

# Ethics and Engineering

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## Further reading...

<https://ethicaldecisions.net/>

# Why ethics?

- Two essential points:
  - Ethics is **hard**, much like engineering.
  - When organizations go astray ethically, it is usually because **we don't know how to think about the issues**
    - *...not because we are **bad people**.*
- This is evident in 2 case studies.
  - Ford Pinto (1972)
  - Guidant Corporation (2014)

# Ford Pinto

- Early 1970s: Exploding gas tank in Ford Pinto
  - in low-speed collisions.



# Ford Pinto

- The company knew of the danger.
  - Decided not to fix the defect.
  - Would have cost \$11 per car.
    - To fix bolts that punctured the gas tank on collision.



# Ford Pinto

- Dennis Gioia was centrally involved.
  - Now a professor of business ethics and organizational behavior.



# Ford Pinto

- Gioia tells the inside story honestly in an article.

Pinto Fires and Personal Ethics:  
A Script Analysis of Missed Opportunities

*Journal of Business Ethics* **11**: 379–389, 1992.

*Dennis A. Gioia*



## Ford Pinto

- Gioia held engineering and MBA degrees.
  - He wanted to make a **positive contribution** and saw business as an opportunity to do so.
  - So he joined Ford as Field Recall Coordinator.





## Ford Pinto

- Cost-benefit analysis showed that the defect should not be fixed.

*Costs:*                    \$137 000 000

(Estimated as the costs of a production fix to all similarly designed cars and trucks with the gas tank aft of the axle (12 500 000 vehicles  $\times$  \$11/vehicle))

*Benefits:*                \$49 530 000

(Estimated as the savings from preventing (180 projected deaths  $\times$  \$200 000/ death) + (180 projected burn injuries  $\times$  \$67 000/injury) + (2 100 burned cars  $\times$  \$700/car))

## Ford Pinto

- 1978: Ford executives prosecuted for reckless homicide.
  - After 3 teenage girls were killed by exploding gas tank in Indiana.
  - Ford executives acquitted due to lack of evidence.

## Ford Pinto

- Gioia later began using the Pinto case in his classes.
- Then and for years afterward, he believed he had made the right decision at Ford, given the evidence at hand.
  - Then he changed his mind (according to his article).
  - **Why?**
  - He doesn't explain.

# Ford Pinto

- Lesson: We often make the wrong decision because **we don't know what is right.**
  - **Not** because we are **bad people.**
  - We don't have the **conceptual equipment** to analyze the issue.



# Guidant Corporation

- The Pinto case may seem easy to you.
  - But try this one:
  - *The case of Guidant Corporation defibrillators*



Now part of Boston Scientific

# Guidant Corporation

- A tragic malfunction.
  - Joshua Oukrop died of heart failure on a cycling trip.
    - His implanted defibrillator malfunctioned.
    - Guidant had known of defect for some time.



Lee Oukrop with photo of his deceased son, Joshua

# Guidant Corporation

- Guidant did not notify doctors or patients.
  - Although it notified the FDA as required by law.
  - Joshua's doctors were furious.
  - They said they would have replaced the device.



# Guidant Corporation

- Guidant's argument
  - Lethal risk of leaving device in place: **0.10-0.24%**.
  - Risk of replacing it: **0.42%**
  - Doctors & patients would want to replace it (as did Joshua's doctors).
  - This is why FDA doesn't require public notice of defect.
  - Better not to notify.



Dr. Joseph M. Smith  
*Guidant executive  
at the time* 16



# Guidant Corporation

- Argument from Joshua's doctors
  - Dr. Maron: "It is a statistical argument that has little to do with real people"
  - People have a "right" to know.
  - Joshua's father: "Whoever made this decision at Guidant, I pray he doesn't have a son who this happens to."



Barry J. Maron  
*One of Joshua's doctors*

# How about professional ethics?

- Professions exist to assure the public of certain **standards of conduct**.
  - Clients need not research competence and responsibility of every individual.



