Opinion Paper

Duygu Aydemir and Nuriye Nuray Ulusu*

Identifying and solving scientific problems in the medicine: key to become a competent scientist

Tıptaki bilimsel problemlerin belirlenmesi ve çözülmesi: Yetkin bir bilim insanı olmanın anahtarı

Abstract: The scientific method can be described as a multistep and detailed process, in which finding the best question is the first and most crucial step. Thus, scientific problem should be examined thoroughly in different ways and perspectives. The amount and diversity of scientific data are enormously increasing and becoming more specific day by day, therefore traditional observational biology is not sufficient on an individual basis to understand and treat multifactorial diseases. Moreover, protocols, documentations, information, outcomes, precisions, and considerations of evidence should be improved to answer scientific questions correctly during the scientific research. Because of the diversity of the data and the methods, statisticians and methodologists should be involved and contribute to the all stages of research. Besides that, all scientific data should be certainly reproducible and repeatable. Scientific knowledge is in a state of flux and becomes more complex day by day. Thus, becoming a competent scientist needs, abilities and skills such as creativity, hardworking and self-discipline that all requires lifelong learning, searching, and widening scientific horizons consistently.

*Corresponding author: Prof. Nuriye Nuray Ulusu, Koç University, School of Medicine, Rumelifeneri Yolu, Sariyer, 34450, Istanbul, Turkey; and Koç University Research Center for Translational Medicine (KUTTAM), Sariyer, 34450, Istanbul, Turkey, Phone: +90 (212) 338 11 60, Fax: +90 (212) 338 11 68, e-mail: nulusu@ku.edu.tr. https://orcid.org/0000-0002-3173-1389
Duygu Aydemir: Koç University, School of Medicine, Sariyer, Istanbul, Turkey; and Koç University Research Center for Translational Medicine (KUTTAM), Sariyer, Istanbul, Turkey, e-mail: daydemir16@ku.edu.tr

Öz: Bilimsel yöntem, en iyi soruyu bulmanın ilk ve en önemli adım olduğu çok aşamalı ve ayrıntılı bir süreç olarak tanımlanabilir. Bu nedenle, bilimsel problem farklı şekillerde ve bakış açılarıyla ayrıntılı olarak incelenmelidir. Bilimsel verilerin sayısı ve çeşitliliği gün geçtikçe son derece hızlı bir biçimde artmakta ve daha belirgin hale gelmektedir, bu nedenle gelenekseli, gözlemsel biyoloji, çok faktörlü hastalıkları anlamak ve tedavi etmek için tek başına yeterli değildir. Ayrıca, bilimsel araştırma sırasında bilimsel sorulara doğru cevap verebilmek için protokoller, belgeler, bilgiler, sonuçlar, kesinlikler ve kanıtlar iyileştirilmelidir. Verilerin çeşitliliği ve yöntemlerden dolayı, istatistikçiler ve metod geliştirenler araştırmaya katılmalı ve araştırmanın her aşamasına katkıda bulunmalıdır. Bunun yanı sıra, tüm bilimsel veriler kesinlikle tekrarlanabilir olmalıdır. Bilimsel bilgi bir akış halindedir ve gün geçtikçe daha karmaşık hale gelir. Böylece, yetkin bir bilim insanının yaratıcılık, çalışkanlık ve öz disiplin gibi ihtiyaçları, yetenekleri ve becerileri herkesin yaşam boyu öğrenmeyi, aramayı ve bilimsel ufukları tutarlı bir şekilde genişletmeyi gerektiren bir hale gelir.

Introduction

The scientific method in medicine is comprised of research design, conducting research, data analyzing and interpretation that all contribute to the solving specified

problems. Research design types can be categorized as a case study, survey, observational study, semi-experimental, experimental, review, meta-analytic or comparative [1]. However, before choosing research design type in medicine, finding the best question of which either comprises huge populations such as patients with diabetes, cancer or affects small groups like people with rare diseases is the first and most crucial step. Although rare diseases impact fewer human beings, in total many people are affected from them in the worldwide since there are no cure [2–4].

