Personal Genomic Information: A Consumer's Perspective
David Ewing Duncan

MS. AU: Our next speaker is David Ewing Duncan, and Mr. Duncan is the director of the Center for Life Science Policy and visiting researcher at the Graduate School of Journalism at the University of California at Berkeley. He is an award-winning, best-selling author of six books and numerous essays, articles, and short stories, and a television, radio, and film producer and correspondent.

Mr. Duncan is also the founder and editorial director of the Bioagenda Institute, which is an independent, nonprofit program of events and educational initiatives that discusses and analyzes critical issues in life sciences.

Mr. Duncan will be presenting his perspective and experience in utilizing multiple personal genome services. Mr. Duncan will be presenting for about 20 minutes, and then the Committee will have about 10 minutes for questions and answers again.

Thank you, Mr. Duncan.

MR. DUNCAN: I want to thank the Committee for inviting me. Good morning. I did want to say briefly, after the parade here thanking Francis Collins for his service for many years and as a journalist, Francis is always accessible. He has always been very clear in explaining things. We always deeply appreciate that. So, thank you very much, Francis, for all of that over the years, the journey that you and I have both had and that you have had with other journalists.

I have a lot to cover here in 20 minutes. I'm here this morning as one consumer, a party of one, a subset of one, who has been tested by all of the major genomic testing services that have been discussed in these meetings and actually quite a bit more.

I'm not your average consumer, I have to hastily add. I am a journalist covering biotechnology and an author that is writing a book called Experimental Man: What One Man's Body Reveals about His Future, Your Health, and Our Toxic World. That was my publisher's subtitle. You can tell me what you think after my presentation.

For the book I'm having not only my genes tested but also environmental impacts on my body along with tests on my brain, organs, blood cells, microbes, proteomes, and other assorted -omes. I will add here that this is all non-invasive, which is part of the point of these tests.

I'm also the director of a new program at the University of California at Berkeley called the Center for Life Science Policy, as was mentioned. We are launching this fall, and there will be a lot more information about this coming out over the next few months, for those who are interested.

In conjunction with my book, the Center for Life Science Policy is developing the Experimental Man Project, which is an educational effort that includes a website and other activities.

The experiment, by the way, that I'm running is for one man to take and analyze a wide array of new tests that aim to forecast the future health outcomes of a healthy individual. This is a rather radical concept which I will talk about here and there in the presentation.

I started this project with a visit to my physician, who declared me to be a healthy white male, 50 years old. I always love that medical terminology. Occasionally one's name is mentioned in there when they are describing you.

I also come from a mostly healthy family that lives a long time, some of us actually over 90 years old, a couple even over 100. So we don't have a lot of heritable diseases floating around that are obvious, anyway.

As we enter this brave new world of personalized medicine, I want to emphasize what we are talking about. This has been mentioned over and over again, but it is worth mentioning again in a consumer context. In the past we have focused on the ill and the unhealthy mostly, since pretty much the beginning of human history. We face a future here that is a focus on the healthy individual, which is quite exciting, on prevention and improving health. Essentially, we are trying to predict the future in a way that hasn't been done before.

The Committee has asked me to address several questions, which are listed here. I'm going to summarize those in groups in the presentation here, the first one being expectations. "What were your reasons for pursuing personal genome services?"

I have already mentioned my primary purpose was really as a communicator and a journalist. I also have a natural curiosity about technology and information. I keep wondering if there will be a Pandora gene discovered one of these days, which I certainly am homozygote high risk for.

A distant third, really, for me anyway, was an insight to my future health. Coming from a healthy family and considering myself pretty much "impervious to disease," that was a distant third.

"What sort of information did you anticipate receiving from these services?" I actually had fairly low expectations of getting extremely useful information. The normal consumer I'm not sure would certainly have the access and information that I have as a journalist, so that is partly colored by the fact that I knew going into this that this is an early phase of the science.

I also probably deep down, when I really think about it, wanted confirmation that I am as well as I think I am. Yesterday we had a presentation from the Yankovich group about different categories of patients. I'm not sure exactly where I fit in, but I'm probably the one that likes to keep myself healthy and doesn't do it because I think I might get sick but because I like to be healthy. I don't think much about being sick, thankfully.

Also, I went into this with some expectations about what my family results might be. That was a different set of expectations because I was asking other people, members of my family, who were also tested, by the way -- my parents, my brother, and my daughter -- on some of these tests. It did make me pause a minute bringing my family into my experiment, but they very heartily agreed to go along with this.

The next set of questions are tests and results. This is going to be the bulk of the talk here. "What tests did you take? What were your results? Were there differences, overlapping results, et cetera?"