# How about professional ethics?

- Professions exist to assure the public of certain **standards of conduct**.
  - Clients need not research competence and responsibility of every individual.
  - Professionals make an implicit **promise** to abide by these standards.
    - A **Code of Ethics** help to clarify the promise.
  - **Professional ethics = obligations under this promise**



# How about professional ethics?

- Professional ethics is necessary...
  - ...for the very **existence** of the profession.
- But the professional promise **cannot anticipate** every situation.
  - ...and codes of ethics tend to consist of **generalities**.



# AIChE Code of Ethics

- Regarding the Pinto case...

[Engineers should] *hold paramount* the safety, health and welfare of the public and protect the environment in performance of their professional duties [emphasis added].

- How safe is safe?
- If safety is paramount, should we sell only the safest possible car, regardless of price?

# AIChE Code of Ethics

- Regarding the Guidant case...

[Engineers should] formally advise their employers or clients (and consider *further disclosure*, if warranted) if they perceive that a consequence of their duties will adversely affect the present or future health or safety of *their colleagues or the public* [emphasis added].

- Guidant's failure disclose a defect did **not** adversely affect the health or safety of the **public** as a whole.
- But it adversely affected some **individuals**. Does this matter?

# Ethical principles

- But we must have principles for resolving such issues in an **objective way**.
  - Otherwise, we can rationalize anything.
  - **Generalization principle**
  - **Utilitarian principle**
  - **Respect for autonomy**

## Ethics in a nutshell

- We should all **play by the same rules.**
- Ethics is **how we agree** on the rules.
  - Nobody says this is easy.
  - Why should we expect ethics to be easy, especially in a complicated world?





# Universality of reason

- This is an assumption on which we rely throughout.
  - What is rational **does not depend on who I am.**
  - I don't get to have my own logic.
- The assumption underlies science and all forms of rational inquiry.
  - Ethics assumes nothing more.



# Generalization principle

- Basic premise: We always act for a reason.
  - Every action has a rationale.

# Generalization principle

- Basic premise: We always act for a reason.
  - Every action has a rationale.
- So, if the reason justifies the action for me...
  - It justifies the action for **anyone** to whom the reason applies...
  - ...due to the **universality of reason**.

## Example - Theft

- Suppose I steal a watch from a shop.
- I have 2 reasons:
  - I want a new watch.
  - I won't get caught.
    - *Security at the shop is lax.*



## Example - Theft

- So I am making a decision for everyone:
  - All who want a watch and think they won't get caught should steal one.



## Example - Theft

- So I am making a decision for everyone:
  - All who want a watch and think they won't get caught should steal one.
- But if all do this, they will get caught.
  - The shop will install security.
  - My reasons will no longer apply



## Example - Theft

- I am not saying that all these people actually **will** steal watches.
  - Only that if they did, my reasons would no longer apply.



## Example - Theft

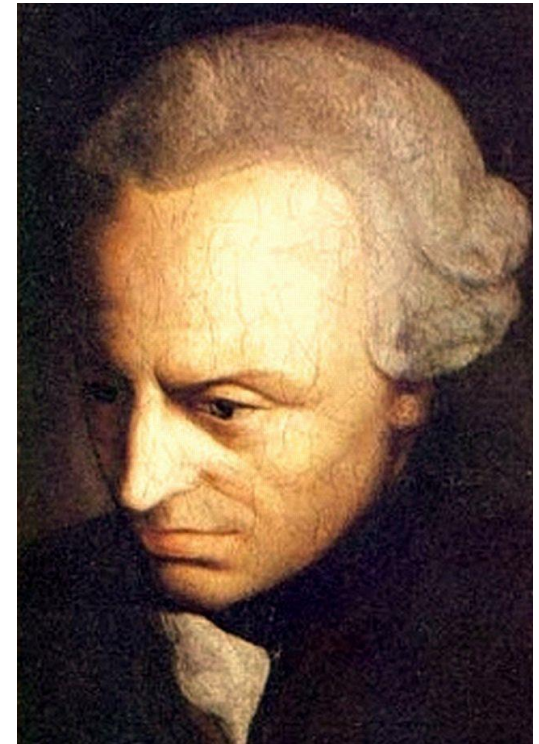
- My reasons are **inconsistent** with the assumption that people will act on them.
- I am caught in a contradiction.
  - My reasons imply that these people **should** steal.
  - These same reasons presuppose that they will **not** steal.





