

# Max's Case—Thyroid Cancer, MEN II,\* and Genetic Testing

## Part I

Max is 15 years old. Many of Max's relatives on his mother's side died quite young (20s, 30s, and 40s) from thyroid cancer. Max's mom died several years ago, but not from thyroid cancer. There are many genetic reasons for thyroid cancer, including an inherited mutation that leads to a rare disorder called MEN II (multiple endocrine neoplasia II). The MEN II-causing mutation leads to a 100-percent chance of a kind of thyroid cancer that will be fatal if left untreated. The thyroid cancer arises early in life, sometimes even during adolescence.

Max's doctor informs Max and his father that there is a genetic test for this inherited mutation. (None of Max's other relatives have ever been tested.) If Max tested positive, he could soon have surgery to remove his thyroid gland so that he would never develop thyroid cancer. Without his thyroid, Max would have to take a daily pill containing a hormone called thyroxine, an important chemical produced by the thyroid gland, for the rest of his life. The doctors would determine the appropriate dosage for Max. If the dosage isn't quite right, Max could temporarily experience side effects such as sweating, muscle cramps, and headaches. However, if he experienced these symptoms, the doctors would adjust the dosage, and the side effects normally disappear. If people without thyroids fail to take their medication for long periods of time, their metabolism is dangerously affected; eventually, failure to take the medication can be fatal.

Max refuses to have the genetic test, insisting it is *his* life. He doesn't want this information, says he wouldn't want preventive surgery, and doesn't like the idea of daily medication after the surgery. Max's father and doctor still insist that he should have the genetic test.

## Part II

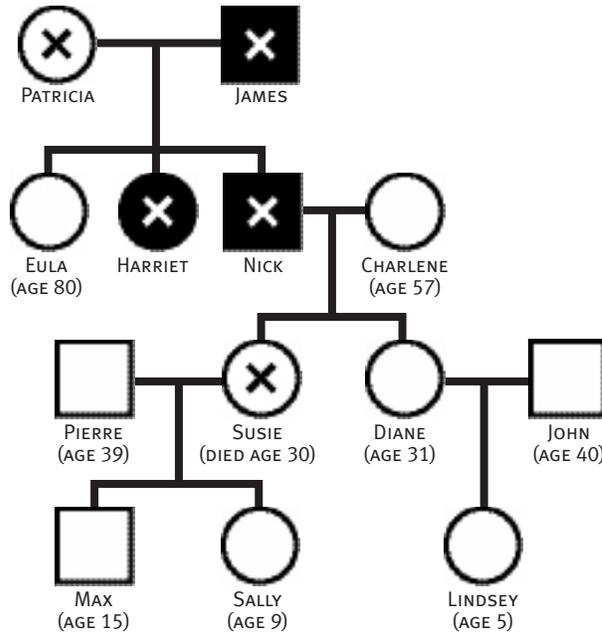
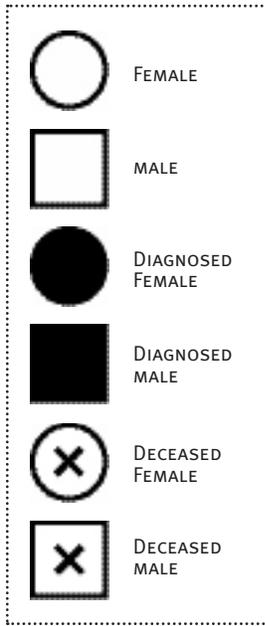
**Ethical Question:** Who should decide whether Max will have this genetic test? Should Max decide? Should his father decide? Should his doctor decide? Why?

## Part III

As you can see from the pedigree that follows, Max has multiple relatives who have died of thyroid cancer, including his grandfather Nick. However, remember that there are many different types of thyroid cancer; only a small percentage of thyroid cancers are MEN II. Therefore, the fact that Max has relatives who have had thyroid cancer does not necessarily mean that MEN II runs in his family. His relatives could have gotten thyroid cancer for reasons only partly (or not at all) related to inheritance. Diane has been cancer-free, though she has high levels of thyroxine, which could be a warning sign of thyroid cancer in the future. There is no history of thyroid cancer on Pierre's side of the family.

\*Multiple endocrine neoplasia type 2.

### Max's Family Tree on His Mother's (Susie's) Side



NOTE: Shaded individuals had thyroid cancer. Harriet, James, and Nick were each diagnosed with it in their teens, 20s, or 30s, and all died of it. Susie died, but not of thyroid cancer. No individual is yet known to have MEN II; only a small percentage of thyroid cancers are due to the MEN II mutation. On Pierre's side of the family, there is no history of thyroid cancer.

Question	Answer
1. Who had thyroid cancer, and when were they diagnosed with it?	
2. Who died of thyroid cancer?	
3. Of those who had thyroid cancer, who is known to have had MEN II?	
4. Who died of reasons not related to thyroid cancer?	
5. Who has elevated levels of thyroxine, which could be a warning sign of future thyroid cancer?	
6. If someone had MEN II, what would his or her genotype be?	<i>The MEN II gene is dominant. The genotype could be homozygous dominant (TT) or heterozygous (Tt). Since the dominant allele is rare, assume that a person with MEN II is heterozygous.</i>
7. If someone did <i>not</i> have MEN II (even if they did have thyroid cancer), what would his or her genotype be?	