A baseline of the tests that I have taken. I have been tested on most of the major SNP array chips, some insertion/deletion information, some copy variants. I have also been tested for several dozen individual genes and coming in the next few months I'm hoping, anyway, to get my full genome sequence. We are working on that right now. By the way, that is plenty of information

even without the full genome, as you will see here. Trying to figure out what exactly one makes of the full genome is another question.

I have been tested by many companies and academic labs, nonprofits. I was one of the few people around 2001, which is of course the jurassic age for genomic testing, that actually had several hundred markers tested for a Wired story that I wrote back in 2001. That was even before Craig Venter announced that he had been tested by his own company. So, very early on getting some results.

I do want to emphasize that some of these results and this information has been around for a while, so although we have been having this flurry of association studies coming out this information and its attempted application on individuals and consumers has been around for a while.

The costs of all of my tests. If you add up all of these numbers, my individual test was around $16,000. If you add my family in, it is about $20,000. I'm gratified that many of the companies and labs did this pro bono or some of the costs were covered by publications that I was writing for.

By the way, if I get my full genome sequence, it will be quite a bit more money, at least $100,000, perhaps much more.

Participants. As I mentioned, my mother and father, who are both in their mid 70s and very healthy; my brother, who is 48; and my daughter, who is 19, is a biology major at St. Andrews in Scotland and basically made me test her. I was a little reluctant to bring my daughter into this. She is over the minority age. It was her decision and she insisted, and there we have it.

I'm going to focus on three companies primarily that have been discussed a lot, what they call the Big Three, although I think DNA Direct should also be on there as maybe the Big Four. You will hear details about these companies and can read about them in the packet that was given. From a consumer point of view, there are two or three differences in each of the companies that are worth noting.

Navigenics focuses primarily on diseases. They do not do ancestry or some other traits of that sort. They do offer counseling, and they are more expensive than the other two sites, at $2,500.

These images, by the way, are my results. You can't really see them in detail, but you will get to see them in a minute.

deCODEme offers a few more diseases. They also have ancestry and other attributes. deCODE we have to say, too, is also a publicly traded company. It has been around for over a decade. They do drug discovery. Their scientists have come up with at least some of the major studies that all of the sites use in the association studies. So they have some scientists actually working in their back shop as well as having a website.

At the moment they offer no counseling, and they come in at $1,000 or so.

23andMe is also at $1,000. 23andMe hits the jackpot for the larger number of traits that they feature. It is interesting that they have a rating system that they put into their large number of traits. They rate these traits whether they are preliminary or established. While there has been

some criticism of that rating system, how accurate it might be, I think that is heading in the right direction for consumers to try to understand which of these traits has the best science behind it.

Two other approaches I want to mention just quickly here, one of which you will hear from later. DNA Direct, which is one of the older online companies, offers only individual tests, primarily for those who have a predisposition in the family or some other reason for ordering a test.

I have had one test ordered from DNA Direct, and it was a different experience than the others because they do have a heavy counseling aspect to this. I talked to the counselor two or three times. Also, they have an extraordinarily rich site of information which includes pros and cons of testing. It actually tells you reasons why you shouldn't take the test as well as why you might want to take them.

The Coriell Institute is not represented here, although I would recommend that the Committee look into what the Coriell Institute is doing. There is a small blurb in the materials I was given about them. Their genome-wide testing website will be up in the next few months.

This is a nonprofit. I'm sure you all who are scientists know of them for producing tissues and storing cell lines. They are going to be testing for free on a Navigenics-style test with 15, 16, 17 diseases, about 10,000 to 100,000 people over the next several years. They have NIH funding and other grant money.

They are also doing something interesting for those who consider doctors to be less educated than perhaps they should for genetics. They are starting out by testing doctors in the Philadelphia area, where they are.

Now to the results. I'm going to give you results for three diseases for the three sites that I mentioned. The first two were rather randomly chosen: age-related macular degeneration, because it is an A and was at the top of the list on some of the sites. Being, as I said, a healthy person, I don't have many anecdotes or stories to tell about how this affected me because I came out, actually, pretty well on most of these.

But if you look over to the right-hand columns, and if you have a minute you can study this chart more thoroughly. I don't have time to go into all of the columns here. But the critical numbers and items for a consumer would be the ones in color there. This is a threat level color code, much like you would get in an airport, which I have added here just for convenience sake.

You can see in that age-related macular degeneration for the individual SNP risk factors that I have threat level colors that range from green, which are quite low risk, to red, which are high risk. The second-to-last column there on the right tells you which company gave me the result for which SNP.

By the way, there are a number of different SNPs here, as you notice, for the same disease. Different SNPs for the different sites as well.

On the far right are my lifetime or overall risk factors that the sites give. They list several SNPs, different risk factors for the SNPs, and then an overall risk factor.

The far right is the average risk, and this is interesting for a consumer, and a bit head-scratching. The average risk for the different sites are different. My risk factors are also a bit different. In

this case it is not a huge factor. I am low on all of them, which is really all I want to know, but it is worth noting that there is a bit of difference there among the results.

