HYGIENE and EPIDEMIOLOGY

Selected Chapters

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et al.

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In Prague, September 2019
Vladimír Bencko

INTRODUCTORY NOTE

Hygiene and epidemiology we conceive classically as tightly connected, partially overlapping disciplines without any fashionable attributes or transient labels making the orientation in basic disciplines of the preventive efforts in medicine just more difficult or confusing. The goal of hygiene and epidemiology in our present situation is to positively influence the **quality of human life**.

Hygiene, together with **epidemiology**, represent the integral, **biomedical fundaments** of **public health** or **community medicine** representing a more recent concept. Unlike the social medicine, which is the third indispensable component of public health, that strongly accentuates moral, ethical, and organizational aspects of health care, hygiene and epidemiology since ancient times, have been **developing out of empiricism**, and over a hundred years, these two disciplines have shared the same rules as other sciences. For example from the thousand year of empirical experience, some correct anti-epidemic measures were deduced even times of. The **threat of vast epidemics** depopulating countryside and towns and paralysing the fighting armies, compelled medicine to develop a new medical discipline. Hygiene bears the name of the **Goddess of Health** – the Greek **Hygieia** together with Asclepias worshipped in Epidaurus of the Peloponnesian Peninsula. She is presented as beautiful woman, whose symbol is a snake drinking water from a bowl the goddess holds in her hand.

Hygiene is science of **health preservation**. Originally, it deals with all factors affecting the physical health and psychic well-being of man. Relating to man's health it includes the **quality of water and** other **drinks**, **food and nutrition**, **clothing**, **working conditions and physical strain** as such, **sleep**, **cleanliness of the body**, **bad habits** like **tobacco**, **alcohol** and the other **drug abuse**, and **mental health**. As to the public aspects, it covers **climate**, **soil**, sorts of building materials and **housing** arrangements, **heating**, **ventilation**, **waste disposal**, medical knowledge of **disease incidence and prevention**, down to burial of the dead.

The **firm link of hygienic theories and practice** with health status of the population remained preserved in the original form only in **infectious diseases**, later on in the self-contained **epidemiology** the remarkable course of which to present day **epidemiology of non-communicable diseases** is sufficiently well known.

Since the Enlightenment era, the efforts for disease prevention in our country have traditionally enjoyed a good standard. The important drive was the charitable attitude of many

physicians and health personnel and straining create organizational, and educational conditions enabling **primary prevention principles** to be introduced into practice. The Institute of Hygiene at Czech Faculty of Medicine at Charles University of Prague (the present Institute of Hygiene and Epidemiology, First Faculty of Medicine, Charles University) was founded in the school year 1897/1898. An analogical Institute at the German Faculty of Medicine in Prague was founded in 1884. However, it ceased to exist along with the German section of Charles University in the turbulent post-war time when the Czech sector, after Nazi close down was re-opened.

The current institutional integration of hygiene and epidemiology at the First Faculty of Medicine in the school year 1992/1993, including teaching programme and final state examinations reflect the rational integrative efforts in the past decades in the field of education and training of medical youth at the break of millenniums.

Here follow some examples of various successful **practical applications** of our **preventive medicine**, more specifically, in epidemiology branch. The post-war activities against **venereal diseases** and the starting campaign resulting in a significant drop of the incidence of **tuberculosis** and then **brucellosis**, requiring a close cooperation with the veterinary service, deserve, by extent and organization, as well as by achieved positive results, and despite a fairly long time lapse, the highest appreciation.

The former Czechoslovakia was the first country in the world that started **anti-polio** mass **vaccination** already in beginning of the sixties, thus being an example for other countries. Our physicians shared in the first and until today unique **eradication** action of another infectious disease – **smallpox**. Neither of the two praiseworthy deeds has ever been fairly appreciated on the international scene, though, e.g. smallpox eradication surely was a big success of the preventive medicine on a global scale, and deserved the highest esteem by awarding a prize equivalent to the Nobel prize. **John Snow** is often recognized as the **founder of epidemiology**. He, a practicing physician, conducted what is regarded today as a classic study of the transmission of **cholera in London** in the mid – 1800s. For the development of epidemiology in our country became important establishment of the National Institute of Public Health founded in 1925 in Prague. The Institute's collaborators had been acquiring experience mostly in the USA. Thus a modern school of epidemiology was born, of its representatives at least **Karel Raška** should be remembered. He was head of the contagious diseases division at WHO headquarters in Geneva, and was one of the authors and managers of the smallpox eradication programme. In the post-war time our top specialists passed the training courses in epidemiology at the London School of Hygiene and Tropical Medicine with which some of our health research and educational institutions have been keeping up busy working contacts ever since. Concerning the noncommunicable diseases, we must remember the extensive epidemiological study on **endemic goitre** performed by our clinical endocrinologists in the late forties and early fifties, which can still stand the current, relatively strict qualitative criteria for epidemiological studies, resulting in the systematic *iodination of salt*. Again, we were among the first to introduce **fluoridation of drinking water** for caries prevention. This campaign was, as well preceded by thorough epidemiological study.