# Generalization principle

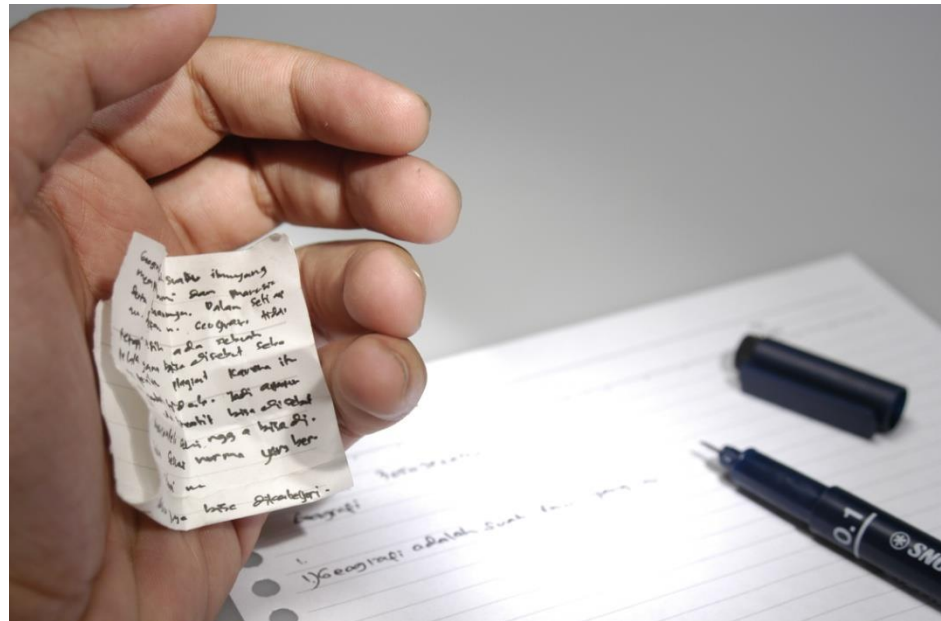
- The principle is:
  - The **reasons** for an action should be **consistent** with the assumption that **everyone with the same reasons acts the same way**.



Immanuel Kant, 1724-1804

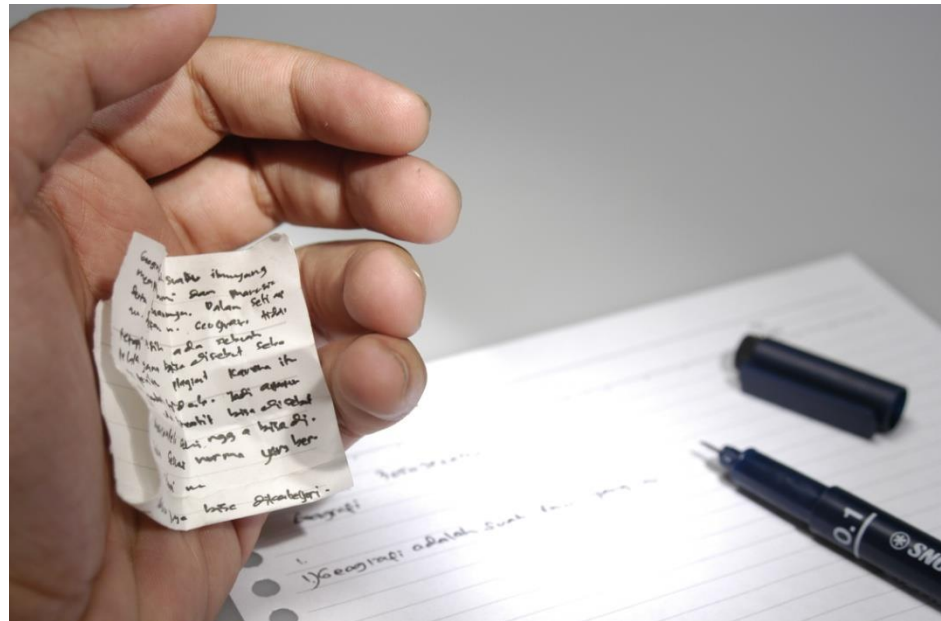
## Example - Cheating

- What is wrong with cheating on an exam?
- My reasons:
  - I will get a better grade.
  - Which means I will get a better job.



