cancer growing or coming back, such as exercising, eating a certain type of diet, or taking nutritional supplements. Unfortunately, it's not yet clear if there are things you can do that will help.

Tobacco use has clearly been linked to pancreas cancer, so not smoking may help reduce your risk. We don't know for certain if this will help, but we do know that it can help improve your appetite and overall health. It can also reduce the chance of developing other types of cancer. If you want to quit smoking and need help, call your American Cancer Society at 1-800-227-2345.

Other healthy behaviors such as eating well, getting regular physical activity, and staying at a healthy weight might help as well, but no one knows for sure. However, we do know that these types of changes can have positive effects on your health that can extend beyond your risk of cancer.

About dietary supplements

So far, no dietary supplements (including vitamins, minerals, and herbal products) have been shown to clearly help lower the risk of pancreatic cancer progressing or coming back. This doesn't mean that no supplements will help, but it's important to know that none have been proven to do so.

Dietary supplements are not regulated like medicines in the United States – they do not have to be proven effective (or even safe) before being sold, although there are limits on what they're allowed to claim they can do. If you're thinking about taking any type of nutritional supplement, talk to your health care team. They can help you decide which ones you can use safely while avoiding those that might be harmful.

If the cancer comes back

If your cancer does come back at some point, your treatment options will depend on the where the cancer is, what treatments you've had before, and your current health and preferences. Treatment options might include surgery, radiation therapy, chemotherapy, or some combination of these. For more on how recurrent cancer is treated, see Treatment of pancreatic cancer, based on extent of the cancer.

For more general information on dealing with a recurrence, you might also want to see *When Your Cancer Comes Back: Cancer Recurrence*.

Getting emotional support

Some amount of feeling depressed, anxious, or worried is normal when pancreatic cancer is a part of your life. Some people are affected more than others. But everyone can benefit from help and support from other people, whether friends and family, religious groups, support groups, professional counselors, or others. Learn more in *Emotions After Cancer Treatment*.

What's new in pancreatic cancer research?

Research into the causes, diagnosis, and treatment of pancreatic cancer is under way in many medical centers throughout the world.

Genetics and early detection

Scientists are learning more about some of the gene changes in pancreas cells that cause them to become cancer. Inherited changes in genes such as *BRCA2*, *p16*, and the genes responsible for Lynch syndrome can increase a person's risk of developing pancreatic cancer.

Researchers are now looking at how these and other genes may be altered in pancreatic cancers that are not inherited. Pancreatic cancer actually develops over many years in a series of steps known as pancreatic intraepithelial neoplasia or PanIN. In the early steps, such as PanIN 1, there are changes in a small number of genes, and the duct cells of the pancreas do not look very abnormal. In later steps such as PanIN 2 and PanIN 3, there are abnormalities in several genes and the duct cells look more abnormal.

Researchers are using this information to develop tests for detecting **acquired** (not inherited) gene changes in pancreatic pre-cancerous conditions. One of the most common DNA changes in these conditions affects the *KRAS* oncogene, which affects regulation of cell growth. New diagnostic tests are often able to recognize this change in samples of pancreatic juice collected during an ERCP (endoscopic retrograde cholangiopancreatography).

For now, imaging tests like endoscopic ultrasound (EUS), ERCP, and genetic tests for changes in certain genes (such as *KRAS*) are options for people with a strong family history of pancreatic cancer. But these tests are not recommended for widespread testing of people at average risk who do not have any symptoms.

Other tests are looking to see if groups of proteins found in the blood might be used to find pancreatic cancer early, when it is likely to be easier to treat. Some early results with this approach have been promising, but more research is needed to confirm its usefulness.

Treatment

A lot of research is focused on finding better treatments for pancreatic cancer. Improving surgery and radiation therapy are major goals, as is determining the best combination of treatments for people with certain stages of cancer.

Surgery

Surgery to remove pancreatic cancer (most often a Whipple procedure) is a long and complex operation that can be hard both for the surgeon and the patient. It often requires a long hospital stay, at least in part because of the long incision made in the belly.

A newer approach now used at some major medical centers is to do the operation laparoscopically. For this approach, the surgeon makes several small incisions in the belly instead of one large one. Long, thin surgical tools and a tiny video camera are then inserted through these cuts to do the operation. One advantage of this surgery is that people often recover from it more quickly. But this is still a difficult operation. Surgeons are looking to see how it compares to the standard operation and which patients might be helped the most by it.

Radiation therapy

Some studies are looking at different ways to give radiation to treat pancreatic cancer. These include intraoperative radiation therapy (in which a single large dose of radiation is given to the area of the cancer in the operating room at the time of surgery) and proton beam radiation (which uses a special type of radiation that might do less damage to nearby normal cells).

Chemotherapy

Many clinical trials are testing new combinations of chemotherapy drugs for pancreatic cancer. Many studies are seeing if combining gemcitabine with other drugs can help people live longer. Other newer chemo drugs are also being tested, as are combinations of chemo drugs with newer types of drugs.

Targeted therapies

Targeted drugs work differently from standard chemo drugs in that they attack only specific targets on cancer cells (or nearby cells). Targeted therapies may prove to be useful along with, or instead of, current treatments. In general, they seem to have fewer side effects than traditional chemo drugs. Looking for new targets to attack is an active area of cancer research.

Growth factor inhibitors: Many types of cancer cells, including pancreatic cancer cells, have certain proteins on their surface that help them grow. These proteins are called *growth factor receptors*. One example is epidermal growth factor receptor (EGFR).

Several drugs that target EGFR are now being studied. One, known as erlotinib (Tarceva), is already approved for use along with gemcitabine.