The frequent socio-political changes, occurring in our country in the last century unfortunately too often, used to disrupt the balanced system of prevention. Today we have to adapt the primary prevention system to the extensive social and economic changes we are now undergoing. Much has already been done but a backup to **complexly structured primary prevention activities** are still urgently needed.

Our school of hygiene rooted from the traditional German school of bacteriology-based hygiene founded by **Max von Pettenkofer** who implemented a **sand filtration** into production of a **safe drinking water** and **Robert Koch**. Founder of our school of hygiene, **Gustáv Kabrhel**, pupil of Max von Pettenkofer enriched the process with an experimental aspects e.g. by providing study of effectiveness of the sand filtration (**Kabrhel-index**), later on with pathophysiological factors to be demonstrated in the works of **Jaroslav Teissinger**, who already in the mid/thirties laid the foundations of the present day **biological exposure tests or biomarkers of exposure to environmental toxicants**. A few years following the last London smog episode when the most reliable health indicator was recorded mortality, **Ladislav Kapalin** and **Karel Symon** tried to demonstrate the adverse environmental effects on the changes of **growth** and **haematological parameters** in exposed children, and in this way, they contributed to the application of rather sophisticated and more sensitive indicators of the health status of children.

The **network of hygienic stations** according to the Soviet model set up in the late fifties, together with the establishment of the Medical Faculty of Hygiene, the present 3rd Faculty of Medicine at Charles University in fact was a progressive undertake though fraught with inherent faults usual in any kind of systems designed for a rather different setting, and probably optimal elsewhere. Nowadays what we still miss most is the expert, critical analysis of successes, failures or errors of our previous hygienic service. There are two circumstances likely to make this problem still very difficult. The first: the **effectivity of hygienic service** activities can be rated by success in preventing health threatening factors. This brings us, in the first place, to skating on a thin ice of any kind of conditionals. The other serious issue, was the advanced **public health legislation**, which, owing to **profuse numbers** of **exceptions** became less effective than expected. Then the famous Parkinson-laws relentlessly operated on either side of the iron curtain. From the relatively modest beginnings, the hygienic stations became inflated to the "maxi" size in the late eighties, frequently criticized by the Western experts on the problems of preventive medicine of our public health system. However, it is necessary to underline that these critics envy us the institutionalised structure of public health engaged in primary prevention, i.e. disease prevention by influencing **life style**, **living conditions**, **resistance of the human organism**, etc., and warned against total disruption of this structure while trying to square up with the totalitarian legacy.

The trends in **integrating primary prevention** into the current activities of every physician and paramedical personnel have been implemented but slowly and with **many obstacles** in all social systems in global scale. This is evident in the problems related to implementation such global WHO programs, like the decade dedicated to the "Drinking water for all", or "Health for all by 2000" anchored in national programmes adapted to the local conditions. Intentionally, primary prevention tries to **suppress the causes of the diseases, reduce their incidence, and improve life expectancy and quality of life**. The constituents of **primary prevention** are **protection** and **promotion** of health.

Health protection strives to safeguard humans against any **unacceptable health risks** produced by the activities of man. In the Health Protection Programme the government and industry invest tens of thousand millions crowns yearly. There is no need to glorify or condemn this fact, as it is a must. But for that the present day industrial sphere would collapse because of incompatibility of harmful living conditions with human existence.

The purpose of the preparatory studies of the students for your final state examination in hygiene and epidemiology is **to understand the fundamental principles and importance of the primary prevention in context with medical practice**. This also covers timely notifications of infections, their flexible surveillance thereof, reports on incident malignancies enabling administration of the national cancer register, and chiefly, the necessity of your **personal engagement** as physicians in primary prevention programmes and last but not least in the early diagnosis and a rational treatment of your patients, that is, the **secondary prevention**. The qualified advice on life style, occupational risks and health risks from bad habits considering the social and health situation in the family at your patient may significantly help to create your profile of a desired, competent family doctor.