## Example - Cheating

- Nearly all students have these reasons.
- If they all cheat...
  - Everyone will have a top grade.
  - Good grades won't get me a better job.



## Example - Promises

- **Breaking a promise** normally violates generalization principle.
  - If I break it merely for convenience or profit.



## Example - Promises

- Suppose everyone broke promises when convenient.
  - It would be impossible to **make** promises in the first place, and therefore impossible to **break** one!
  - “Promises” would be a joke.



## Example - Agreements

- **Breaking an agreement** violates generalization principle.
  - If I break it merely for convenience or profit.
  - An agreement (or contract) is a **mutual promise**.



## Example - Agreements

- Suppose everyone broke agreements when convenient.
  - It would be impossible to **make** agreements in the first place.
  - And therefore impossible to achieve my purposes by **breaking** them!
  - The whole point of having an agreement is that you keep it when you **don't want** to keep it

## Example - Lying

- Lying for mere convenience violates the generalization principle.
  - If the reason for lying implies that people will believe the lie.
  - If everyone lied when convenient, no one would believe the lies.
    - *The possibility of **communication** presupposes a certain amount of credibility.*





## Example - Lying

- Lying can be generalizable, depending on the reasons.
  - Workers in an Amsterdam office building lied to Nazi police, 1940-42.
    - *They denied knowing the whereabouts of Anne Frank's family, who they knew were hiding in the building.*
    - *Their purpose was to avoid revealing a Jewish family's location to the Nazi regime.*



## Example - Lying

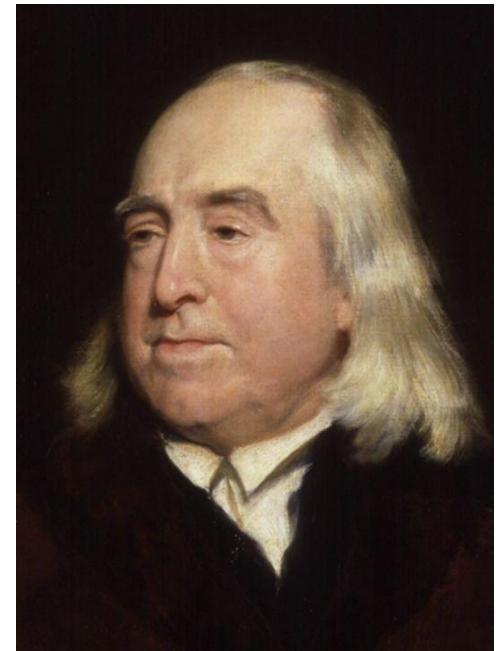
- Lying can be generalizable, depending on the reasons.
  - This is generalizable
    - *If everyone lied to avoid revealing a Jewish family's location to the Nazi regime, it would still be possible to accomplish this purpose by lying.*
    - *It would not be necessary for the police to believe the lies.*



# Utility

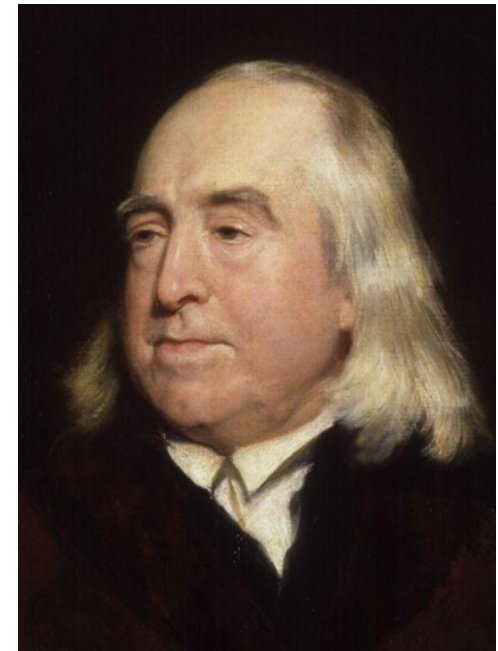
- Basic premise: Action is a means to an end.
  - You may want to achieve some goal.
  - Maybe your ultimate goal is happiness.
  - Whatever it is, let's call it **utility**.
  - It's what you regard as **inherently valuable**, as the **end** to which your actions are a **means**.

