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**Talking Points**

**STS Forum: Setting the Tone – Life Sciences- Track B**

It is not an overstatement to say that progress in the life sciences in this century may well determine the future of humankind.

Life sciences will not only impact health, but may well affect the development of sustainable environmental and energy technologies.

As Francis Bacon once proclaimed “knowledge is power ... but nature, to be commanded, must be obeyed...”

In that regard we are facing enormous challenges—and at the same time, unprecedented opportunities.

Let me discuss what I see as the major drivers of the health challenges we face and how they set the tone for the health sciences topics chosen at this meeting.

Above all else is perhaps the evolution of the world population over the next 50 years.

Projections indicate that most of the estimated population growth—an additional 3 billion people by 2050, a number as large as that of the entire population in 1950—will occur in the less developed economies.

This will lead to growing differences in the distribution of resources on a per capita basis with a great potential for instability and degradation of the human-environment interface.

There will be growing health disparities both *within* countries (including within nations with more developed economies) and *between* countries—and increasing difficulties in sustaining current models of healthcare delivery systems in *every* country.

Recent world health organization projections show a persistence of infectious and environmentally-driven diseases such as HIV/AIDS, pulmonary diseases, and a great potential for the emergence of new global health threats.

They also indicate that there will be a parallel worldwide growth in the burden of chronic diseases—diseases that were once the hallmark of developed economies.

Interestingly, this will occur in parallel with a *decrease* in the average disease burden per capita—primarily due to longer life expectancy, outlining the growing importance of degenerative diseases of the aged as a topic of research.

Alongside these challenges, there are also unprecedented opportunities for progress.

A core topic of discussion at the STS this year is genomics—and rightly so.

As an example—when I began my tenure as NIH director in 2002, we knew of one strong genetic association for type 2 diabetes.

This year, we learned of 12 suspected associations, half of which were totally unsuspected and found in non coding regions of the DNA that have no firmly established function.

A week does not go by without one of the 27 institutes of NIH reporting a new potentially significant finding to my office.

However, it is important to realize that the completion of the human genome and the recent discoveries in genome wide association studies are just the beginning of a long and difficult scientific process of renewed discovery starting with replication, validation and ultimately functional interpretation at the basic level of all of these genomic findings if they are to be ultimately translated into effective strategies.

Progress is also hampered by a need for a more fundamental understanding of the complexity of biological systems beyond genomics, as revealed by the advances of the past 20 years.

Billions of years of evolution have created systems that are more complex than anyone suspected—and we still know too little about them.

The life sciences are moving from a phase that focused on the understanding of the many components of life systems to understanding the regulation and interactions of the many elements of the system in normal and abnormal conditions.

In other words, we are moving from a better understanding of the *hardware* components of life, to a greater focus on the *software* of life systems.

This requires:

- a reinforced commitment to basic science discoveries,
- an increased focus on dynamic quantitation of biological systems behavior in health and disease; and
- a focus on the earliest possible stage of dysfunction of these molecular pathways to enable preemptive early interventions.

To succeed, we must take an active stance to break the mostly artificial barriers between traditional scientific disciplines. To succeed, we must encourage:

- new modes of interdisciplinary research;

- greater interactions between life, physical and quantitative sciences and technology
- high risk/high impact pioneering research as opposed to incremental research
- independent research by young investigators as early as possible in their career

Moreover, we must improve our ability in translational sciences by more effectively training and supporting a new generation of scientists who will be better able to interact with the basic sciences and the clinical sciences in a bidirectional mode, and who will be better able to study human diseases with the modern tools of investigation that have emerged in the past few years.

We must also keep in mind that no country has all the talent and the resources needed for this task. Therefore, we must encourage more effective worldwide collaborations. (For example, NIH's commitment to such collaborations has tripled in the past 7 years.)

These developments will require a strong debate around the core issues of *bioethics*—the second topic of discussion here at the STS.

Without a global consensus on ethical approaches to science and a standardized model of coherent regulations, progress will be hampered.

Clearly, as I said earlier, such progress may well have a substantial impact on environmental issues, such as the preservation of arable lands and the increased productivity of crops. This is the basis of the third topic in the STS life sciences track: GMOs.

From my standpoint, it is also clear that the practice of medicine and healthcare delivery systems will have to undergo a radical transformation, moving from a *curative* to a more *preemptive* paradigm based on a greater predictive knowledge at the individual level of molecular and environmental risk factors.

This early intervention model of care will require a radical transformation of healthcare delivery systems and their socio-economics on a worldwide basis.

In conclusion, I'd like to share with you a thought about the importance of the conversation here at the STS. If you had a time machine that could carry you to the year 5007 ...

Would you meet a historian who will tell you how bright and prescient the people of the 21st century were, or ...

Would you instead meet an archeologist from an unknown civilization, wondering why our people in the 21st century got it so wrong!

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