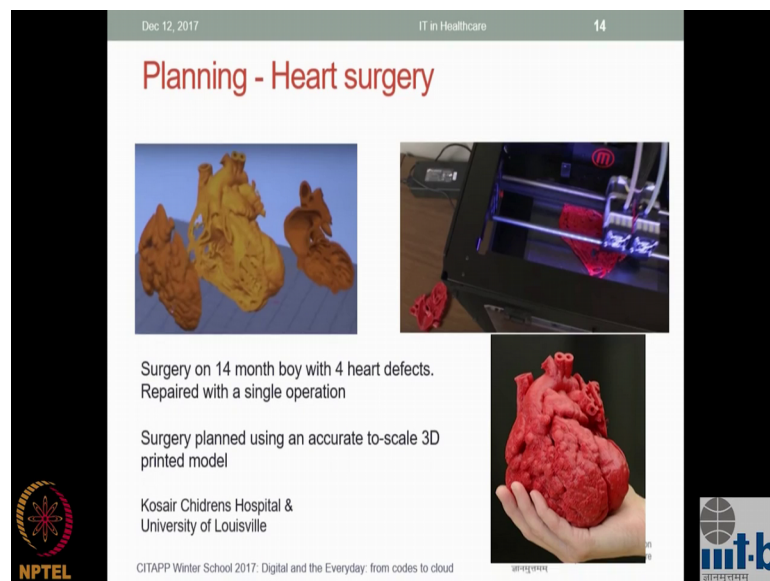**Digital And The Everyday: From Codes To Cloud**
Prof. T K Srikanth
Department of Multidisciplinary
International Institute of Information Technology, Bangalore

Lecture – 13
Promises and Challenges of e-Health Part 02

Just to see where this is heading, so there is lots of work and lots of interesting things happening in the space right. So, if you take the visualization or visual data to the next step, now people now we are looking at how 3D printing can be used in medicine. One of the most exciting areas is surgery planning where while in the earlier screen when we saw looks things like MRI that can be visualized on the screen, it is still a virtual image and it is still on a flat screen; a doctor would get a much better perception of the problem they could hold the problem in their hand before they did surgery right.

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So, the approach the three d printing is taking us can we take the same MRI type data and actually print out a physical model, which the doctors can now play around with to say what does the condition really look like, how should I approach surgery what is the best direction of access, what are the other organs that might or might not get affected and so, on. So, this is now real it s not any more rough fiction there are hospitals in India that are using this quite regularly, it is not very difficult technology there is some technology to be done. But where it is become very helpful is in treating I would say

somewhat abnormal conditions especially with young children, where every case is almost different the reason they come to the hospital is there is some particular abnormality that needs to be looked at, and it would not fit any standard textbook that you have.

So, rather the doctor starting the surgery and then trying to figure out what is really going on, they can do a lot of pre work and hopefully reduce surgery time improve the kind reduce the kind of cuts there to make improve chances of survival success and so on. So, this is one end of where we are going; so, but know again healthcare data has been used a long time to understand you know health conditions better apart from individual data.

So, the other thing that is very important is to look at macro data aggregate data, and say how can we get useful information out of it. And I thought you know you lose one use one of these as the, this is probably one is a classic example. So, there is anyone familiar with this London Cholera outbreak can heard of.

Student: Sir John Snow.

Yes exactly. So, the story I mean this happened 170 years back right. So, Cholera at that time was the causes of Cholera were not known. In fact, it was strongly held it was because of bad air or something like that, and there is lots of debates about it. In the 1850s London had a serious outbreak of cholera, thousands of people died IDo not unfortunately remember the exact number, and you know there the public health system was struggling with this, and basically people who are just dying and there was no idea of what was causing it and therefore, how this could be stopped.

So, along came this person john snow who I think was an architect and a physician type of person, who said let us analyze this data in a more systematic way, and what he did is basically took a map of London and on that marked all the locations of all the people Who had died from Cholera.