Jeremy Bentham  
Father of utilitarianism



# Utility

- If I regard something as inherently valuable...
  - I must regard it as inherently valuable for **anyone**...
  - due to the **universality of reason**.
- To be consistent, I must create as much utility as I can for everyone.
  - “The greatest good for the greatest number.”



## Maximizing utility

- More precisely, I should maximize **net expected utility**:

$$\max_d \sum_i \Pr(i | d) \sum_j u_j(i | d)$$

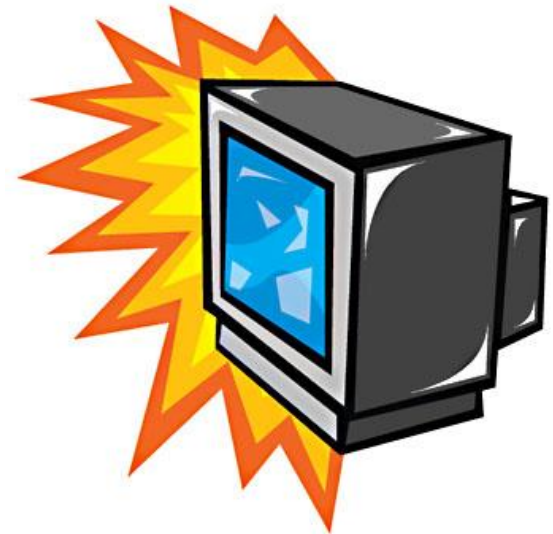
where

$\Pr(i | d)$  = probability of outcome  $i$  given decision  $d$

$u_j(i | d)$  = net utility for person  $j$  in outcome  $i$  given decision  $d$

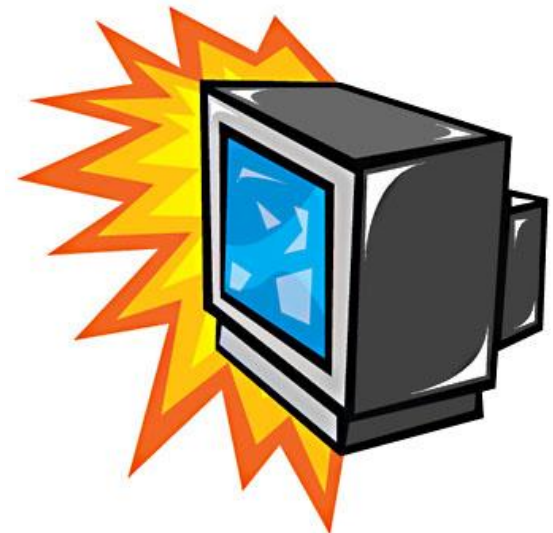
## Maximizing utility

- For example, suppose I listen to loud TV in my hotel room at 2 am.
  - Keeping other guests awake.
  - Why is this unethical?
  - May not violate hotel rules.



## Maximizing utility

- For example, suppose I listen to loud TV in my hotel room at 2 am.
  - Keeping other guests awake.
  - Why is this unethical?
  - May not violate hotel rules.
- It reduces net utility.
  - Maybe it makes me a little happier.
  - But it substantially reduces utility of other guests.



# Utilitarian principle

- An act is ethical only if I can rationally believe that **no other act...**
  - creates **more net expected utility...**
  - and **satisfies other ethical principles.**
  - Counts **everyone's** utility.





# Autonomy

- Autonomy = self-law
  - I act **autonomously** when I freely make up my own mind about what to do, based on coherent reasons I give for my decision.
  - An **agent** is someone who can act autonomously.
  - Humans are agents, insects are not.



