SURVEILLANCE OF DRINKING-WATER QUALITY

A clothbound edition is available at
Sw. fr. 29.—

For list of national distributors, see back cover

WORLD HEALTH ORGANIZATION GENEVA 1976

CONTENTS

WORLD HEALTH ORGANIZATION
MONOGRAPH SERIES
No. 63

SURVEILLANCE OF DRINKING-WATER QUALITY

SURVEILLANCE OF DRINKING-WATER QUALITY

WORLD HEALTH ORGANIZATION
GENEVA
1976

ISBN 92 4 140063 3

PRINTED IN BELGIUM

CONTENTS

PREFACE

For some time the World Health Organization has been concerned about the lack of a single, comprehensive, but concise, source of practical information about, and guidelines for, public health surveillance of drinking-water quality in the developing countries. Surprisingly, few comprehensive studies of this subject have been undertaken, and there are few developing countries where formally organized, nationwide, fully adequate, and effective surveillance programmes have been implemented.

Major efforts have been made, and more are underway, to provide safe and convenient piped water supplies to many of the world's population. The benefits of safe and adequate drinking-water supplies are not automatically assured with the construction of waterworks and distribution systems. Indeed, experience has shown that without proper surveillance the water supply system itself may become an effective channel for spreading disease.

In this publication are assembled information and guidelines for planning, organizing, and operating programmes for surveillance of drinking-water quality at the national or regional level in the developing countries. The monograph is intended for use by officials with public health responsibilities and those responsible for the production and distribution of drinking-water, engineers and sanitarians engaged in public health or water supply activities, water treatment plant operators, and other persons who have a professional interest in water supply.

The guidelines presented here originated from a study of methods and procedures for the surveillance of drinking-water quality in developing countries initiated in 1968 under an arrangement between WHO and the University of North Carolina at Chapel Hill, USA, with Professor F. E. McJunkin as principal investigator. Information was obtained through on-site reviews of surveillance programmes in some eight countries; from correspondence and interviews with health and water supply officials and members of the WHO secretariat dealing with problems of environmental health; from comments and suggestions made by the panel of reviewers; by review of WHO publications and unpublished documents, especially country reports, questionnaires, and cholera team reports; and by review of the technical and scientific literature.

A draft of the guidelines prepared by Professor McJunkin was circulated to a number of reviewers and revised in the light of their comments and suggestions; a list of the reviewers is given in Annex 10. The revised draft was then discussed at a meeting of advisers convened in Geneva from 18 to 24 February 1975, when the guidelines were finalized. The names of those who participated in the meeting

are listed in Annex 9. The World Health Organization is grateful to the reviewers and advisers, and particularly to Professor McJunkin, for their efforts in formulating these guidelines.

The feasibility of each concept presented here has been demonstrated under operational conditions. However, no guidelines of a general character can be used rigidly or arbitrarily and without exception; progressive innovation should always be encouraged. Nevertheless, major departures from the proposed guidelines and concepts should be reviewed critically.

In addition to effective surveillance, well planned, designed, operated, and maintained water systems are essential in providing safe, wholesome water supplies. Interested readers will find much useful information on these aspects of water supply in four WHO publications: Water supply for rural areas and small communities (28), Operation and control of water treatment processes (17), Slow sand filtration (29), *and* International standards for drinking-water (10).

1. Introduction

Surveillance

Surveillance of drinking-water quality can be defined as "the continuous and vigilant public health assessment and overview of the safety and acceptability of drinking-water supplies". Public health protection of drinking-water supplies should assure that each component of the system—source, treatment, storage, and distribution—functions without risk of failure. Flawless treatment serves no purpose if the distribution system permits contamination through faulty installations or cross-connexions, an excellent distribution system will not protect the public health if the distributed water receives insufficient treatment, while a heavily polluted source may overwhelm the treatment capacity.

The elements of a surveillance programme include engineering and the physical, biological, chemical, and institutional examination of water supplies. The enginering examination or *sanitary survey* is an *on-site inspection and evaluation* by a qualified person of all conditions, devices, and practices in the water supply system that could present a health hazard to the consumer. Physical, biological (generally bacteriological), and chemical examinations include testing of water samples in both the field and the laboratory. Institutional examination concerns those elements of operation and management that may result in health hazards to consumers, e.g., incompetent operators.

