Radiation therapy is one of the most well used applications of optimization in health care.

In practice, radiation machines are connected to treatment planning software that implements and solves optimization models.

Both linear optimization models, like we saw here, and other types of optimization models.

Some examples of radiation machines that use optimization software are Pinnacle by Philips, RayStation by RaySearch Labs and Eclipse by Varian.

There are many extensions to the optimization model we described here.

One is the selection of beam angles.

The beam angles can be selected jointly with the intensity profiles by using an integer optimization.

This allows the treatment to be further personalized to the specific tumor and person receiving the radiation.

Integer optimization is another type of optimization model and will be the topic of next week.

Another extension is accounting for uncertainty.

Often the quality of IMRT treatments is degraded due to uncertain organ motion.

For example, in lung cancer, the target area is around the lungs.

But since the patient is breathing throughout the treatment, the target area is moving and the location is slightly uncertain.

We can manage this uncertainty using a method known as robust optimization.

There is a significant amount of literature on this method and its application to radiation therapy.

Linear optimization significantly improves the efficiency of radiation therapy.

Manually designing an IMRT treatment would be inefficient and impractical.

By using linear optimization, IMRT can be designed in an efficient and systematic way.

As we saw in this lecture, clinical criteria can be modeled using constraints and the treatment planner can explore trade-offs by changing the model.

But ultimately, IMRT and the use of optimization benefits the patient.

In head and neck cancers saliva glands were rarely spared prior to IMRT, but by using optimized IMRT treatments, saliva glands can now be spared.

In prostate cancer, IMRT treatments reduced toxicities and allow for higher tumor doses to be delivered safely.

And in lung cancer optimized IMRT reduced the risk of radiation induced pneumonitis.

These are just three examples of the benefits of IMRT.

Overall, optimized IMRT allows clinicians to deliver treatment that was previously impossible and to improve the quality of life for patients.