# Autonomy

- Autonomous vs. programmed
  - An “autonomous car” is **not** autonomous in this sense.
  - It is only **programmed**.
    - ...and therefore independent of real-time human control.



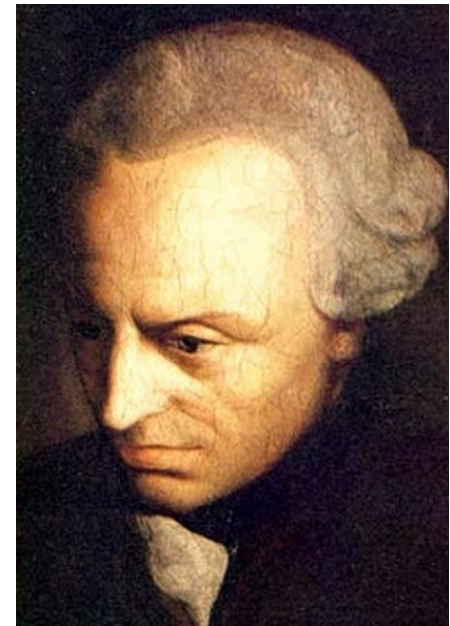
# Autonomy

- Why must actions have reasons?
  - An MRI machine can detect our decisions **before we make them.**
  - We are determined by chemistry and biology, as are insects.
  - How to distinguish us from insects?
  - Our behavior has a **second kind of explanation.**



# Autonomy

- Dual standpoint theory.
  - Our autonomous decisions can be explained as based on the **reasons** we give for the decisions.
  - ...**as well as** the result of chemistry and biology.
  - An insect's behavior has only the **latter** kind of explanation.



Immanuel Kant  
Proposed a dual standpoint theory in his book,  
*Grundlegung zur metaphysik der Sitten*

# Autonomy

- Robots as agents.
  - A **robot** can in principle be autonomous, if it can coherently explain its reasons.
  - This is known in AI as **reasons responsiveness**.
  - This kind of **explanation** has become a central issue in AI applications.



# Autonomy

- Fundamental obligation: **respect autonomy.**
  - This rules out murder, coercion, slavery, etc.

**AUTONOMY**

# Action plans

- To make things more precise...
  - An action has the form of an **action plan**.
    - *If the reasons for my action apply, **then** do it.*
    - *Example: “If I want to catch the bus, and the bus stop is across the street, and no cars are coming, then cross the street.”*



© Can Stock Photo

# Coercion

- Coercion does **not** violate my autonomy if it is **consistent with my action plan**.
  - I start to cross the street to catch a bus, and you pull me *out of the path of a car*.
  - This is *consistent* with my action plan.
  - Not a violation of autonomy.



© Can Stock Photo



# Principle of autonomy

- *It is unethical for me to select an action plan that I am rationally constrained to believe is **inconsistent** with an **ethical** action plan of another agent.*

# Informed consent

- Coercion does **not** violate autonomy if there is **informed consent**.
  - My employer tells me I must transfer to another city or be fired.
  - This is inconsistent with my action plan.
  - But by taking the job, I implicitly agreed to abide by the company's business decisions.
  - So my action plan is consistent with the company's decision.



# Case studies revisited

- Ford Pinto
- Guidant defibrillators

# Ford Pinto

- The cost-benefit analysis was a legitimate **utilitarian** calculation.
  - Considered net expected utility, measured in monetary terms.
    - *Not just company cost.*
  - Failure to fix the defect **may well have satisfied the utilitarian principle.**
  - But there are **two other principles** to satisfy!

