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CMSC691 – Medical Software Engineering
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Question 1:

You check your pulse and discover that your heart rate is 100 beats per minute. Is this rate normal or abnormal? What additional information would you use in making this judgment? How does the context in which data are collected influence the interpretation of those data?

As a nonphysician, I would query the internet to determine what a normal heart rate is. However, depending on my previous activity this rate could be normal. Therefore, if I had just ran five miles I wouldn't bother looking it up. Let's say that I hadn't just run and detected this higher than average heart rate. To determine what I should do about this issue, or if it was even an issue I would check online reference databases for health information. Likely, any information from non-reputable sites wouldn't even be considered. A probable scenario involves just hitting up Google and WebMD for some quick information.

Question 2:

Given the imprecision of many medical terms, why do you think that serious instances of miscommunication among health care professionals are not more common? Why is greater standardization of terminology necessary if computers rather than humans are to manipulate patient data?

Currently information tends to be transmitted (faxed, spoken, etc) from physician or nurse directly to physicians or nurses. This free text must be read by the receiving end. Humans have unbelievably powerful natural language processors. This processing of free text allows variances in terminology to be ignored. One doctor might use term X, and then read a report with term Y. But based on context clues from the surrounding text and medical information, the doctor should have little challenge understanding term Y. This ability to draw meaning from context is fairly easy and normal for humans to do; and something we do unknowingly all the time. Computer Science has a field entirely focused on what humans do with context in text, Natural Language Processing. Currently, processing free text is a hard problem. If medical terminology is not standardized, computers will have to determine meaning from context for unknown terms or similar terms. Given that there are a large number of ways to describe many medical conditions, each of these methods will either need to be mapped together as the same meaning, or translated into the standardized term upon entry. If the medical terms are standardized, either in use or at point of entry (physician or nurse entering them into the computer terminal) then computer systems can avoid the natural language processing hard problems. If the terms are standardized, the data can also be queried more easily. If the terms and medical information are written in free text, then querying it is considerably more difficult. Even using latent semantic analysis you can still miss out on the true meaning of the medical data. And if the goal of the system is to possibly help in diagnosis, then easily query-able data is much more useful.

Question 3:

Based on the discussion of coding schemes for representing medical information, discuss three challenges you foresee in attempting to construct a standardized medical terminology to be used in hospitals, physicians' offices, and research institutions throughout the United States.

- 1) Coding schemes are currently developed by the users in specialties, versus medical institutions in a standard method. This is addressed in other fields, via standards organizations such as the IEEE. This source dependent attempt at standardizations is a very important issue. It's entirely likely that there will be variances in terminology between research institutions and hospitals, as well as specific departments within a hospital.
- 2) Ignoring egos that start arguments over whose terminology is more correct or precise; there are actual issues of standardizing precision in terminologies. Most medical information that is not a specific disease or disorder involves a certain amount of "fuzzy" data. This data can be how a person feels, or how severe the pain is. Standardizing how a cough hurts in one case from another is an intractable task.
- 3) Say you could standardize the terms with precision; you would then need to get the standard in use by every doctor and institution for it to be worth the effort. This presents a rather complicated task of getting all physicians to agree to the system. Then the insurance companies would have to agree and then the rates would have to agree based on an exact terminology and coding. This leads to an entirely fun issue pertaining to billing. If someone was sick, but your terminology said they were X sick instead of Y sick they might not get the treatment covered. This could add complications to physicians' discretion in treatment decisions.

Question 4:

How would medical practice change if nonphysicians were to collect all medical data?

If all medical data was collected from nonphysician humans than it would likely be not carry as much validity in diagnosing issues as data collected via trained professionals. Simultaneously, nonphysicians could mean computers and electronic monitoring systems. If there was a device collecting personal health information, temperatures, etc, then it would likely be tested as well as a physician for accuracy. However, the raw data would have no meaning or immediate use. It would have to be reviewed by either an intelligent computer system, or more likely by a trained physician. The medical practice would likely shift to a more proactive focus. In more recent years medicine has started focusing on managed care, whereby a patient is not only seen when they're sick. This proactive view towards health helps in prevention. A lot of this prevention can be done via sensors and humans collecting data; monitoring your temperature, and pathogens in the system. How often you feel ill, etc. It doesn't take a physician to collect this information. Therefore the proactive shift would also relieve some burden on physicians for data collection. Also, it would streamline efforts in that the machines or humans might pick up on an irregularity and not need to see a physician because they have enough data to enter into a machine to determine probable causes, etc. In summary, doctors would spend less time seeing patients who think they're sick when they may not be; but also doctors may start seeing trends from all the collected data. Especially if the data was automatically transmitted, collected and processed.

On the other hand, I'm torn. However, there is an error in the question. Nonphysicians likely cannot collect all medical data. Provided techs aren't physicians. By techs, I'm referring to lab techs, such as radiology technicians. A primary part of a doctor's job is observations; there would be a big whole if all medical data was collected via non-physicians. A doctor visit is not only about what the patient is observing and feeling, but what the doctor objectively observes about the patient. And this would be lost if ALL medical data was collected by nonphysicians. That leaves me undecided on how the medical practice would change. By strict definition, I believe the medical practice would change for the worse. However, as I previously explained, if not all data, but most data was collected by non-physicians than the system could improve.