Present problems in the medical and biological sciences should be examined thoroughly in different ways and perspectives to find the best scientific question. Therefore, researchers should widen their scientific horizons consistently and should develop deep insight in their specific fields [5–11]. The amount and diversity of scientific data are enormously increasing and becoming more specific day by day. Therefore, traditional observational biology is not sufficient alone to understand and treat multifactorial diseases such as obesity, cancer or neurological disorders. Every data contributes to the scientific knowledge in the worldwide. Thus, access to the largest data by using omic technologies such as lipidomics, metabolics, proteomics, genomics, etc. has led to the revolution in the medical and biological sciences, that enable scientist to reveal complex mechanisms behind various diseases which affect either huge or small populations. Thus, not only determining the problem, but also knowing how to analyze and integrate the scientific data is crucial to become a competent scientist [4–10].

Protocols, documentations, information, outcomes, precisions and considerations of evidence should be improved for data analysis and interpretation. However, in research design there are also other factors affecting the research quality, for instance originality, instruments used in the experiments that all parameters together contribute to the increasing validity and the reliability of a research [11]. Also, since methods using in each field are diversifying day by day, choosing the best and most effective methods play a vital role to obtain the most accurate and reliable data. Therefore, statisticians and methodologists should be involved and contribute to the all stages of medical and biological research. Besides that, all scientific data and procedure should be certainly reproducible and repeatable in every area of the discipline including medicine [11].

The scientific world is continuously in progress and improving itself day by day. New methods and data analyzing approaches, including various omic technologies revolutionize the medical research field. Thus,

researchers encounter new concepts such as subtyping patients with diseases to reveal biomarker that enables us to discover personalized medicine techniques. Personalized treatments are promising therapeutic approaches which increasing efficacy of the treatment and reducing side effects. These factors enable us to predict disease susceptibility that all together contribute to the improving human health [10–12].

The researcher's creativity, critical thinking skills, abilities and successes are directly correlated with the researchers' deep knowledge on a specific topic, current technologies, data analysis and interpretation. Since science continues from past to present, every step we follow reflects an evolutionary step on the way. Scientific knowledge is in a state of flux and becomes more complex and competitive day by day. Therefore, being a competent scientist needs various skills such as creativity, hardworking and self-discipline, since this process is a lifelong journey requiring consistently learning, searching, and widening scientific horizons for a lifetime.

Conclusion

Currently the world has realized the importance and the need of describing reasons of various public health concerns, since this is the key to solving them. Therefore, finding the best question of which either comprises huge populations or affects small groups is the first and most crucial step in the medical and biological sciences. The amount and diversity of scientific data and novel methods are enormously increasing and becoming more specific day by day. Therefore, a researcher's creative and critical thinking, abilities and successes are directly correlated with the researchers' deep knowledge on a specific topic, current technologies, data analysis and interpretation.

References

1. Mann CJ. Observational research methods. Research design II: cohort, cross sectional, and case-control studies. J Emerg Med 2003;20:54–60.
2. Lewis ND. The scientific method in medicine. J Natl Med Assoc 1958;50:325–8.
3. Donders Y. The right to enjoy the benefits of scientific progress: in search of state obligations in relation to health. Med Health Care Philos 2011;1:371–81.
4. Whicher D, Philbin S, Aronson N. An overview of the impact of rare disease characteristics on research methodology. Orphanet J Rare Dis 2018;13:14.

5. Fernald DH, Coombs L, DeAlleaume L, West D, Parnes B. An assessment of the Hawthorne Dale H. Scientific Method in Medical Research. Br Med J 1950;2:1185–90.

6. Carney TJ, Weber DJ. Public health intelligence: learning from the Ebola crisis. Am J Public Health 2015;105:1740–4.

7. Dolmans DH, Loyens SM, Marcq H, Gijbels D. Deep and surface learning in problem-based learning: a review of the literature. Adv Health Sci Educ 2016;21:1087–112.

8. Crockett ET. A research education program model to prepare a highly-qualified workforce in biomedical and health-related research and increase diversity. BMC Med Educ 2014;14:202.

9. Brown SA. Patient similarity: emerging concepts in systems and precision medicine. Front Physiol 2016;7:561.

10. Gligorijević V, Malod-Dognin N, Pržulj N. Integrative methods for analyzing big data in precision medicine. Proteomics 2016;16:741–58.

11. Ioannidis JP, Greenland S, Hlatky MA, Khoury MJ, Macleod MR, Moher D, et al. Increasing value and reducing waste in research design, conduct, and analysis. Lancet 2014;383:166–75.

12. Redekop WK, Mladsi D. The faces of personalized medicine: a framework for understanding its meaning and scope. Value Health 2013;16:4–9.