# Ford Pinto

- Failure to fix violates **autonomy**.
  - Ford was rationally constrained to believe that the defect would cause serious injury or death for at least one person.
    - *In fact, many people (as assumed by Ford's cost/benefit analysis).*
    - *This is **violation of autonomy** without informed consent.*



# Ford Pinto

- Failure to fix violates **autonomy**.
  - Why no informed consent?
    - *True, **all car manufacturers** are rationally constrained to believe that **people will be killed in their cars**.*
    - *But customers give **informed consent** to this risk, because they assume the normal risks of driving.*
    - *A defective gas tank is not normal and therefore **not a risk assumed by the customer**.*



# Ford Pinto

- Failure to fix may violate **generalization principle**.
  - Violation of **implied warranty**.
    - *There is an implied **agreement** that the product is fit for the purpose for which it is sold (**warranty of merchantability**).*
    - *Perhaps a car that can explode in low-speed collisions is unfit for driving your kids to school (for example).*
    - *Violation of this agreement, merely for profit or convenience, is contrary to generalization principle.*



# Ford Pinto

- Conclusion...
  - **Ford's decision not to recall was unethical.**



# Guidant Corporation

- Guidant's decision conforms to **utilitarian principle**.
  - It minimized risk for 14,000 patients.
  - Would have potentially saved 100-200 lives.
    - *If problem had not been broadcast by news media.*



# Guidant Corporation

- Guidant's decision conforms to **utilitarian principle**.
  - It minimized risk for 14,000 patients.
  - Would have potentially saved 100-200 lives.
    - *If problem had not been broadcast by news media.*
    - *This is a factual claim. If it is false, the analysis is different.*
    - *Possibly, the risk of replacement is predictably lower for some patients, but for the sake of argument we assume otherwise.*



# Guidant Corporation

- Violation of **autonomy**?
  - Patients have a **right** to know about their health status?
    - *A right claim is not an argument.*
  - But patients **want** to know.
    - *The autonomy principle doesn't require us to give people anything they want just because they want it.*

# Guidant Corporation

- Violation of **autonomy**?
  - Interference with patient's **action plan** to be informed of any risk?
    - *This is not an action plan.*
    - *An action plan must involve an **action by the agent**.*
    - *Informing the patient is an action taken **by the company**.*
    - *No interference with action plans.*

# Guidant Corporation

- Violation of **autonomy**?
  - Exposure to lethal risk **without informed or implied consent**?
    - *In the Ford case, failure to **fix** the defect was violation of autonomy without implied consent.*
    - *Failure to **recall** exposed customers to **continued unnecessary risk** without implied consent.*
    - *However, Guidant **fixed** the defect.*
    - *Failure to recall did **not** expose patients to continued unnecessary risk.*
    - *If replacement had lower risk, this would be an autonomy violation.*

# Guidant Corporation

- Violation of **generalization principle?**
  - **Implied warranty** perhaps not an issue.
    - *Defibrillator was fit for the purpose for which it was sold.*
    - *Patients are willing to replace it, even though the risk of replacement is higher than the original risk of failure.*
    - *So they presumably would have been willing to receive the implant in full knowledge of the risk.*



# Guidant Corporation

- **Is it deception?**
  - *Deception is causing someone to believe something you know is false.*
  - *Failure to notify **may** cause patients to believe that no (significant?) defect has been discovered.*
  - *This may be ungeneralizable if the **reason for not notifying** is to cause them to believe this.*
  - *But the reason is only to **reduce risk**, which may be generalizable (already generalized?).*

# Guidant Corporation

- Conclusion...
  - **Guidant's decision was ethical**
  - ...albeit very difficult and unpleasant.



# Guidant Corporation

## ■ Follow-up.

- Guidant later got into legal trouble.
  - *For failing to notify FDA of additional problems with its defibrillator, and continuing to sell some defective devices.*
  - *FDA also found quality control problems at plants.*
- Guidant sentenced in 2011 to pay \$296 million in fines and forfeiture.

By JOEL ROBERTS AP | December 27, 2005, 12:55 PM

## FDA Issues Warning To Guidant



In a file photo Dr. William J. Groh, a cardiologist who is the director of the pacemaker and implanted defibrillator clinic at Indiana University's medical school holds a Guidant Contact Renewal 3 defibrillator in his office in Indianapolis Friday, June 24, 2004. / AP

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Guidant Corp. said Tuesday the U.S. Food and Drug Administration sent the company a warning letter about unresolved problems it found during an inspection earlier this year at the medical device maker's St. Paul, Minnesota, facility.

Questions?  
Other ethical issues?