Letter to the Editor

Physical scientists research biomedicine: a call for caution

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It is noticeable that nowadays there are more and more scientists with physical science or engineering background working on or started to work on biomedical projects, but rarely vice versa. This reflects the multi-discipline nature of some projects, however, also at least partially can be explained that biomedical research is seen as trendy, fundable, and likely to get more citations and with results more publishable in high impact journals (1,2). It is also apparent with some publications and lectures that not all these physical scientists/engineers are well-prepared to work on projects which do not align with their own expertise. Some studies are against very basic principles of pharmacology or biology, while others try to solve medical problems which do not exist clinically. I reviewed a number of submissions including a few from prestigious American universities to *Nature* journals which made no sense with the study design. Much of manpower and financial resource are being wasteful spent. There are also examples of clinical trials which were ill-planned right from the start and in the end only causing much inconvenience to patients to say at the least. In addition, ample examples exist where experienced physical scientists worked with inexperienced medical scientists and resulted in avoidable failures.

In the fields of pharmaceuticals and biotechnologies, for some reasons which have not been fully explained both Japan and South Korea have not been very successful in developing novel drugs. While Japan and South Korea have first-class carmakers such as Toyota, Nissan, Hyundai, Honda, Suzuki etc. and electronics companies such as Samsung, Toshiba, Hitachi, LG, Sony etc., Japanese and South Korean pharmaceutical companies are much less visible. For the year of 2013 of the ten top pharmaceutical companies none of them were Japanese or Korean; and of the 25 top biotech companies none of them were Japanese or Korean (3,4), despite the fact that Japan has been a major geopolitical and economic power since early 20th century and till now produced seven noble prize winners in chemistry (and ten noble prize winners in physics). In one paper written in year 2005, Hashimoto and Haneda quantitatively measured the poorness of Japanese pharmaceutical industry R&D efficiency (5). Taiwan, Hong Kong, and Singapore did not do any better. Japanese pharmaceutical industry realized for some time that they were not very successful in hunting new drugs (partially explained as the ‘creativity problem’), many companies resorted to setting-up pharmaceutical R&D centers in Europe and America, hoping the talents there might help them (6). Of note while Switzerland has a population of only approximately 8 million, in year 2013 two of the three top pharmaceutical companies were Swiss, i.e., Novartis and Hoffmann-La Roche. It is also of note that for Nobel Prize during 1901-2005, Switzerland had the top relative representation (Share of Nobel laureates/Share of population) of 28.09, followed by UK of 9.38 , Germany of 9.16, France of 5.21, and USA of 4.32 (7).

I have worked for a number of years in a R&D headquarter of a then globally top 5 pharmaceutical company. There I was reminded again and again that hunting profitable drugs is a very risky business (8-11), and close collaboration and frequent interaction of chemists, pharmacologists, and clinical trialists are vital. Important decisions had to be made after group debate rather than by a single bright-star scientist. The past experience showed the chilling fact that out of every 10,000 compounds considered drugable and researched on by the experienced pharmaceutical industry, no more than one would have chance to reach the market. Most publications on biology topics in top journals of *Nature* and *Science* failed to materialize to help patients.

In the year of 2012 for China and South Korea and the year of 2011 for others countries, on purchasing power parity comparison the expenditures on R&D in billions of US$ were 405.3 for USA, 296.8 for China, 160.3 for Japan, 69.5 for Germany, and 38.4 for UK. With such intense research activities in China, as a medical scientist I am concerned that some very talented physical scientists working on biomedical projects which are doomed to fail and very little can be learned. While Mr. Leonardo da Vinci [1452-1466] was very successful in multiple areas in arts and sciences (12), he lived in an era when not many people had access to education and the competition was much less intense, and the accumulated knowledge was much less than current days. Sir Isaac Newton [1642-1727] was one of the foremost mathematicians and physicists; his even greater efforts spent on chemistry, history and theology have been much less recognized (13). Dr. Albert Einstein [1879-1955], the most brilliant genius in modern science, focused his scientific efforts on physics (14). It is important that talented scientists keeping on areas they are most likely to excel. If physical scientists want to work on projects aiming to improve patients care, it is critically important that experienced physical scientists and experienced medical scientists work closely together right from the study conception.

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