Anti-angiogenesis factors: All cancers depend on new blood vessels to nourish their growth. To block the growth of these vessels and thereby starve the tumor, scientists have developed anti-angiogenesis drugs. These are being studied in clinical trials for patients with pancreatic cancer.

Drugs that target the tumor stroma (supporting tissue): Chemotherapy is not always helpful for pancreatic cancer. This is partly because of the cancer cells themselves. But another reason might be that the dense supportive tissue (*stroma*) in the tumor seems to form a barrier that helps protect the cancer cells from the chemo drugs. Researchers are now testing drugs such as PEGPH20, which attack the stroma directly to help break it down. This might allow chemo or other drugs to be more effective. This and similar drugs are now in clinical trials.

Drugs that target cancer stem cells: One theory as to why pancreatic cancer is difficult to treat is based on the idea that not all of the cancer cells in a tumor are the same. There might be a small group of cancer cells, called stem cells, that drive tumor growth and are resistant to chemo, so even if the other cells are killed, the cancer will continue to grow. Drugs that are thought to target such stem cells, such as BBI-608 and demcizumab, are now being tested along with chemotherapy, and some early results from these studies have been promising.

Other targeted therapies: Many drugs targeting other aspects of cancer cells are now being studied for use in pancreatic cancer.

Immune therapy

Immune therapies attempt to boost a person's immune system or give them ready-made components of an immune system to attack cancer cells. Some studies of these treatments have shown promising results.

Monoclonal antibodies: One form of immune therapy uses injections of man-made *monoclonal antibodies*. These immune system proteins are made to home in on a specific molecule, such as carcinoembryonic antigen (CEA), which is sometimes found on the surface of pancreatic cancer cells. Toxins or radioactive atoms can be attached to these antibodies, which bring them directly to the tumor cells. The hope is that they will affect cancer cells while leaving normal cells alone. For use in pancreatic cancer, these types of treatments are available only in clinical trials at this time.

Cancer vaccines: Several types of vaccines for boosting the body's immune response to pancreatic cancer cells are being tested in clinical trials. Unlike vaccines against infections like measles or mumps, these vaccines are designed to help treat, not prevent, pancreatic cancer. One possible advantage of these types of treatments is that they tend to have very limited side effects. At this time, vaccines are available only in clinical trials.

Drugs that target immune system checkpoints: The immune system normally keeps itself from attacking other normal cells in the body by using "checkpoints" – molecules

on immune cells that need to be activated (or inactivated) to start an immune response. Cancer cells sometimes find ways to use these checkpoints to avoid being attacked by the immune system. Newer drugs that target these checkpoints have shown a lot of promise in treating some types of cancer. Some of these are now being studied for use in pancreatic cancer.

Individualization of therapy

Some drugs seem to work better if certain types of mutations can be found in the patient's tumor. For example, erlotinib may work better in patients whose tumors have a particular change in the *EGFR* gene. This concept is an area of intense study. There might also be some gene alterations that affect how well gemcitabine will work in a particular patient. Identifying markers that can predict how well a drug will work before it is given is an important area of research in many types of cancer.

Advances for pancreatic neuroendocrine tumors (NETs)

Many pancreatic NETs have receptors for somatostatin on their cells. This allows these tumors to be detected with imaging tests such as somatostatin receptor scintigraphy (OctreoScan), as well as to be treated with octreotide and other drugs like it.

Newer forms of octreotide have shown even more promise in detecting and treating NETs. For example:

- **Gallium-68 (Ga-68) DOTATATE** is a slightly radioactive drug that can be used as part of a PET/CT scan to detect NETs. Some research has found that it might be better at this than the OctreoScan.
- **Lutetium-177 (Lu-177) DOTATATE** is a different radioactive form of this drug that can be used to treat some NETs. It is injected into a vein, and the octreotide portion of the drug brings the radiation directly to the tumor. This type of treatment, known as *peptide receptor radionuclide therapy* (PRRT), has been shown to shrink some tumors and keep others from growing in early studies.

Additional resources for pancreatic cancer

More information from your American Cancer Society

We have a lot more information that you might find helpful. Explore www.cancer.org or call our National Cancer Information Center toll-free number, 1-800-227-2345. We're here to help you any time, day or night.

Other national organizations and websites*

Along with the American Cancer Society, other sources of information and support include:

Pancreatic Cancer Action Network, Inc.
Toll-free number: 1-877-272-6226
Website www.pancan.org

> Has a "Patient and Liaison Services" (PALS) program which offers information about pancreatic cancer, treatment options, diet and nutrition, specialists and clinical trials specific to pancreatic cancer, and more; also has the PALS Survivor and Caregiver Network through which newly-diagnosed people and families are matched with volunteer survivors and caregivers

Confronting Pancreatic Cancer (Pancreatica)
Website: www.pancreatica.org

> For practical, impartial, understandable information about pancreatic cancer; also has a free phone information and counseling line at 1-800-525-3777 and another free phone service that will put you in contact with a fellow survivor at 1-800-433-0464

Hirshberg Foundation for Pancreatic Cancer Research
Phone number: 1-310-473-5121
Website: www.pancreatic.org

> Provides information, resources, and support to pancreatic cancer patients and their families, including referrals for treatment facilities, second opinions, and doctors across the US

The Lustgarten Foundation for Pancreatic Cancer Research
Toll-free number: 1-866-789-1000
Website: www.lustgarten.org

> Offers a free patient handbook called "Understanding Pancreatic Cancer," newsletters, and a free quarterly "Ask an Expert" patient information series which includes updates on topics of interest to those with pancreatic cancer

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

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