Another way to present the data here for diabetes type II, comparing the three sites. There are 19 different SNPs that I counted when I went online on these three sites a few days ago. They are changing a lot, so who knows, they may have changed by now. But, 19 different SNPs among the three sites for 15 different genes.

My range of results were yellow, 0.82, to 2.61, red. That was the only red, actually, out of the 19. My lifetime risks for the three sites were within shouting distance of each other, about 4 percent apart, which isn't bad.

The average of all the sites was around 25 percent for type II diabetes. I'm below that, which is also, as a consumer, really all I want to know. So that was good news.

It is worth noting that there were only four SNPs that overlapped on all three sites. Out of those four, two of them actually had different enough results that they raised an eyebrow for me, meaning that the same SNPs had different risk factors associated with them on at least two of the sites.

There are four additional SNPs that were on two out of the three sites. So there were overlaps of an additional four on two out of three. Then, 11 orphans that were just on one site only.

Is the data consistent. Basically, to summarize this slide, I would say within acceptable parameters for at least this consumer most of it was fairly consistent. The one area that was a little strange was to have all this variance of risk factors within a disease, all the way from green to red. In talking to the companies, they all correlate those and use them as modifiers to come up with that final score, but that is a little confusing to present such widely diverse results for people that don't really comprehend or understand how one would factor all that into a final score.

There was one exception, however, and that is my heart attack gene markers. I don't have heart disease in the family, but I did get what I considered somewhat confusing results for my heart attack gene markers on the three sites. On one site I have low risk, on one high, and one might say in the middle. For something like heart attack, this is probably not the most comforting results. Actually, for someone like me who wants to confirm that I'm healthy, it is not going to be useful information to have such variance in results.

Again, you can see my color-coding there, the range from yellow to orange to red. On the far right are these lifetime or overall risks. For deCODEme and Navigenics you have a spread from 42 percent decode risk factor for me, to 62 percent. The average is 49 percent, according to the sites. 23andMe uses a slightly different method, although it is worth noting that my risk factor is almost twice the average on the 23andMe site, although I think I noticed when I went on last night that that risk factor had slightly changed.

Why the different results. I do encourage you to, obviously, talk to the companies about this. But some of the information that I have gleaned as a reporter, and you can obviously see it even as a consumer, is that there are different SNPs and studies used, as I intimated, for the different diseases. There are different methods for determining risk for the different websites. You also have different methods for determining combined SNPs, as I have mentioned.

There is also a reliance on correlative SNPs, which I don't really have time to get into. That has to do with linkage disequilibrium and the fact that not everyone in a population actually shares correlative SNPs. In other words, sometimes you are homozygote, sometimes you are heterozygote, is my understanding of this.

Again, I am not a scientist. I should have said that at the top of this. These reflections are through a person who is trying to comprehend and understand this, and I hope I get it right but this is how it has been explained to me.

In the end, this heart attack result did leave me scratching my head, wondering what it all meant. I did, with later tests in the Experimental Man Project, find out that I did hit the mother load in a Mendelian sense of a lot of high-risk homozygote SNPs that indicate that I do have a higher than normal risk factor for heart disease. I will get into that in a second.

[As to] the three generation study with my family, I will just go over one result which was a bit surprising. We did find out that my father and my brother were heterozygote for Alzheimer's. I was sitting there one morning in San Francisco as the sun was coming up over the bay and turned on my computer and got these results back. That was a little disconcerting because, as a non-scientist, to see anything to do with Alzheimer's is a bit scary. We don't have that in my family, but I called a couple of experts right away. They reassured me that, actually, the heterozygote risk for this is fairly low. Homozygote is what you don't want.

I called my father, who is 76 years old, about to turn 77, and he shrugged and said, "Well, I have made it this far. I'm probably okay."

My brother, who is 48, equally shrugged. We come from Puritan stock from the Midwest and we just don't talk about these things very much. But he seemed to be unconcerned and hopefully that will continue.

I want to mention very quickly here the difference between a rare disease and a common disease for a consumer or for a patient. My brother does have a rare genetic disorder, which is osteogenesis imperfecta. It would have been fantastic to have had a test to know this early in his life. We went through a lot of turmoil within the family trying to figure this out.

I'm not sure, however, and I discussed this with my family, if we would want to find this out in a direct-to-consumer sort of process. It may be in the future that one doesn't even think about that, that is how you get the information. At the moment, my brother, anyway, would prefer to get this through a medical professional.

The sites at the moment that we are talking about don't offer rare diseases, probably for this reason. But it is worth thinking about.

Recreational and preliminary. I won't spend a lot of time here. Ancestry is fun. I encourage it for everybody. I don't have bitter taste. I seem to have a lower IQ by three points. I am at a substantially higher risk for heroin addiction, and I am going to live to be over 100 despite my substantially higher risk for heroin addiction.