Full evaluation of the health risks in a large water system would include, as a minimum, careful and critical examination of the following points:

- Quality of source
- Output of source
- Protection of source
- Adequacy and reliability of treatment
- Distribution system (quality, pressure, and continuity)
- Quality control (records, sampling, tests)
- Cross-connexion and back-siphonage control
- Chlorine residual in the distribution system (where appropriate)
- Construction and repair practices (including disinfection before services are resumed)
- Maintenance procedures
- Standard of operation

Table 1. Common failures of water surveillance

1.	Failure to assure general awareness of the danger of outbreaks of water-borne disease and/or to bring such outbreaks to the attention of water purveyors
2.	Lack of established surveillance policies and procedures
3.	Failure to make sanitary surveys
4.	Failure to collect samples of raw and delivered water
5.	Failure to enforce correction of deficiencies and remedial measures
6.	Failure of laboratories to notify waterworks of results of analyses
7.	Inadequate approval programme for new sources
8.	Failure to adopt and enforce drinking-water standards
9.	Failure to protect watersheds, wells, and springs from surface contamination
10.	Failure to maintain positive continuous hydraulic pressure throughout the distribution system
11.	Failure to maintain a continuous chlorine residual in distribution systems
12.	Inadequate or non-existent cross-connexion and back-siphonage control programmes
13.	Lack of standard laboratory procedures
14.	Failure to maintain plant records, e.g., residual chlorine levels
15.	Failure to maintain surveillance records
16.	Bacteriological samples taken from fixed locations unrepresentative of the distribution system
17.	Failure to disinfect new construction and repair work
18.	Lack of adequate legal authority
19.	Inadequate budget and manpower
20.	Inadequate numbers of personnel suitably trained and qualified
21.	Inadequate laboratory facilities and support
22.	Failure to promote adequate maintenance programmes

Surveillance is not merely finding out what is wrong and putting matters right, it includes undertaking remedial action to reduce or eliminate health hazards and advising on, assisting with, and stimulating improvements whenever possible. Surveillance also includes more general activities to promote the safety of water supplies—operator training and health education of the public in the prevention of water-borne enteric disease, for example. Although such activities may be carried out by another agency, the surveillance agency should cooperate and maintain an active interest in this work.

Because no regulatory agency can be present constantly, surveillance must be shared between the water-supplying and the surveillance agencies. The periodic checks made by the surveillance agency ensure that water producers are satisfactorily monitoring their own activities. The water utility is continually responsible for the quality and safety of the water it supplies. However, the surveillance agency, acting on behalf of the public health interests, is ultimately responsible for ensuring that all drinking-water under its jurisdiction is free from health hazards.

The long period (several years) required for planning, financing, designing, and constructing a major water supply project for a community frequently results in a diminished concern for water quality, and provisions for adequate standards of operation, maintenance, and surveil-

lance are often neglected. Yet, paradoxically, a new water supply system can readily become an effective channel for widespread transmission of disease.

Table 1 summarizes some of the more common surveillance failures as determined in a recent multi-country survey. Many of these failures reflect lack of capital and human resources, but some are compounded by complacency and apathy on the part of water supply and surveillance authorities. Effective surveillance is, to a large extent, a matter of correct attitude.

There are no mysteries in surveillance. There are no "breakthroughs", "shortcuts", or new discoveries to be reported. There are some ideas to be gained from the experience, good and bad, of others. This monograph attempts to bring together under one cover a set of useful procedures for those responsible for the quality of water delivered to urban and rural communities, particularly in the developing countries.

Reasons for surveillance

Water and health

Authoritative estimates indicate that each year some 500 million people are affected by incapacitating water-borne or water-associated disease, and that as many as 10 million of these—about half of them infants—die (*1*). It is estimated that 25 % of the world's hospital beds are occupied because of unwholesome water (*2*). The illnesses include typhoid, cholera, infectious hepatitis, bacillary and amoebic dysenteries, and many varieties of gastrointestinal disease (*3, 4, 5*). The existence of potential health hazards associated with water supplies is related to the quality of water consumed. For example, water that contains no *Salmonella typhi* cannot transmit typhoid fever. The health implications of water-related parasitic diseases in water development schemes are discussed in a brochure produced by the Food and Agriculture Organization of the United Nations (FAO) in conjunction with WHO (*6*).

In documented epidemics of water-borne disease definite deficiencies in the water supply system were shown to exist during the time when disease was transmitted. Most often the deficiencies were unforeseen pollution of a previously safe source, use of polluted raw water without treatment, failure of treatment processes, or pollution of the distribution system, including cross-connexions. All of these are subject to control and correction through proper surveillance.