

Commission of the European Communities

Medicine

Proceedings of the 1st International Workshop on Data Banks in Occupational Health

Villa Ponti, Varese, Italy
October 30/31, 1986

Edited by

L. Parmeggiani, R. Roi, G. Aresini, G. Del Bino

Jointly organised by the International Committee on Data
banks in Occupational Health of the ICOH and the Joint
Research Centre - Ispra Establishment of the CEC.



International Commission
on Occupational Health



Commission of the European Communities
Joint Research Centre
Ispra Establishment

Sponsored by the ILO, WHO, IRPTC-UNEP, CEC and the
Istituto Superiore di Sanità.

EUR 11022 EN

1987

COMPUTERIZED EVALUATION OF AUDIOMETRIC SCREENING RESULTS IN INDUSTRY

G. Broich^(1,6), F.M. Gobba⁽²⁾, A. Prestinoni⁽³⁾, F. Precerutti⁽⁴⁾,
R. Sarti⁽³⁾, G. Tartoni⁽⁵⁾, A.R. Tarantini⁽²⁾, A. Tampieri⁽⁵⁾

- (1) Dept. of O. Pathology, State University of New York at Stony Brook
- (2) Cattedra di Medicina del Lavoro, Università di Modena
- (3) Centro di Prevenzione Primaria, Fondazione Clinica del Lavoro, Pavia
- (4) Cattedra di Audiologia, Università di Pavia
- (5) Cattedra di Biomedica e Statistica Medica, Università di Modena
- (6) Corresponding author, now at : G. Broich, MD,
Via Regione Gioiello 62/64,
I-27043 BRONI (Pavia), Italy

Summary

The purpose of industrial screening projects consists in large part in the evaluation of general noise exposure levels, results of audiometric tests from the exposed workers and the final comparison of the obtained data. For this purpose the data should be easy to obtain, permanently maintained and evaluated through as rigid as possible parameters. The use of computer programs can reduce screening costs as well as enhance data presentation and exchange between different medical groups. Through appropriate medical judgement parameters, the program can produce homogeneous diagnostic groups and highly comparable, easily retrievable results. We are here proposing such a computerized system as developed by us, answering to the following questions:

- 1. Data Bank for audiometric screening results;*
- 2. Data Bank for industrial noise exposure levels and time;*
- 3. Automatic evaluation of hearing loss and grouping into specific damage groups;*
- 4. Automatic search and matching of the exposure level groups and the hearing damage level groups.*

The program depends on subjective data for its audiometric input and objective measurement data for the noise level and exposure time values. The following evaluation does not need personnel and is done automatically. Large amount of data can be easily analysed for populations of several companies or data from different companies, homogeneous for exposure levels or damage prevalence can be compared, for a better clinical evaluation of noise damage in workers. This may lead to a greater possibility of hearing level damage prediction on a statistical basis also for the single worker in its specific working conditions.

Introduction

Industrial audiometric screening is of main importance in the prevention of hearing damage in the noise exposed worker. Its use has risen parallel to a greater sensibility for the importance of prevention in occupational medicine. Industrial screening yields large amounts of data, which are generally restricted to a few fairly constant parameters. Furthermore audiometric testing itself originates numeric data, easily subjected to an automatic analysis through a computing device. The necessity to maintain in an easily accessible way a large amount of audiometric data and subject them to automatic analysis, has generated lately a rising interest in the development of so called Expert Systems with the Computer. Between 1983 and 1985 two of us (G.B. and G.P.) developed a comprehensive expert system for general otologic clinical use. This system is able to manage the patient data file (archive) as well as audiometric and vestibular testing data, subjects them to automatic analysis generating diagnostic groups and finally contains statistic routines for epidemiologic evaluations. We have now taken the part of that program centered on the tonal audiometry and the creation and maintainance of the corresponding data files, and rewritten some diagnostic alghorythms in order to conform our diagnostic groups to those in use in industrial audiology [1]. The use of a basic data structure compatible with both occupational health screening and otological clinical results has the advantage of allowing the interchange of data between the otologic and occupational health services of the national health service. In this way data from one service may be read and re-elaborated by the other under different viewpoints without extracosts. This corresponds to the modern philosophy of extending preventive medicine for general health maintainance and in order to keep skyrocketing health costs under control.

