Clinical Ethics Seen with Machine Learning in Healthcare
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**Machine Learning:** a subfield of artificial intelligence that allows computers to adjust and gain the ability to learn off a situation, without having explicit programming.1

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### Data Vulnerability

The concerns between the safety of the patient's privacy and how their personal information is held in machine learning continues to grow. Technology has a huge impact on how the patient's information is stored and used throughout their experience in the healthcare system. As sharing information through clouds becomes more available, technology contains a large portion of personal information, it becomes vulnerable and targeted by hacking.

**Potential Risks:**
- **Hacking**
- Threatens integrity of the technology2
- Possibly reveals sensitive and confidential information3
- Allows private information to be shared without the patient’s knowledge

This directly violates the ethical principle of autonomy. The patient no longer has control over what information they want released. Depending on the sensitive material, the released data can also cause harm to the patient and violate the ethical principle of non-maleficence. These challenges directly conflict with the benefits of the technological improvements seen with machine learning.

![Figure 1: Sources that contribute to the healthcare data collection.](image)

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### Lack of Individuality & Responsibility

With technology overcoming the medical field, machine learning provides an advanced way to diagnose patients efficiently. This causes the machines to only look at the facts of the case, instead of the whole environment. The implication would be severe once the doctor disagrees with the machine learning diagnosis. For example, say the doctor believes that the patient has one disease, while machine learning believes it’s a completely different disease. How does the patient receive proper treatment if there is no right answer?2 The responsibility of the decision would be critical for the patient. The doctor could be facing a malpractice situation no matter what option they choose. Since machine learning only focused on the imaging facts, it could be missing crucial information the doctor noticed. Diagnosing would become more defensive and harm the patient more than help.2 This would lead to a mistrust between the doctor and machine learning system, ultimately leading to mistrust between the patient and the healthcare system.3 How will the patient receive justice for their mistreatment if the doctor chose the wrong prognosis for their diagnosis? The ethical principles of justice and nonmaleficence would be compromised. This is another aspect that needs to be evaluated while machine learning is being implicated into the healthcare system.

![Figure 2: Developmental phases of machine learning based on the healthcare system.](image)

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### Introduction

Machine learning is a new type of artificial intelligence (AI) used in healthcare today. The AI contains the ability to continue to adapt to each patient’s situation and learn how to handle the circumstance without containing the specific programming. This process would allow patients to receive a faster and possibly more accurate diagnosis compared to the doctors, “series of studies demonstrating ‘expert-level’ accuracy of machine learning algorithms.”4 By creating a system that allows more patients to get accurate readings on the first examination, it best supports the patients’ needs and allows them to receive the proper treatment quickly.

- **Medical Uses:**
  - Straightforward applications within the medical field
  - Imaging
  - Radiology, ophthalmology, dermatology, epidemiology, or pathology
  - Example: epidemiology4
  - Involves a large data set of possibilities
  - Computer system would be able to cycle through the facts efficiently
  - Create a plausible diagnosis and prognosis for the patient4
  - Eliminates limitations of an individual not being able to frequently use or value data4

With machine learning continuing to modernize healthcare, there are some issues with this advanced technology. There are ethical dilemmas that contradict the four major ethical principles: autonomy, non-maleficence, beneficence, and justice. The contradictions between the advancements in technology and the ethical principles create complications in the healthcare system between the patient, physician, and the healthcare system itself. These dilemmas include, but are not limited to:

- **Data Vulnerability**
- **Lack of Individuality & Responsibility**
- **Limitation of AI/Technology**

![Figure 3: Common sources of imaging used in the medical field that machine learning can use for diagnosing patients.](image)

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### Limitations

Machine learning collects a wide variety of data through imaging but relies only on the facts it’s given. This allows it to be able to determine a diagnosis based solely on statistics, but not on individuals (as mentioned in the ‘Lack of individuality’ section). If the technological imaging is not available, machine learning cannot function properly. Machine learning can also order unnecessary imaging to prove a diagnosis when a doctor could rule out the diagnosis through other processes.5 The variety of random testing can cause more harm and inconvenience to the patient, conflicting with beneficence. Justice is also compromised due to the concept of machine learning pursuing the ideal of ‘algorithmic fairness.’6 This ideal is when the technology demonstrates a lack of between-group bias when it is being applied to the individual.7 Justice cannot be helped if the patient is not treated fairly.

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### Summary

- **Machine learning is AI that adjusts to the situation without specific programming.**
- **Uses imaging and other facts to determine diagnosis**
- **Compromises the four main ethical principles**
  - autonomy, non-maleficence, beneficence, justice
- **Data vulnerability compromises autonomy and potentially non-maleficence**
- **Lack of individuality and responsibility compromise justice and non-maleficence**
- **Limitations of machine learning compromise beneficence**

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### References