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Technical Reports

Switzerland: The status of silicosis from the past to the end of the 20th century. Control and prevention

Summary

The silicosis issue in Switzerland is reviewed on the basis of data provided by Suva, the Swiss National Insurance Fund, in charge of law enforcement and of prevention. Pictures of the past period and nowadays consecutively to the occupational medicine surveillance and industrial hygiene practice showed that major improvements have been realized. In the 30's, a constant rise of new cases of silicosis has been observed every year. From 1940 to end of the 60's, a plateau was reached with about 200 to 300 cases per year. Since 1974, a significant decrease is observed, the annual number of new cases being about 100. Since 1989, the new cases level off at 30–50 per year due to drastic control measures and present announced cases are residuals of previous exposures. The number of annual deaths ranges at the unit level with a patient's life expectancy nearly equal to that of the general population. Prevention efforts however should be continued since the activities of concern have changed. Small enterprises with a limited number of personnel dispersed throughout the country, working in the sectors of stone cutting and grinding, civil engineering and cleaning of building surfaces make prevention difficult and may lower its efficiency. In addition, information should also reach categories of individual workers like professional pottery crafstmen or leisure-exposed persons.

Contrary to a commonly spread thinking, silicosis is not an occupational disease of the past associated with works in coal mines although awareness of the consequences of such jobs has greatly contributed to the prevention and mortality reduction. Silicosis has been a major area of concern in occupational medicine in Switzerland and is still the cause of occupational disease in the insurance statistics. Historically, the very first cases of silicosis in Switzerland were recorded since 1906 from observations of a few pneumoconiosis caused in the stone polishing work. At that time, medical doctors made more easily the diagnosis of tuberculosis than that of silicosis. Publication of the two first cases under the silicosis label appeared in 1916. It is worth to notice that abatement measures were already claimed and that following the requests, the employer accepted to financially support the diseased people. The medical experience pertaining to pneumoconiosis was still very limited at that period of time and there was no sufficient evidence to recognise silicosis as an occupational disease entitled to compensation according to the law. By 1932, patients with silicosis were provided with certain assistance. This specific pneumoconiosis was recognised as an occupational disease under Swiss Law in 1938. Until the end of the 80's, the number of silicosis cases still represents the historical heritage from the underground works (drilling of railway and road tunnels, or drilling of water transportation galleries to the Alp damps, exploitation of coal mines and iron mines during the 2nd world war).

This paper reviews available data on the past and present status of the silicosis issue in Switzerland. It addresses the control and prevention policies in the fields of occupational medicine and occupational hygiene in this country. The actual trends of silicosis in the work environment and the still present areas of concern are pointed out.

Legal bases and structures of organization for the protection of workers

The main features can be summarized as follows:

- All workers in Switzerland are compulsorily insured against occupational accidents and diseases according to the law
- SUVA i.e. the Swiss National Insurance Fund which is the organization enforcing the Swiss Occupational Accidents and Diseases Bill was created in 1911. It cumulates the role of a qualified execution body for health and safety at the workplace and a social insurance institution (among other private insurance companies). It was estimated that two-thirds of the workers are insured through SUVA
- Local cantonal institutions (e.g. Institute of Ecotoxicology in Geneva) can have the role of surveillance and compliance verification of the law but are in no case mandated to give a decision on occupational diseases.
- It is clear from the law that the employer is responsible of the working conditions and of the workers health. Workers must collaborate to the preventive and control measures. Although SUVA has contributed to a great deal in helping employers and employees to control the risk of silicosis, employers can seek help from private consulting health and safety firms or from other specialists in academic institutions.

Development and evolution of research on silicosis

The first "scientific study and struggle group" against silicosis was created in 1944–1945 in Zurich. In 1960 a monography including all scientific works ever published on silicosis in Swiss journals from the years 1945 to 1960 was compiled by Rüttner[1]. A symposium entitled "50 years of fight against silicosis in Switzerland" was organized at the initiative of the occupational medicine group of SUVA in 1982[2]. Maillard et al. presented the trends after half a century of observations[3]. At present, there is no fundamental research conducted on silicosis so far in Switzerland except publications in the form of medical thesis[4,5]. SUVA and the IST-Institute of Occupational Health Sciences in Lausanne are the rare places which offer services for the determination of cristalline silica in dust samples using either X-ray diffraction or Fourier transformed infra red methods.