Methods

The program first creates patient centered data records divided internally in general patient information (Figure 1), workplace information (Figure 2) and clinical information (Figure 3). The parts 2 and 3 are liberally updatable and as new exams are performed with time, they are added to the patient file as new records. Once a patient name or code number is given, the program searches automatically for it among the available data. If data are found, the new workplace information or clinical audiometric data are added with a new exam number, if no information is found, a new patient data group is created and the system prompts for patient general information. Audiometric data may be digitized in manually or be entered directly through an RS232 interface if an

appropriate audiometer is used. The compatibly formatted data may be obtained by on site testing and memorized temporarily in the audiometric unit attached to a small portable computer, and then downloaded periodically through a modem into the main unit, host of the program. Noise exposure levels are entered manually and calculated as equivalent continuous A-weighted sound pressure levels for 8 daily working hours, exposure time is in years. The exposure equivalent levels are kept in memory as distinct values. The program itself groups them furthermore into the following groups set by us: $\leq 80\text{dB}$, 81-85dB, 86-90dB exceeding 90dB. The audiometric results are automatically subjected to an evaluation as resumed in the chart in Figure 4. The resulting groups are defined as follows:

- Group 0 : Normal audiometry
- Group I-V : Noise damage present [1]
- Group VI : Hearing damage not due to noise.

We have furthermore added the subgroups p/m/t, graded in a scale from 1 to 3 for the perceptive, mixed or transmission hearing loss and its degree. The results of the diagnostic grouping routines are kept with the data record and are so available to other programs, like statistic or predictive programs (see our second paper, p. 157).

Discussion and Conclusions

The program allows to create an otologic occupational health file with a first evaluation of the patient data. Data are ordered by patient name and code, but can be retrieved through a search routine by keywords taken from each single input, searches by date of first visit are equally possible as those by workplace or diagnostic group. Exposure equivalent levels may be searched by distinct values or value intervals. The diffusion of digitalized audiometers has suggested to introduce an input facility through a 3S232 interface, reducing so the worktime of the audiometrists and with this reducing costs sensibly. This also because the program originated in a clinical otologic setting, with the precise request to not only accept data directly, but also to be able to pilot external audiometric devices [2,3]. Personnel worktime uses to be one of the largest cost factors in health screenings and avoiding the reentering of all data from papersheets into the computer may justify the extracost for an interfaceable audiometer.

Keeping not only the exposure level and hearing damage groups on file, but the whole range of audiometric data, has the disadvantage of larger data records, but allows for further re-elaborations and regrouping, if new experience should suggest so in the future. This assures full compa-