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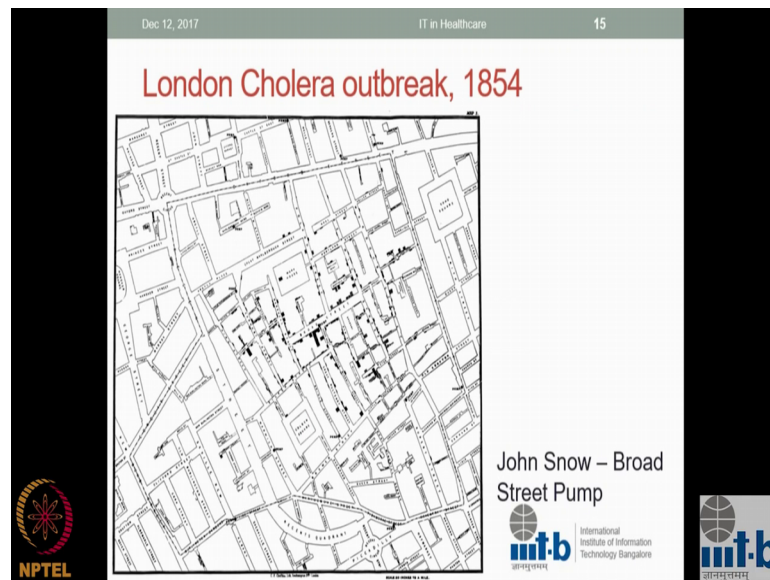
Luckily they had public record here to just go to every hospital, pick the thing get their address and start marking it down. And then he had this intuition that, this were more than probably intuition that this was not because of just bad air it was because of contaminated water. So, at that time the source of water was hand pumps public pumps. So, what he did is he also mapped where the pumps were there are the little circles you can see here and there and he started seeing clusters of data and so, for example, that particular location was where there was the highest death and if you look at it.

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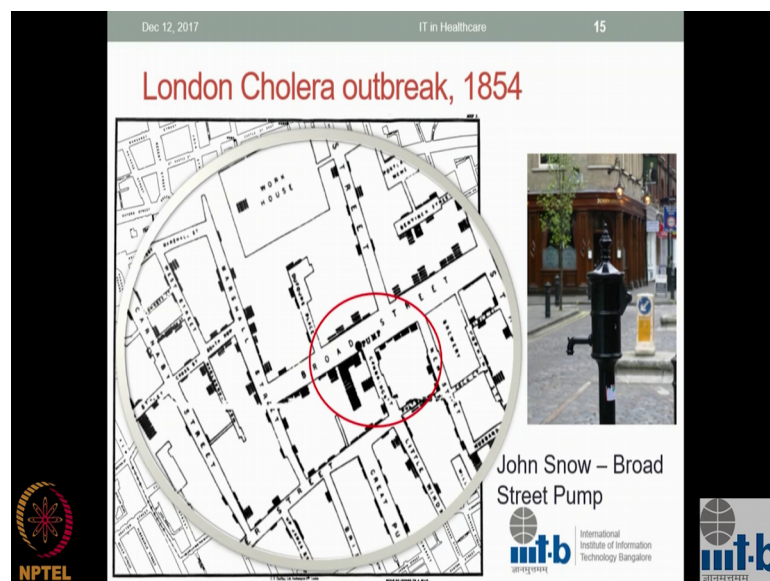
He said that here is the pump and here are the people, and because it is a hand pump that is why you had to go for water you would go to the pump closest to you logically right.

So, all he had to do was do kind of find clusters of people around pumps, and a found was a very good correlation he was able to show that the number of deaths were very high around certain pumps. So, then he went and studied those pumps, tested the water in the pumps and found that it had been contaminated by sewage essentially, because at that time they had only soak pits as there was no sewage system in London at that time.

So, he was able to establish that contaminated water contaminated by human waste, was the cause of Cholera. And actually took a long 20 30 years for this to get accepted because partly probably you know the corporation did not want to accept that this was a problem and. In fact, that pump is still standing there as a testament to that, and incidentally the first action of the municipal corporation was to remove the handles of all the pumps that were contaminated right there is something wrong in the water let us not use it.