Here are some closing notes: By the old proverb "Cut your coat according to your cloth" we naturally try to introduce the up to date style of teaching and research work of our Institute, as you can see from the quotations on important projects and publications by the staff of the Institute published during the past decades. It consists of **biological monitoring** and **health risk assessment of human exposure to environmental toxicants**, mostly **toxic metals** and **polyhalogenated hydrocarbons**, and health aspects of increasing risks from **traffic emissions**. Our interest involves the selected issues of **hospital hygiene**, before all **antibiotics resistance** and **waste disposal** from health care facilities. Presently, the Institute is dealing with **indoor environment** problems including the permanent urgent problems of smoking being one of the important **risk factors of life style**.

Currently, we participate in international multicentre studies organized by International Agency for Research on Cancer (IARC), WHO/Lyon and National Cancer Institute (NCI) Bethesda, concerning **epidemiology of cancer** and **ethical aspects of environmental epidemiology** and **quality of life**.

Like other institutes engaged in the field of primary prevention we also try to continue meaningful cooperation on the international scene with WHO, IPCS, CCMS/NATO, etc.

A certain hope open to us in the future is the **steadily rising cost of patients' treatment** that will urge responsible political bodies to recognize the **importance of primary prevention** from cost/benefit aspects and introduce its principles in the health care practice policy.

These questions are related to the key issues of philosophy, and hopefully as well to the future practice of **sustainable survival philosophy** – or in a more euphemistic term – the sustainable development principle. Apart from the expected progress of noncommunicable diseases epidemiology there exist a number of potential risks arising from **gene manipulations** in microbiology, pharmaceutical microbiology and, e. g. **bio transformation of persistent xenobiotics** – all of them involved in the solution of **waste disposal** problems. The described future tasks require, under consideration of some hygienic and epidemiological specifics, **unrestrained mutual cooperation** of the both medical branches. As documented

by experience of some other fields of sciences the fastest progress is expected when the individual disciplines overlap, e.g. in methodical applications of **molecular toxicology** in **environmental epidemiology**. A wider range of applied epidemiological methods in clinical studies is awaiting us as well.

The focus of interest of both disciplines remains the **primary prevention** of most widespread diseases and subsequent efforts to positively influence the **quality of human life**.

In medicine, until our days, the Hippocrates' statement still holds: Life is short, and Art is long; the occasion is fleeting, experience fallacious, and judgment difficult. The physician must not only be prepared to do what is right himself, but must also motivate the patient, the attendants, and externals cooperate. If we honour this in curative medicine, we should do so in preventive medicine twice as much.

In Prague September 2019
Vladimír Bencko

PART 1 ENVIRONMENT AND HUMAN HEALTH

CHAPTER 1.1 BIOLOGICAL MONITORING AND HUMAN EXPOSURE TO XENOBIOTICS

In the background of the growing interest of public health authorities in biomarkers of human exposure to environmental pollutants is the simple fact that the **total extent** of **environmental pollution** is often **difficult** to **assess**, both qualitatively and quantitatively. Analyses of non-systematically collected air and surface water samples yield virtually worthless data in this respect, for the actual degree of environmental contamination may vary across a relatively wide range. Concentrations of **air pollutants** are influenced by actual **weather conditions**, local air movement or by **inversions** that may be the cause of the critical accumulation of emissions in the given areas. The quality of **surface waters**, especially in streams, is generally dependent on **flow rate**, i.e., the degree to which the incoming discharges are diluted by the stream flow. In particular, fluctuation in the quality of surface water is influenced by the discharge of industrial effluents that vary considerably both in amount and composition, depending on the actual industrial production technology used.

Ideally, a continuous measurement of environmental pollution can be effected through the use of a **network** of **automated monitoring systems**, e.g., a **hexagonal scheme** of **air** pollution monitoring networks; or **line systems** for the monitoring of **traffic** or **water stream** pollution, preferably those capable of automatic sampling, analysis, registration and evaluation of data.

The **automated monitoring systems** are not easily accessible at present, both technically and economically, and their use in the near future is expected to remain **limited to highly populated localities having the greatest degree of environmental pollution**.

As an alternative to the technical approach to this problem, **biological indicators** could be used to monitor pollution of the environment. This method appears to be particularly well suited to demonstrating environmental pollution by **potentially toxic organic and inorganic xenobiotic** and **toxic elements**, including toxic metals.

The efforts to use animals in monitoring of noxious substances present in a working environment have a long tradition, starting from **canaries** or **mice** in **coalmines**, used as indicators of presence of, e.g., carbon mono- or dioxide, up to the recent form of a wide range of biological exposure tests. As example of impacts on animal species, it may serve to count