Control and prevention through occupational medicine surveillance

Similar to other countries elsewhere, radiology plays a critical role in the medical surveillance of exposed subjects for the early diagnosis and for the follow-up of the established silicotic patient. The standardized diagnosis of silicosis is based on the chest X-ray radiography classified according to the 1980 International Labour Office (ILO)[6]. The general principles of the medical surveillance of exposed workers as those applied in this country consist of:

1. *The hiring examination.* Engaged persons in an insurance-contracted company whose activity presents a known risk for silicosis must be announced to SUVA within two weeks. In the 15 days that follow, they are examined by the SUVA doctors according to a standard protocol on an official printed form. The medical examinations are essentially relevant to the respiratory system (anamnesis, stethacoustic examination, thoracal radiography; for foundries, only pulmonary function is performed).

2. *The periodical control examination.* As a general rule, exposed persons are reexamined every 3[5] years depending on the level of risk according to the same protocol as for the hiring examination.

3. *The surveillance and treatment of the accepted silicotic patient.* Recognition of the degree of invalidity by SUVA is based on fixed rigourous criteria. The alterations of the pulmonary function serve as a basis, not the radiographic pictures. The accepted patient is submitted to:

- regular medical surveillance, the frequency of which is dictated by his health status,
- regular bacteriological surveillance of the expectorates at stage I–II of the disease,
- a chimioprophylaxis against tuberculosis in certain particular cases.

In the absence of an efficient treatment of the disease cause, measures against the symptoms are taken to reduce the suffering of the patient like treatment of chronic bronchitis, treatment of the core pulmonale, treatment of the pulmonary tuberculosis[7]. The association between silica exposure and lung cancer is considered significantly non relevant yet by the SUVA and is not recognized for compensation in this country. This will probably change in the near future due to the recent IARC publication[8] reclassifiying definitely silica as a human carcinogen (class 1) based on sufficient epidemiological data.

Evolution of reported cases. Trends records

The data compiled hereafter from 1930 to nowadays were obtained from the Swiss National Insurance Fund. We have considered the data

Periods of announcement	Total announced cases	Deaths by all causes	Deaths attributed to other causes	Other denied cases
1930–1937	154	150	22	4
1938–1942	482	411	72	71
1943–1947	1382	988	278	394
1948–1952	1152	791	239	361
1953–1957	1330	839	289	491
1958–1962	1197	717	262	480
1963–1967	1343	560	228	783
1968–1972	1573	311	150	1262
1973–1977	843	102	46	741
1978–1980	234	17	6	217
Total cases	9690	4886	1592	4804

Table 1. *Past Situation. Recognized deaths by silicosis among announced cases and mortality attributed to other causes from 1930 to end 1980.*

from 1930 to 1980 as those of the past situation which corresponds to the 50 years of struggle against silicosis in Switzerland and also to the observed breakthrough. The years from 1981 to nowadays represent the present situation.

Past situation

Table 1 shows the past situation from 1930 to 1980 and data on the compensation recognition and insurance acceptance. Since the criteria for silicosis recognition are rigourously fixed and applied throughout decades, data and trends present a reliable consistency. Out of a total of 9690 announced cases, the rate of deaths attributed to silica exposure was 34%. When medical doctors suspected case to be in relation with silicosis, the patient is declared to the medical staff of SUVA which then state on the degree of recognition and acceptance for compensation according to its defined criteria. Cases are denied when SUVA estimates that the death cannot be ascribed to silicosis or are denied afterwards with loss of compensation when the invalidity (e.g. decrease of lung function) was reexamined and attributed to other causes than occupational factors. Figure 1 shows the diminishing trend of death by silicosis in the course of time from 1930 to 1982 due to technological progresses and to prevention measures. Since Switzerland has no coal mine, 70% of the cases come from the excavation operations during this past period, 16% from foundries and 5% linked to activities with the ceramics.