But he persisted with that was able to convince people about this and it led to the formation of the sewage system in London itself and you know it is completely changed urban life. So, this came from a methodical study of public data this is and so, John Snow is known as the father of epidemiology, he started this whole field of how do we look at aggregate data and study epidemics and growth and spread of epidemics. So, this is a great example of how data can be used and can help, and you know now it is done very standardly whether you look at Zika virus or Ebola or any other newer things it is all about tracking down patients and any but.

Student: (Refer Time: 05:44)

And any you know what could be the possible transfer points we also; obviously, now 150 years later, we have standards pressure analysis tools to do that. So, the same thing could be done by.

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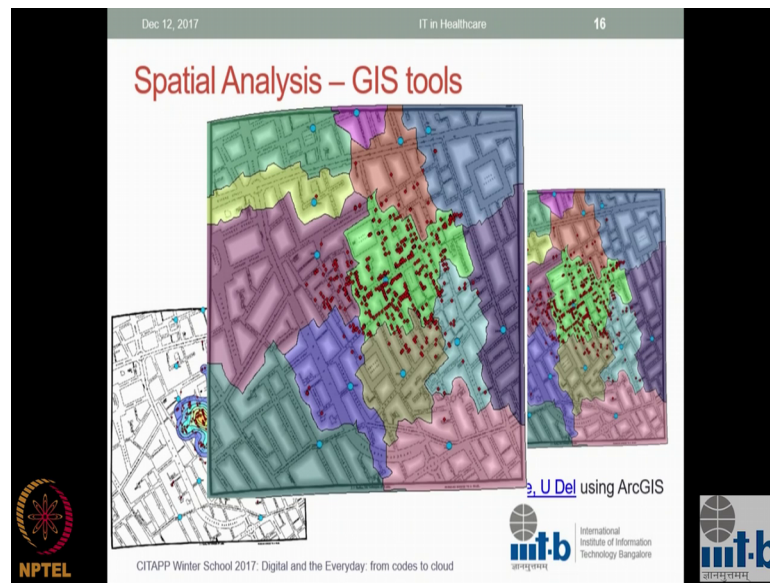
You know this clearly tells us where the concentrations are this shows us where the, you know increased concentrations and so on and so, now, it is fairly standard for in epidemic analysis epidemiology to take aggregate data and try to find patterns out of it visually. So, that is the. So, these are all been in a different ways in which data has been used in healthcare is being used in healthcare I should say, at a from a macro level to an individual patients level down to very fine data about from MRI s or b p monitor.

So, now you have ambulatory devices. So, you can get minute by minute data about your blood sugar or blood pressure or anything over days, and you can do very effective analysis and treatment, it s no longer just a random check or a symptomatic check. So, this given so much data, it is clearly a good candidate for looking at algorithms that can help us manage all this data. Data is there in many forms it is becoming very difficult for an individual or small group to actually analyze all this data, because of the variety and volume of data and it seems to be amenable to machine learning type of algorithms sorry first of all we started the image and signal processing for sure, how do I take ECG data and from that figure out the possible infractions that are happening.

Now,. So, these kinds of algorithms are coming into play heavily in radiology pathology. So, how can. So, looking at a slide under the microscope is really, an image crossing problem at some level I mean a brain does it very well builds an intuition and experience and all that, but at the end of the day it is finding patterns in a particular slide. So, pathology, radiology type of things which are innately image processing oriented seem to be good candidates for image processing algorithms and there is been tremendous progress in that.

So, you familiar with IBM Watson as an example, which digests all the information that is fed to it about cancer research cancer treatment effectiveness of treatments and so on and for a given patient is able to give you suggestions with probability essentially, saying this approach is the highest probable this has 80 percent chance success this has 60 percent chance success and so on.

Presumably give you a very precise recommendations, at this point they are still recommendations because even though even we do not have enough data to know if that is the right way of doing it Google yeah.

Student: (Refer Time: 08:34) question in IBM Watson (Refer Time: 08:36) does this famous u sketch that all could (Refer Time: 08:38) if you have to take you likely to get up a 100 tack with an extra with or. So, whatever nature is go to the nearest hospital then. So, there was one case (Refer Time: 08:53) then the other case, where if the person had

repeated something cough fever some other symptoms then IBM (Refer Time: 09:01) do not want to put in that the actually got a heart attack. So, how do you.