[Laughter.]

MR. DUNCAN: The crush of data which has been mentioned by Teri and others is something also to think about here. We are talking about a very small number, although it seems like a large number because it has come so fast, of association studies.

From my Experimental Man Project, we are up in the upper hundreds now of markers, and many of these are for rare diseases and things that I would have no business really looking into normally but I'm trying to do everything for the Experimental Man Project. If I printed out my Excel chart at the moment, it would be about 24 feet long, and it is going to get much longer.

The final step here, or the final list of questions, are reactions and thoughts. "Did you alter your behavior in light of test results? If so, how?" I want to emphasize again that I am atypical here, both as a journalist and also having much deeper knowledge because I have been tested on many sites.

But the answer is that I did not really alter my behavior. I did have some subsequent tests, as I mentioned, which are not yet ready for consumers, algorithms by companies that do huge modeling which they factored in many, many things. I did find out that I have a higher risk than normal for heart attack and I did alter my diet. There was some talk about statins, but I have not indulged in that yet.

Breast cancer data. I was going to talk more about that, but I will discuss that with people later. We did have that show up on some of our results as well, which was some concern for my daughter.

The pluses of direct-to-consumer testing. One gets a great insight into personal and societal health with accurate results. You get a certain personal empowerment. I believe that the appearance of these companies and these websites is actually pushing along this process much faster than it was going. It is pushing the health industry and the health research establishment to think more about applying this great research, which much money has been spent on and much effort, towards individuals and establishing guidelines and ethics education and funding.

I think we need more of this. This is a fabulous discussion to have here, driven really in part by the appearance of these services.

Opening up new avenues for research and medical and drug development, which has been mentioned.

A few minuses at the moment, and most of these I consider to be somewhat temporary, but important. This is early days. Association studies are not always applicable to individuals. That was actually not the original intent, is my understanding of much of that science.

Disease and non-disease results are sometimes mixed on these sites, which at first is somewhat jarring, although I guess you get used to it after a while.

There are no standards that I can tell as a consumer that reassure me of the validity of these tests, and especially the risk factors. The number at the end of the day that you want as a consumer is that number. What is my risk factor.

I think consumers are perhaps a bit smarter than sometimes they are given credit for. I think if you explain to them over and over and over again even the fact that these risk factors may change

over time as the information becomes more available, people will begin to understand that and pick it up. There needs to be an educational process for that.

A minus is that most physicians, including my own, who is a wonderful physician, really had no idea what to do with the information when I brought it to him.

There is a potential to frighten certain people. I don't think we are hitting that market yet with these early adopters, but we certainly will. Then, the high costs and who is going to pay.

A few thoughts and suggestions. Consumers, I believe, should be free to access their information and buy services, and in fact they will. Any attempt to harness this information or keep it away from consumers, especially with the Web the way it is, being amorphous around the world, people who want this information will be able to get it in some way.

I love the discussion that is going on here and would encourage that as a consumer to help me and others understand.

Early adopters I think should be part of the experiment. Again, I suggest looking into the Coriell approach, especially the fact that they are testing doctors first.

We need to establish guidelines and standards, I believe, for the tests and the information, uniform risk assessments, et cetera. Kind of a Good Housekeeping Seal of Approval, if you remember that. I think most consumers would like to have some kind of assurance that this information is accurate. In fact, that was reflected in one of the studies that was commented on yesterday.

Also, who will pay. And a few others here. I think it would be helpful to have a crash program to set validation standards. This is clinical validation standards in preventive medicine.

Disease markers I believe are more important and should be handled differently than, say, ancestry.

I believe that physicians should be involved with some of the decisions in the companies in assessing people's results.

Also, 23andMe recently did start offering a locator system online for finding a genetic counselor in your area. We could possibly do that for physicians as well. This is fairly easy with the technology and computers today.

To conclude, I want to go back to the beginning. Genetics is just the beginning of this process. In my book and in the Experimental Man Project, we are also doing environment, brain, and body. I have a funny feeling that a committee like this, or this Committee, will be in session for many years discussing each of these new developments when we start applying envirogenetics, as we call it, and environment-gene interaction.

There is a lot of interesting research going on with using brain waves, for instance, as biomarkers. FMRI studies, as you all know, are very small and in the early days right now, but they will begin to play a role in preventive medicine, et cetera.

I would love to have you all check out our new Experimental Man website, xperimentalman.com. We are just getting it going, but this will eventually download all of my

results. We will have a wiki-style site where others can participate in what we are calling the Experimental Man Portal, where various groups, companies, and others who offer information about applying genetics to individuals will be able to have a link from the site.

Finally, the book comes out in March. I hope you all will pick up a copy. Thank you very much.