Present situation

Figure 2 shows the data on the various degrees of compensation over the last 13 years from 1981 to 1993. On the average, 65% of the

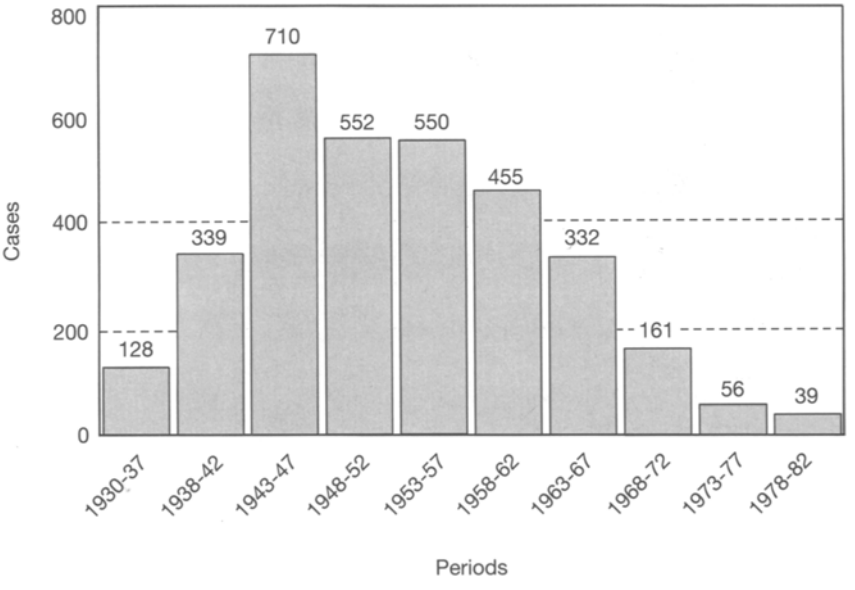
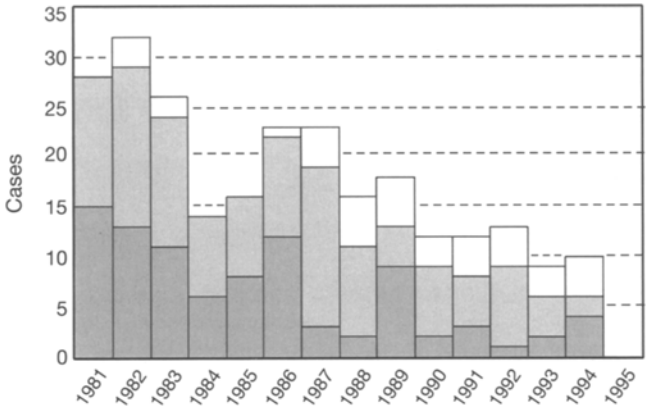


Figure 1. *Past situation. Silicosis: Number of deaths over 5 year periods.*



	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Medical indemnity	0	3	2	0	0	1	4	5	5	3	4	4	3	4	0
Invalidity pension	13	16	13	8	8	10	16	9	4	7	5	8	4	2	0
Survivor pension	15	13	11	6	8	12	3	2	9	2	3	1	2	4	0

Figure 2. *Present situation. Silicosis: Total compensated cases.*

total announced cases were not considered health-prejudiciable and therefore do not receive compensation. Associated to prevention measures, the mortality statistics seem to indicate that a baseline level is reached (Fig. 3). The evolution of the mean age at death from the past to the present time is shown in Figure 4. The mean age at death of insured silicotics comes more and more closer to that of the swiss masculine resident population above 20 years old. In the year 1930–1937, the difference of age at death between the two populations is more than 15 years. Nowadays there may be no difference but it should be borne in mind that the impaired persons are very invalidated. Over the period from 1981 to 1993, the mean age at the announcement of the health impairment is 61 while the mean age at death is 74 years. It is expected that silicosis will be diagnosed in patients showing no symptoms or mild disability after the age of 50. At this background level, pneumoconiosis will interfere to a lesser extent with life expectancy, and will not be death-damaging while geriatric diseases and various types of cancer will account at the same level.