Yeah these are very much incomplete that way.

Student: (Refer Time: 09:08) may you can like kind of suspended the whole.

Yeah exactly. so, I mean there is no they are not yet at the level of maturity where they can be they can replace the doctors know where that right, they are still recommendation systems and our decision support systems and for a near future we should expect that doctors will still take the call. So, but at the same time the benefits of this seem to be very good because they can see patterns in data which humans may not have the time to do. So, one many there is you know many doctors are suggesting that this should be the way medicine is done, that you have access to a software algorithm whatever that is going to give you there is going to help your decision making and you take the call.

So, if you think about it increasingly doctors especially specialists are going to spend less an less time with you because of the crush on you know the patient load that they have. They come out of a surgery spend two minutes talk with a next patient go back to the next surgery and so on. It is unrealistic to expect that they will make a completely objective deterministic this one, while a machine could point out errors could point out.

So, as a support system it is very valuable and that is likely the way it will continue for some time. One of the big challenges and is that it s a black box right. So, Google now has this they are applying their deep mind alphago type technology to, pathology sample this one and they claim that they can come up with the diagnosis better than most pathologists ok.

But pathologists are not convinced, because they want to understand what led to that determination. You talk to many doctors who are still very skeptical when they like the idea that it can help, but they want to know why what because especially the confirmation of diagnosis and the treatment plan depend a lot on what are the chain of reasoning that went there and till our AI and ML systems can evolve to that we are still in it is going to be a support system, but it s moving at a rapid pace. So, we should expect realistically then in five years or less I mean Google's latest alpha chess thing shows that

it does not take very long time to figure out these things, if you can find the right problem to attack.

So, let us say roughly in a 5 to 10 year time frame, we should expect that algorithm based decision support systems are going to be very important in the healthcare thing. For that you need to have reliable data that is curated, tested and you know accessible for these algorithms to work. And now we move from diagnosis to predictor systems more on the lines of what you are saying if certain pattern of events have been detected can that predict say the fact that this person will need to be taken to an ICU or that this person can be discharged and will not need a readmission, if they follow the protocol right. So, we can you can use predictive systems to identify possible problems, but still you know in a very still in a very early stage.

But this is again one of the promises that we are looking at, and it will come with uncertainty for some time.

Student: (Refer Time: 12:15)

One of the big benefits that we can think about is while we are talking about a lot of these in hospitals in high end clinics and so on, it has potential big impact in public health and I will just uses in uses now and then come back to it later. So, one of the big challenges we have in public health is, the sheer skewed ratio of doctors to patients; the number of doctor there is roughly one hospital per hundred-thousand people in India roughly and if they all have to come to the major and these includes all kinds of hospitals.

So, if you all the patients have to come to the major hospitals just a processing of this is a huge load on the system, there are very few specialists the pyramid is very sharp and can we use technologies like this to improve the screening process and there are lots of company startups especially working in this space; for instance can be do eyes screening in the field apply intelligent algorithms to it, and have only the critical or the important cases actually be referred up and most can be treated in the field.

So, there are people doing this for eye for inner ear and various other various other kinds of diseases, it relies on the fact that we can capture data remotely using the smartphones or some low cost devices; do some computation on the data typically images or other

data come up with a and come up with a diagnosis, they come up with a categorization and decide that only this category of people actually need to see a specialist and others can be treated in the field.

If that is successfully done, it could reduce it could have two big impacts one has reduced the load on the specialist. So, they can treat the serious cases better and more importantly reduce a need for patients to make trips to the main hospitals, which is one of the biggest burdens on the system right now.

