I'll now hand over to Naveed Sattar who's going to take us beyond genotyping into the mysteries of other kinds of omic assays. Naveed, thank you.

Okay, thank you Rory. You know when UK Biobank is diverse when it includes Glaswegians, so I'm just kidding, because this is Glasgow that, as you know all, the sun always shines in Glasgow, unlike Edinburgh, Cathie! I'm just kidding! Right, that's enough [laughs], okay. So, the importance of wider routine assays, and actually you all know this, why do we biomarkers? Well we need it for diagnosis of many diseases, haemoglobin A1 for diabetes, or glucose or troponin levels for MI, for example, or liver function tests for things like fatty liver disease and we have sort of risk scores. We have risk scores for cardiovascular disease which is decent, but it could be improved. We have risk scores for diabetes which is excellent, doesn't require any biomarkers actually, not any blood-based biomarkers. We would like better risk scores for things like dementia, NASH, so those are the kind of things we want to move forward to.

We also need biomarkers obviously too, particularly linked to genetics, and you're going to probably hear a bit more about that, to identify causal pathways and, of course, if there are biomarkers that help us determine who will or will not better respond to particular therapy, that that also is an advantage, so that's the kind of reasons and you all know this, it's not rocket science. So, this is probably, if you haven't seen this, these are the biomarkers that are now due out in the next couple of months, Naomi, I would say, yes. So, they're all measured, they're with Naomi on her desk, not all [laughs], not physically, so all of these on all 500,000 participants are due out in the next couple of months. So, they're markers in the liver, which the common liver function test we measure in the hospital every day, kidney function measures including some novel things like cystatin C which isn't that common in routine practice, but it's certainly got some credibility. Bone and joint disease, diabetes, haemoglobin A1 and glucose. Cardiovascular, so it's the lipids, there's a nice paper on [?LP(a) 0:02:06.1] that's just come out which Adam and I contributed to which makes this kind of interesting as well, and also linked to cancer. But these are not just cancer linked, you know, sex hormones, IFG-1, SHBG may be linked to a variety of different diseases, but they're all coming out and you can see the plethora of questions that you may be able to ask once they come out linked to phenotype, other aspects and to outcomes.

The two that we wanted to get in the first place which were not there were the cardiac biomarkers, NT-proBNP, troponin and I'm leading an application which we hope will go in September, but there's some logistics to try and measure these also on all 500,000. I think that it will be a fantastic addition to the platform. I'll just give you one data slide. This is a paper led by Emanuele Di Angelantonio, and John Danesh, and myself and colleagues, with multiple cohorts, but comparing top third, bottom third for cardiovascular outcomes and using HDL as kind of the benchmark. So, HDL certainly improves coronary heart disease, but if

you segue that into fatal/non-fatal, well NT-proBNP is a stronger marker for fatal disease than is HDL. Whereas HDL is better for non-fatal disease and of course NT-proBNP is a much stronger marker for heart failure, which you would all recognise and for many of the stroke outcomes because it has links to hypertension. So, it's something we want to also add and we're working towards that.

Infectious diseases, the slides that Naomi sent me. There's an application that's gone in based on lots of pilot work. Pick your favourite pathogen, I'm not going to go through them, but the application has gone into, I think I'll show you, it's on the next slide, but a whole range of pathogens hopefully will be measured in the next few years. Yes, here it is. So, the method is based on Luminex, bespoke panel, small sample volume, automatable panel, it's based on a collaboration with a German cancer research centre and there's been a validation of the assays with the pilots done on 10,000 UK Biobank samples. The timeline, if it gets funded, it's three years to measure all half a million people, again, in the UK laboratory, subject to particular funding, so that would also be a fantastic addition to the UK Biobank.

The last two slides then, and then of course we come to the omics and we're going to hear three talks covering some of these aspects, so there's many more platforms, as you know, out there that measure a whole range of the kind of biological flow of data and information. Epigenomics we're going hear, we're going to hear about, I think, proteomics and metabolomics or some aspects of these, and then once you've had those three talks I'll invite the speakers up, we can have some questions from you guys in terms of particular aspects to this as well.

So, summary, biomarkers galore, more opportunities but huge challenges ahead and the challenges are things like, for the UKB and all of us, is quality control, getting good robust measurements, but soon you're going to have lots of established essays coming. They've submitted applications, infectious agents, which I've told you about. There's an application being developed in cardiac biomarkers and then there is opportunity for new assays which we're looking at and the key thing, there's wide choice. What we're interested in is robustness, coverage, scientific value and value for money; those are the key aspects for us. Okay, I'll stop there and we'll move on to the next talk, thank you very much [applause].

[END OF TRANSCRIPT]