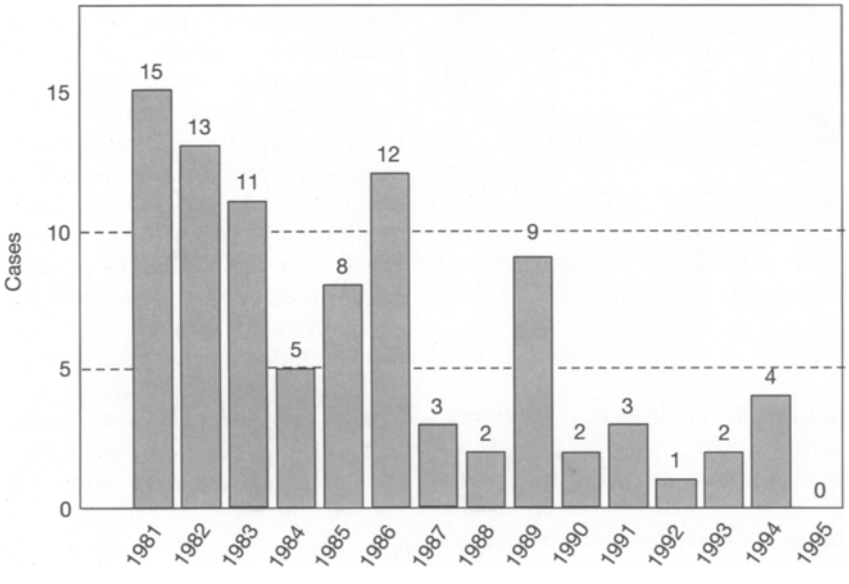


Figure 3. *Present situation. Silicosis: annual number of deaths.*

Figure 5 shows the data on the prophylaxis of population exposed to the risk of quartz dust. The evolution of the number of insured enterprises and insured workers as well as the number of medical examinations over the years presents a slight decrease. Data on the same topics concerning the previous decades (1950–1980) are in the same order of magnitude.

Prevention by occupational hygiene and information

This activity includes several types of actions:

- The measurement of exposure to quartz dusts is an integral part of the health risk assessment. Dust samples are collected and analyzed for their contents in free cristalline silica which are compared with the Swiss list of threshold limit values. Depending on the content of cristalline SiO_2 in the dusts[9], the swiss permissible exposure limit (PEL) is:
  - 0.15 mg/m³ when the content of SiO_2 is > 4% (w/w) in the respirable fraction
  - 4 mg/m³ when SiO_2 is 1–4% in the respirable fraction
  - 6 mg/m³ when SiO_2 is 0–1% in the total dust collected.

For amorphous silica (including uncalcined diatomaceous earth), the PEL is 4 mg/m³ in total dust. The PEL is 0.3 mg/m³ of the respirable fraction for quartz glass (also fused silica, silica fume and calcined diatomaceous earth). In

