

Anticipating Personalized Medicine A Case Study

**All details of the case study – including rates of recurrence, genetic biomarkers, and patient profiles – are hypothetical. Nevertheless, the scenario depicted is scientifically and medically plausible.*

Anticipating Personalized Medicine: A Case Study

Breast cancer is the second leading cause of cancer death in women. Some of these cancers have already spread to the lymph nodes by the time they are discovered. Very aggressive treatment – a combination of surgery, radiation, hormonal treatment, and chemotherapy – is indicated for these women. Women whose cancers are confined to their breast, with no lymph node involvement, are divided into Low Risk and High Risk categories, and treatment varies accordingly. Categorization is based on tumor size and histological studies, with Low Risk women having small tumors and/or favorable histology and High Risk women having larger tumors and/or unfavorable histological findings (see chart). High Risk women currently receive the same treatment as lymph node positive women, that is, surgery (lumpectomy), radiation, hormonal treatment, and chemotherapy. Low Risk women do not receive chemotherapy, although there is a 10% rate of recurrence in these women, with half the recurrences leading to death.

Recent research has identified a biomarker, Luc-3, that is present in some breast tumors. Among women with advanced, lymph node positive cancers, 95% have the Luc-3 biomarker; 80% of the women in the High Risk group have the biomarker; and 20% of Low Risk women have the Luc-3 biomarker. Preliminary studies indicate that the Luc-3 biomarker may be the most accurate way to distinguish between women who will and will not have a recurrence of their cancer.

	LYMPH NODE POSITIVE	LYMPH NODE NEGATIVE	
		High Risk	Low Risk
Treatment	Surgery Radiation Hormonal Treatment Chemotherapy	Surgery Radiation Hormonal Treatment Chemotherapy	Surgery Radiation Hormonal Treatment
Tumor size	Medium – Large	Medium - Large	Small
Histology	Unfavorable	Unfavorable	Favorable
Presence of Luc-3 Biomarker in tumor	95%	80%	20%
Rate of Recurrence	79%	47%	10%

Some doctors and researchers advocate testing all women with breast cancer for Luc-3. Those who are positive for the biomarker would receive chemotherapy, no matter what their risk category is. Similarly, women who are Luc-3 negative will not receive chemo, regardless of their risk category.

This revised treatment strategy would mean that some women who previously would not have received chemo will now have the treatment, and some women who previously would have been treated with chemotherapy will not receive it. This strategy could potentially save thousands of

lives per year. Also, women who are Luc-3 negative may be spared chemotherapy, with its adverse, sometimes very serious, toxic effects. (Effects can range from susceptibility to infection, hair loss, anemia, weakness, and weight loss, to very severe effects like delirium, heart failure, and death.)

On the down side, treatment options derived from Luc-3 status are relatively recent. Thus, women in the Low Risk group – who have a 90% chance of complete recovery and a 50% chance of successful treatment should their disease reoccur with no follow-up chemotherapy – will now receive chemotherapy, with all its risks. And some women who were previously treated with chemotherapy due to their High Risk status, will now be offered the option of forgoing chemo. They will be relying on the relatively recent identification of Luc-3 as a predictor of recurrence, thus forgoing the standard chemotherapy that might save their lives.

Dr. Anderson is an oncologist with a special expertise in treating breast cancer. In the past week, four women have been referred to her for follow-up after breast surgery and radiation treatments. Each of the women is **Low Risk, Luc-3 positive**. Dr. Anderson needs to decide whether to recommend chemotherapy for these women based on their Luc-3 status.

1. Terri is 35 years old and the mother of two young children. Her mother and aunt died of breast cancer while still in their 50s. Terri's husband is a free lance photographer, with no employer-sponsored health insurance. He and Terri have purchased a low-cost, high deductible insurance policy on the private market. Additionally, Dr. Anderson had submitted a blood sample from Terri that was tested for genetic factors associated with a person's response to chemotherapy, and Terri's tests revealed that she is more likely than the average woman to have very severe adverse side effects from chemotherapy.

2. Leslie is a 45-year-old manager in a large accounting firm, with excellent employer-sponsored health insurance and leave benefits. She has learned she's being considered for promotion to a senior executive position, competing against a male colleague in her firm.

3. Wanda is a 60-year-old African American woman with good health insurance coverage. Although she is Luc-3 positive, there is preliminary data showing that Luc-3 may be a less accurate predictor of risk for African Americans than it is for Caucasians. (There is no data on Hispanic and Asian women.)

4. Suzanne is a 75-year-old woman on Medicare who takes several medications in an attempt to control her severe hypertension and diabetes. She has four grandchildren and fervently wishes to enjoy more years with them.

In other words, each of these women would not have received chemotherapy under standard treatment protocols. Dr. Anderson informs each of the women about the recent, but still preliminary, findings regarding Luc-3 and the risk predictions based on this newly-discovered biomarker. She tells them that women in their risk category who are treated with surgery, radiation, and hormone treatments have a 10 % rate of recurrence, half of which lead to death. Finally, she details the risks and adverse side effects that accompany chemotherapy treatment.

Each woman has a dilemma.

- Terri is afraid that the adverse side effects from chemotherapy, which she is genetically predisposed to, are likely to make it difficult for her to care for her family. On the other hand, she has first-hand knowledge of how deadly breast cancer can be and knows that her husband, who travels frequently on photo assignments, will have difficulty raising their children should she have a recurrence of disease, possibly leading to death. Can she take a chance on receiving standard treatment, which does not include chemo?
- Leslie is afraid that if she receives chemotherapy, she will have to be absent from work for treatment, as well as treatment-related illness. Further, her appearance will be negatively affected, a potentially important consideration for a woman in a highly-visible executive position. To date, she has not told her employer that she has breast cancer, using personal leave to explain her relatively short absences for surgery and radiation treatments, and is afraid that this information may adversely affect her chances for promotion. On the other hand, she understands that the chemotherapy *might* increase her survival chances.
- Wanda is confused. She can't be certain that chemotherapy will work for her, given that preliminary data show that Luc-3 may be a less accurate predictor for African Americans. Wanda believes she has less of a basis on which to calculate the risks in front of her. Thus, she runs the risk of exposing herself to the toxic effects of chemotherapy without reaping the potential benefits of the treatment.
- Suzanne wants to optimize her chances of survival, which she believes may be enhanced by receiving chemotherapy. She also realizes, however, that her health is already fragile and that chemotherapy might be especially difficult or dangerous for her.