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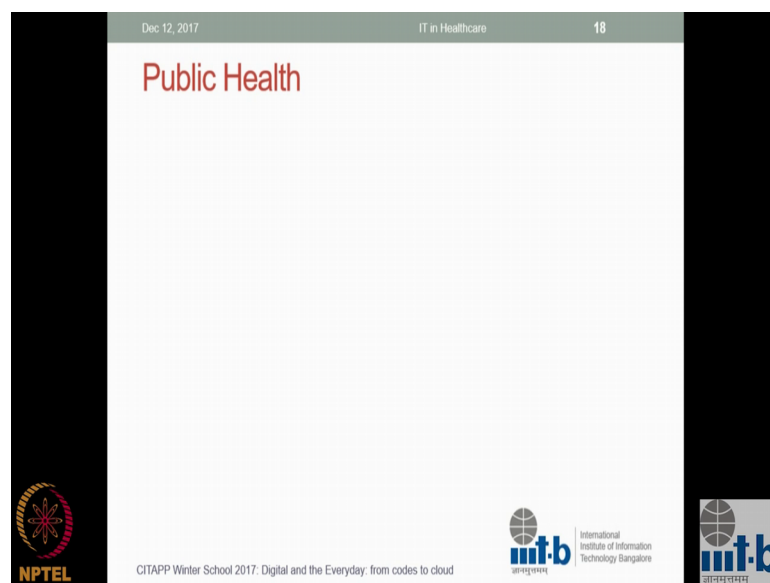
So, this has a big impact potentially in the public health system. So, maybe that is a good way to say. So, what is public health or what are the issues in public health.

Student: Inspection resource.

Yeah come to the problems and lots of problems yeah. So, basically we are talking about the health services that the government runs to cater to and it is open to anybody to. So, in India we have a very particular flavor of it, you can say the UK systems and other kind of public health because the universal health coverage there and so on.

So, we will focus on the India version of public health, which is primarily how do we have hospital hierarchy of a medical facility starting with sub centers, primary health centers community health centers, taluka and district hospitals, urban hospitals, tertiary care hospitals, super specialties and so on all under the government health umbrella, the

government funds these, managers programs in these and you know tries to ensure the overall health of the population, this will improve health indicators of the population. The a little bit of status check is probably important.

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If you look at the UN sustainable goals health indicators are very important, and if you look at a couple of them. So, the maternal mortality and the under five motor the infant mortality, India is not doing I just blow up those.

So, we have a maternal mortality of 174 plus per hundred thousand live births, and infant mortality about 47 birth of these numbers about two years old is improved a little bit from there, it is far from where recommended standards are or what you know the more advanced countries and some of the not so, quote developed countries are in.

So, we are lagging behind by health indicators, we are we have large government programs running it, but the impact is still not there, there are studies that indicate that some improvement has happened in some areas, but long way from the numbers we need to get; we probably need to look at how mortality rate of close to 50 which I think it is about in some places it is less, how can that come to 3 and 4 and things that is the goal.

So, there is still a long way to go in terms of bring the bringing these numbers to a more acceptable level, we should not be happy with these numbers or should not accept that thing. There is a goals that have been set up for 20, 20, 20, 25 where these are supposed

to be brought down significantly and you know the ministry of health is tracking these and doing something.

So, if you take this as a macro problem that in some sense these are just two indicator there many more such indicators.

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So, we have there is an expectation that IT can help and what the government and lots of other players are betting on it is spending a lot of time and money on this, and it is expected that with the proper use of IT, we can improve on many of these things which will all contribute to the health indicators.

Most fundamentally the problem that we struggle with this access to healthcare availability affordability of healthcare and quality healthcare; this has to do with numbers the availability is very low, because the patient doctor population is very poor, they are not necessarily easily to access either for physical other reasons and you can always come to a city, but the cost is very high. So, that is not a good answer, and even if you do get access can we be sure about the quality of health care.

So, you can and; obviously, we want to reduce health indicators that is probably the most important, but you also want to improve the quality of life for people at least in their interaction of healthcare, can we reduce waiting times, can we you know right now if they have to find access to medicine medical care in a high end hospital whole family,

typically travels to that place spends a few days there and you know it is a very painful and expensive process.

So, can we push more of this out into the places where the patients are, can technology help them we have to manage multiple reason. So, there is it is a reality that there is a severe shortage of physicians, even if the government cranks up and in suddenly expands the number of super specialties, there is still a long way from. Right now we produce single digit numbers of specialists every year 20 would be large, and we are talking about a population of 1.2 billions.