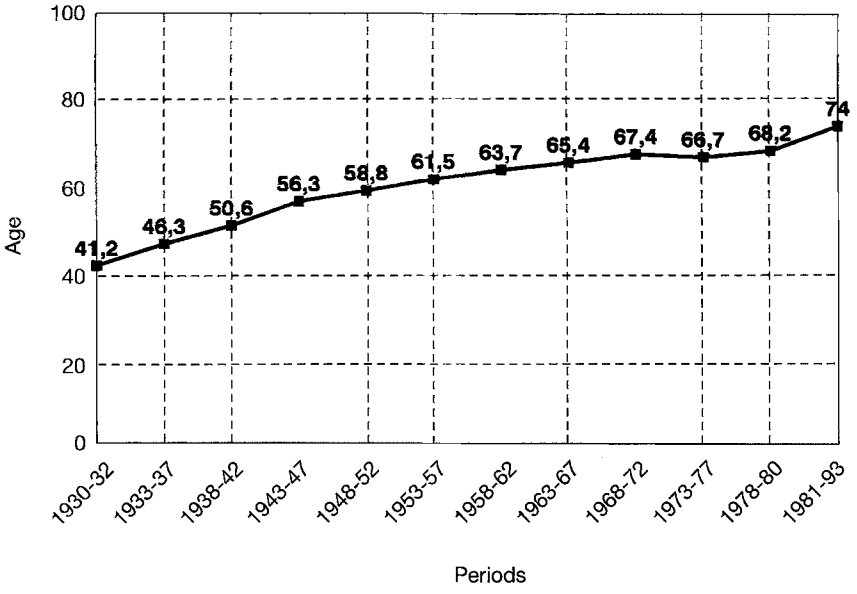


Figure 4. *Past to present situation. Silicosis: Mean age at death.*

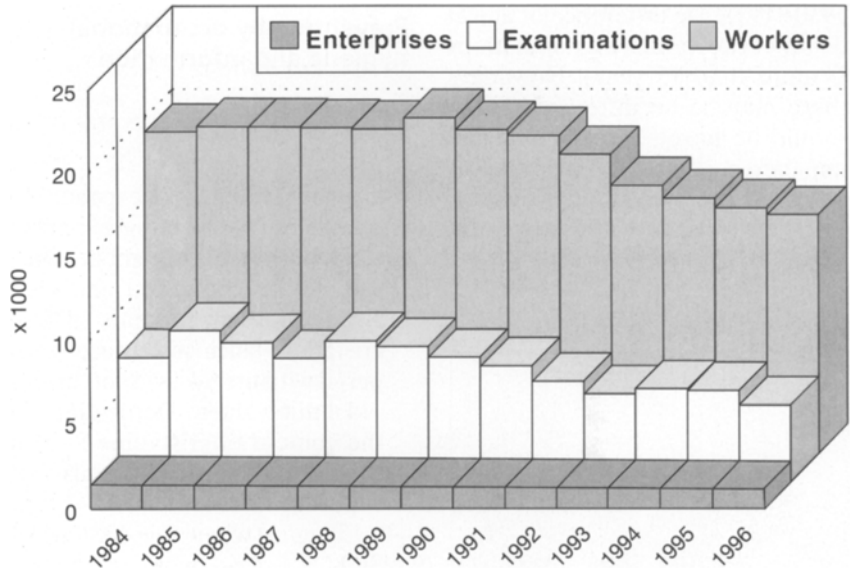


Figure 5. *Present situation. Prevention of silicosis: Trends of statistical data on the number of enterprises and workers under surveillance.*

comparison, the swiss PEL is less severe than those of other countries 0.1 mg/m^3 for quartz or 0.05 mg/m^3 for trydimite and cristobalite[10,11].

Campaigns of measurements are carried out in typical branches of industrial activities e.g. a) Exposure to quartz sand in foundries. Measurement actions from 1984 to 1987 in iron and steel foundries[12]; or b) Exposure to (silica) dust in construction[13]. Miscellaneous determinations have also been conducted by local control institutions (ECOTOX) e.g. c) Exposure in the stone works[14].

- Edition of state of the art guidelines and of information booklets. Organisation of compaigns of prevention. Now, SUVA also collaborates with the industry on how to address safety issues, for example in the "civil engineering work of the next century" for Switzerland (digging of the new giant Alp tunnels by 2010).
- SUVA regularly conducts operations and campaigns for the promotion of safety and hygiene at work, oriented on the fundamental points of the accidents process and of occupational diseases. The objectives of the information campaigns are to increase the awareness of the personnel in enterprises and also that of the general public to dangers. By sensitizing the people to the importance of health and safety, it is hoped that the information campaigns give rise to adequate behaviors.

Technological prevention

In Switzerland, the technical measures against quartz dust started in 1948 when wet drilling was made compulsory, initially in underground mining and excavation. The introduction in the course of time of up-to-date technology and the change of process are factors of progress and greatly contribute to limiting exposures to quartz dusts. The use of quartz sand to clean metal pieces (sandblast) was forbidden in 1960 or exceptionally authorized for very specified cases. Nowadays in place of quartz sand, blasting with materials like corindon, carborundum, scories sand, or steel shot are recommended.

Conclusion

The results and the situation presented in this paper are issued from the official statistics of the national insurance company. It emphasized the insurance view of the situation and probably not the occupational health view in the general swiss public health framework. Unfortunately no data exist to support this point. No information is available to estimate the number of cases rejected by the insurance but which are indeed in relation to the working conditions. Moreover, it is also possible that exposure to quartz in relation to other hazards (fumes of diesel engines for instances) favour other diseases not actually recognized by the insurance (such as lung cancer). In other words, the overall picture presented here may be only one aspect of the real situation in Switzerland.

In this country, the incidence of silicosis becomes for the SUVA a less important concern than before. The annual incidence of silicosis has evoluted in 4 phases: 1) from 1930 to 1940, a constant rise of new cases has been observed every year; 2) from 1940 to end 1960, a plateau was reached with about 200 to 300 cases per year; 3) Since 1974, a rapid decrease is observed, the number of new cases being about 100; 4) Since 1989, the new cases should level off at 30–50 due to drastic control measures. Present announced cases come from previous exposures. One can conclude that major improvements have been realized concerning classical exposures (mines, tunnel drilling).