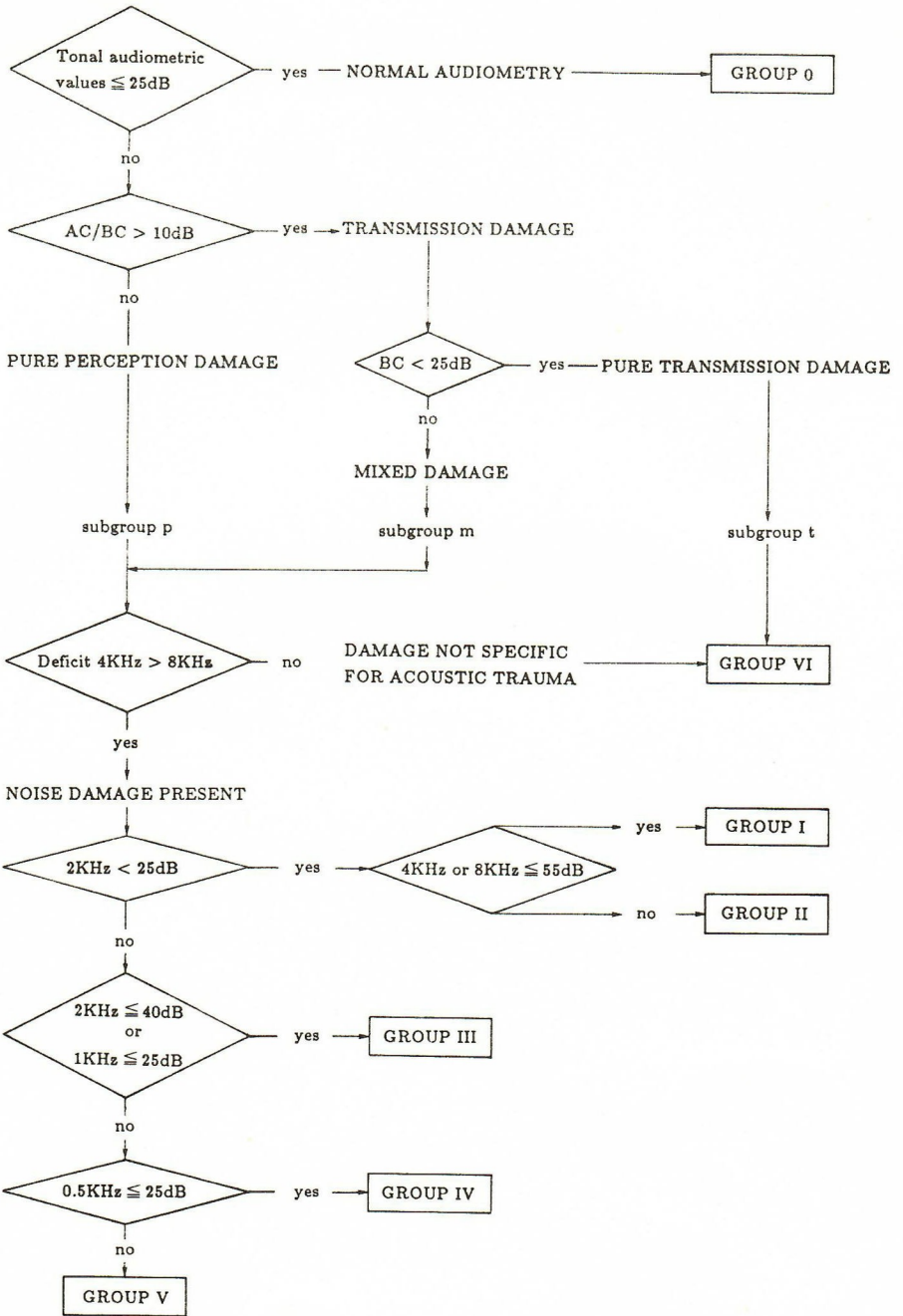


Figure 4 - Decision Flow Chart for the construction of diagnostic audiometric groups. Each ear is considered separately.

rability of patient and workplace data through repeated and future screenings. Furthermore data may be available to other health services for evaluation, avoiding double screening and additional costs. Occupational health screening remains a tool to assure the health of persons and as such it has to be considered as a part in the comprehensive array of medical procedures. Occupational screening is an excellent opportunity to introduce preventive community medicine and its data files should always be set up in accordance with the other interested medical specialists. An efficient collaboration is a must in an advanced country's health service. The development and maintainance of large, nation wide accessible and comprehensive patient data banks will probably be the most important progress in community health management of the rest of the century.

It may be stressed that we do not suggest to attempt to arrive a medical individual diagnosis through our diagnostic groups. We are convinced that this task can never be delegated to a mere machine, as is the computer, but must relay on clinical medical judgement. The diagnostic groups have the only purpose to establish uniform groupings of exposure and damage for the purpose of epidemiological evaluation.

One last caveat may be added, as final thought. Data banks are wonderful tools, but occupational health must never forget to be based and obtain its reason of existence not from some chemical or physical data, but from the persons it is supposed to protect. Collection of large personal data can become very dangerous tool for unjustified invasion of privacy of the patients. In many countries where these banks are starting to work, these preoccupations are already being voiced, like as the Privacy Act in the US and similar discussions in the Federal Republic of Germany and Italy. It has to be avoided that non-medical personnel gains access to personal patient informations through these banks. We are now developing a system of level-oriented codewords to access our program. Medical personnel will so be able to retain full level access, while non-medical personnel will be restricted to informations from which personal patient information, like names, addresses or specific identification, is deleted. We feel that this point cannot be stressed enough each time one talks about gathering data about human beings.

References

- [1] Klockhoff I., Drettner B., Svedberg A., Computerized Classification of the results of Screening Audiometry in Groups of Persons Exposed to Noise, *Audiology* 13, 326-334, 1974.

- [2] **Precerutti G., Broich G.,** La gestione automatizzata del paziente otologico, Congresso Nazionale della Società Italiana di Audiologia, Roma, Ottobre 1983.
- [3] **Broich G., Fresa D.,** I sistemi esperti per la diagnosi otovestibolare, 19° Congresso Nazionale della Società Italiana di Audiologia, Bari, Ottobre 1985.