So, the scale is just huge. So, we have to. So, one of the promises of IT which many health professionals say is that, improve help improve the reach of physicians can the same physician now address a much larger population through the use of appropriate take and this is where telemedicine is playing the potentially big role.

And then how can we improve the efficiency of a lot of money and effort is being spent is it doing the right thing, is it producing the results. So, how do we track it how do we monitor it and so on. So, this is the other place that IT is expected to help, and you know in all the challenges of India of large geographic distances the different entities that are providing health service and so on.

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So, if you take stock of where we are, IT has been used in public health, but it is impact has been minimal at this point. It is not really you know if you if you should look at public health in terms of large numbers are out there, there is very little IT actually being used a lot of the earlier discussions we said are happening in private or in urban hospitals maybe some of the high end the government hospitals, but definitely not in the large. So, it is actually a problem it is been going on for a while people have been trying, but many other have not got past the stage of pilots or local implementation. So, typically there are initiative that will try to do some IT based solution for one particular problem or issue or whatever and that runs in one state for a while and does not sustain after that.

So, the government has been putting greater emphasis on this, and the national health mission which has been around 10 years or something has put a lot of focus, at least on gathering health data and putting programs in place for specific conditions. So, there is an HMIS system that is used across many health care government healthcare programs and so, the track and it is the first phase on many of these is to how do I monitor what is going on, how do I make sure things are happening are enough people being are enough visits happening is, enough vaccinations happening, are pregnant women given the right you know sequence of a booster shots I mean medications and so on.

And the first phase of most of these has been just helping this and traditionally the first traditionally these were done by just paper or excel based reporting, and now that has slowly gone online. So, now, you have online health reporting systems and to that extent they have been successful in the sense there is a structured way in which data is available, that is available data for policy and planning and other macro. If I look at these problems you can abstract it away from healthcare and say these are known problems because IT is there to I mean enough IT solutions do that right it does not work.

So, while for many of these the solutions seem to be obvious, the initial attempts are the obvious solutions have not worked, and their work and not work because of some of that issues that we will discuss right so, but at the same time we have to live with the fact that there is a shortage of doctors, I mean that is a separate problem to improve capacity, but if you do an also the numbers you have to get 100 x the time.

So, doctors that you have that is not feasible in a near timeframe. So, what we can look at is how can these systems make those doctors more effective at many different ways, can

they get better data. So, they can do their decisions better, can they track what they are doing better can they get assistive systems that will help them how can a MBBS doctor in the field get access to enough better decision making system so, that they can treat the patient better.

So, we can improve one part of it is how do we improve the effectiveness of the doctors or there. So, the solution to this might be to look at public health programs as an example and to target an intervention of IT, which is what is largely happening. How do you take some part of the public health program and improve it is functioning, and that will have some impact some improvement it is probably at this point it is still limited, and maybe we will look at some of the challenges in a in a minute right.

So, just; so, on the what is being done there is now also an attempt to start capped. So, the reporting systems are purely reporting they are more like monitoring the program, but there is increasing effort to put patient data also in various centralized or decentralized databases. So, NIC has a e hospital system, which is now mandated at major central government hospitals and they are starting, to use it still using in a very limited way, but in 5 to 10 years maybe that will be better right. There are many issues with this which touch on some other issues for instance how do you identify a patient.

So, patient can go to any hospital in any state any level of hospital, how do you identify a patient.

Student: (Refer Time: 23:30)

no person walks in and says I am so and so, I want to now connect that to any other data about that patient that might already be in the database somewhere. So, there is a china

Student: Unique ID.

Unique ID. So, what kind of unique IDs

Student: Like Adhar.

Like Adhar right. So, we will open up will get back that is what is happening. So, so the first concept that came in is at least at some level we will have unique IDs, and you will

use some mechanism to come up with a unique ID right. Now the next attempt that is being done right now is Adhar will be that unique ID.

So, hospital systems especially in the government framework are using that to identify the patient, that while that works that; obviously, opens up other issues especially when we talk about privacy of medical data today the ID is unique to a hospital. So, the way hospitals used to do it historically was every visit was a new ID effectively, your duration of stay or encounter was an ID.