However, silicosis cannot be considered as an eradicated occupational disease insofar the word appropriate. The risk still exists since a few areas of concern remain in Switzerland and continuing effort must be pursued in the stone cutting und grinding industry, in civil engineering and in cleaning of building surfaces. The limited number of personnel (6 on the average) distributed in a great number of small enterprises dispersed geographically throughout the country, make the prevention difficult und lower the yield of prevention. In addition to the above enterprises, small workshops of dental prosthesis makers also represent workplaces at risk. Moreover, home or leisure pottery workers may also be exposed to silica. It would be informative now to examine the new cases in relation with the nature of exposure.

The workers and other exposed persons should be kept informed of the risk and convinced to use protective equipment.

The hazards related to quartz should also be considered in much a broader perspective than before. As stated above, the other diseases or interactions related to silica should be investigated. Occupational health and safety problems have to be treated in a broad and professional way by the companies themselves with the help of internal or external specialists as the swiss new laws require to do so[15–17]. This comprehensive professional approach fits with the new trends at the international levels and in Europe. It complies with the UE directives.

Zusammenfassung

Zur Situation der Silikose in der Schweiz am Ende des 20. Jahrhunderts. Kontrolle und Prävention

In den 30er Jahren wurde alljährlich ein konstanter Anstieg neuer Silikosefälle registriert. Von 1940 bis Ende der 60er Jahre wurde ein Plateau von 200 bis 300 Fällen pro Jahr erreicht. Seit 1974 stellt man eine bedeutende Abnahme fest. Die jährliche Anzahl neuer Silikosefälle betrug rund 100. Seit 1989 zählt man noch 30 bis 50 neue Fälle pro Jahr. Bei diesen handelt es sich noch um Folgen von früheren Expositionen. Die aktuell geringe Anzahl neuer Silikosefälle ist auf die strengen Vorbeugungsmassnahmen zurückzuführen. Die Lebenserwartung von Personen, die von Silikose betroffen sind, entspricht in etwa derjenigen der allgemeinen Bevölkerung. Die Prävention muss weiterhin aufrecht erhalten werden, denn die Aktivitäten, die ein Silikose-Risiko beinhalten, haben sich geändert. Die Prävention ist schwierig, weil viele kleine Unternehmen betroffen sind. Diese Unternehmen arbeiten im Bereich der gesteinsverarbeitenden Industrie, im Baugewerbe usw. Die Verschiedenheit dieser Aktivitäten verringert die Wirksamkeit von Präventionskampagnen. Es ist nötig, dass auch in Zukunft die Informationen bezüglich Prävention die verschiedensten Kreise erreicht, nämlich sowohl die verschiedenen Kategorien von individuellen Arbeitern wie z.B. Handwerkern im Bereich der Keramik sowie auch Personen, die in ihrer Freizeitaktivität dem Quarzstaub ausgesetzt sind.

Résumé

La situation de la silicose en Suisse en fin de 20è siècle. Contrôle et prévention

La situation de la silicose en Suisse est passée en revue sur la base des données de la Suva, Caisse Nationale Suisse d'Assurance chargée de la prévention et de l'application de la législation. A l'exception des décennies 40–60, à la suite des mesures de surveillance médicale et de la mise en pratique de l'hygiène industrielle, les statistiques montrent d'abord une stabilisation à partir de 1974 puis une nette amélioration depuis 1989. Le nombre de nouveaux cas se situe au niveau de 30–50 par an grâce aux mesures sévères de contrôle et les nouveaux cas ne sont que la conséquence des expositions passées. L'espérance de vie des sujets se rapproche de celle de la population générale. Bien que les principales améliorations aient été réalisees, les efforts de prévention doivent se poursuivre car les activités présentant un risque de silicose ont changé. De petites entreprises avec un nombre limité de personnel, dispersées à travers tout le pays et travaillant dans des secteurs comme l'industrie de la pierre (coupage et broyage), la construction, le nettoyage au jet des surfaces d'immeubles rendent la prévention difficile et réduisent l'efficacité des efforts de prévention. Il faut par ailleurs, continuer à faire parvenir l'information aux catégories de travailleurs individuels comme les artisans dans la céramique ou les personnes exposées dans les activités de loisir.

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