Now, at least it is you for your repeat visit you will get back the same ID. So, at least continuity of information within the hospital system is there correct. So, that is the expectation and that is a goal that has been set up, we have to see how long it takes for that to come there are some practical issues with that going back to privacy and confidentiality and security and things like that. So, how do you share data in a way that will provide this, because right now because doctors are not sure how about how the data will be save used they are restricting the data they are put there the.

Student: (Refer Time: 24:57)

Yes in India we have not evolved those both policies practices rules yet, there is a lot of discomfort among doctors to shared data this is comfort among hospitals. So, its

Student: (Refer Time: 25:12) but it is been it is been achieved in other uses of (Refer Time: 25:14)

Ah not in the even there, there are restrictions on what kind of data can be accessed yes.

Student: (Refer Time: 25:20)

So, that is where it is going. So, the idea of this unique ID is to get there, it will probably take a couple of iterations to get there because, but clearly we need to enable continuity of care and for that there is no way around it, there has to be a way to get data from anywhere and make it all integrated. There the government is there are different challenges, there you have different hospitals. So, some are run by the central government or some are run by the state government stay health as a administration of health is a state subject.

So, each state has it is own way of doing things there is no each program is a vertical silo that cuts across things. So, each of them has their own way of doing it. So, there is not been enough attempt to integrate this, I am happy if my program can do better I will worry about integration later has been the common thing. So, now, that is beginning to change, but we have to look at it. So, the use cases in a public health are even more challenging than what we might have thought in terms of continuity of care; and classic example that is used to test out any solution that comes up is migrant workers as an example. By definition they are mobile they are moving around they can move anywhere.

So, while the government has a very good program for maternity maternal care the mother and child the programs and all that, it still breaks down somewhat across state and other boundaries. So, this unique ID is attempt to move fix that, but it is still not fully there. So, the classic example that we you should think about as use cases solve these are, imagine a migrant construction worker the woman who is pregnant in she is a construction worker and she is pregnant.

So, she goes to the local PHC and go starts her treatment. And the government has and the program has very decent and her checks diagnosis and recommendations that go on. Almost certainly she will go back to her hometown for the actual delivery and that could be in a different state, and at that point if that particular piece of paper that she is carrying does not get properly identified as I said effectively that history is lost.

So, in some sense that doctor starts all over again the history is the oral history that this patient may be able to translate may be able to articulate, and then that gets captured; treatment happens and then let us say the child is born and the child is reasonably healthy and so on, at some point she will move back to some other place probably right.

So, she is constantly moving and its so, critical that and we are talking about infant mortality for up to five years. So, at least for five to six years this information has to be tracked, and it she is definitely going to have many different touch points in that thing. And right now there is no system that consistently will be able to handle all this information, while the architectural framework and theory are there in practice it is not yet evolved.

So, these are practical problems that are still need to be addressed. So, why is not happening. Since we know all the solutions and we technologists believe that these I mean many people we talk to are including myself these are easy things to do it. So, it is done why are we struggling. So, what might be some of the reasons why it is not got any better than this?

Student: (Refer Time: 28:29) regulate regulatory in school (Refer Time: 28:30)

There is no regulation is school right to do what you want.

Student: Too many stakeholders.

Too many stakeholders yes.

Student: (Refer Time: 28:37) data.

Reluctance of few yeah.

Student: (Refer Time: 28:38) paid for all these.

Government what is the problem money is not issue.

Student: Lack of resource.

Lack of.

Student: Resources.

What kind of resources?

Student: (Refer Time: 28:49) technology.

Technology in India they are supposed to be an IT superpower right.

Student: (Refer Time: 28:55) when compare to (Refer Time: 28:56)

No that I think lack of I mean yeah you are right at I mean lack of the appropriate set of resources, where it is actually a interdisciplinary thing, you have to have doctors technologies all sit together and frame from you and that is not happening enough.

Student: (Refer Time: 29:14) resource for example, when two (Refer Time: 29:16) administrated for all the citizen, that is all there is not a problem, but then government cannot do because lack of resources.

Its lack of priority or not lack of resource the flu was identified as a priority program, it would have got the attention it is not right. Now they are much more serious disease burdens to deal with.