

**EPIDEMIOLOGY OF
WORK ACCIDENTS,
LEGISLATION AND
THEIR PREVENTION
THROUGH
COMPUTERIZED
READINESS
ASSESSMENT TESTS: A
NARRATIVE REVIEW¹**

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¹ part of the first author's master's thesis

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Abstract: The aim of this study is to present a historical series of the epidemiology of accidents at work, in the last 20 years, discussing their prevention in the light of the National Occupational Health Policy and seeking to identify evidence of the use of technological innovation tools in the health area, for the reduction of accidents at work. Because it is a comprehensive topic, it was decided not to answer objective and closed questions. A narrative review was used as a method, which meets the proposed objectives well and allows for a broader discussion. The most relevant studies were used, obtained by an arbitrary and non-systematic selection, published in the last 10 years, in the Scopus, PubMed and Google Scholar databases, official Government websites, in addition to gray literature, based on the keywords epidemiology, work accidents, legislation and computerized tests. Despite the existence of old legislation, the occurrence of improvements in the field of work was observed, but this improvement did not contribute to the effective reduction of accidents at work and associated diseases. It is possible that the consequences of the COVID-19 pandemic contribute to an increase in the prevalence of occupational diseases. A tool such as the Computerized Readiness Assessment Test (FOCOS/Prontos System) is promising in preventing countless deaths due to accidents at work, with case studies demonstrating accident prevention and reduction.

Keywords: Occupational Health Policy. Work accidents. Computerized tests, attention.

INTRODUCTION/DEVELOPMENT

Occupational accidents, of multifactorial etiology, continue to claim victims all over the world, being a concern of national and international organizations, focused on prevention. Therefore, this review sought to present the historical series of

epidemiological data on accidents at work, discussing prevention of accidents in the light of the National Occupational Health Policy and identify technological innovations in the health area, seeking to highlight the contributions of these tools in reducing accidents at work.

Given the scope of the theme and the difficulty in establishing a precise research question, the narrative review was used to enable an expanded discussion. A non-systematic review was carried out of the most relevant studies published in the last 10 years. recent data on the epidemiology of accidents at work, legislation and new technologies for accident prevention were shown. The bibliographic search was carried out in the Scopus, PubMed and Google Scholar databases and official Government websites. The keywords epidemiology, work accidents, legislation and computerized tests were used. The arbitrary selection of articles subject to selection bias was admitted, but which perfectly met the debate and the updating of knowledge on the chosen theme.

Despite the fact that work appeared in the beginnings of humanity, the relationship between work activities and diseases remained ignored until about the last two centuries, when groups of entrepreneurs, foreseeing the possibilities of increasing production, decided to acquire spinning and weaving machines and employ people to make them work, replacing the labor of craftsmen. The improvisation of factories and the workforce made up mainly of children and women, associated with the absence of working hours limits, excessive noise caused by primitive machines, precarious lighting, closed environments with little ventilation were the probable causes of countless accidents and many other diseases, such as infectious diseases¹. Even so, it is recognized that work is linked to the development of civilization,

and has been undergoing transformations and gaining ground in law, health and labor safety².

Estimate of WHO/ILO3 on illness and injury in the workplace, reported the deaths of 1.9 million people in 2016. Between 2000-2016, there was a 14% reduction in deaths from work-related deaths, and most of these deaths were respiratory and cardiovascular diseases. A Deaths from heart disease and stroke associated with exposure to long work hours increased by 41% and 19%, respectively. Noncommunicable diseases were responsible for 81% of deaths. The major causes of death were chronic obstructive pulmonary disease (450,000 deaths); stroke (400,000 deaths) and ischemic heart disease with 350,000 deaths³.

Occupational injuries caused 19% of deaths (360,000 deaths).The major occupational risk factors were associated with exposure to long work hours(750,000 deaths); air pollution in the work environment(450,000 deaths);carcinogenic substances;ergonomic risks and noise.To the work-related injuries and illnesses strain health systems, reduce productivity and can have a catastrophic impact on household incomes.Are required more actions that guarantee healthier, safer, more resilient and socially just workplaces, with a central role focused on workplace health promotion and occupational health services³.

An ecological study evaluating occupational diseases in the period 2009-2017, concluded that there was a trend towards an absolute and relative reduction in work-related diseases, identifying women as at greater risk and with greater involvement in the 40-49 age group. Mental disorders were the most identified².

OAEPS (Statistical Yearbook of Social Security) 2021⁴, indicated, increase in accidents at work across the country compared to 2020 data. The possibility of this increase being associated with the resumption of medical expertise discontinued due to

the COVID-19 pandemic. That is why the AEPS recommended the inadequacy of using the 2020 data to understand the behavior of accidents in the country, within the normality of the historical series since, statistically, the data for that year were strongly impacted by the pandemic period, choosing to use data from 2019⁵. As in Europe, it is possible that working at Home Office has contributed to the reduction of accidents in Brazil⁶.

The theme related to accidents at work is important, since accidents can generate impacts both from the biological point of view, such as the death of workers, in addition to social costs, related to the family and society, and economic impacts, since, the cost of the accident to Social Security is extremely expressive.

The COVID-19 pandemic may also have had an impact on the occurrence of diseases and may continue to have an impact in the future as a result of the still unknown consequences of the pandemic. In 2021, 5,664 benefits were paid for permanent disability against 5,638 paid in 2020. Among the sectors of economic activity in which the most accidents at work occurred, the AEPS recorded that among the first six they are 1) Health and Social Services activities (84,780 accidents); 2) Trade and Repair of Motor Vehicles (77,491); 3) Services Provided Mainly to the Company (41,291); 4) Food and Beverage Products (38,867); 5) Construction (34,219) and 6) Transport, Storage and Post Office with 33,267 accidents at work⁵.

The President of the National Association of Labor Attorneys (ANPT), Ângelo Fabiano Farias da Costa, in a speech in the Chamber of Deputies, reported in a session held on 04/25/2018, that Brazil registers about 700 thousand accidents at work per year and that the figures from the first quarter of 2018 show that estimated expenses with accident

benefits in the country already exceed BRL 1 billion. During this period, more than 150,000 Occupational Accident Reports were issued, including 585 fatal victims⁷.

Accidents at work also generate other problems and expenses that increase the cost of accidents in the country. The companies bear the salary of the injured employee in the first 15 days of leave (from the 16th day, the INSS pays) and costs with interruption of work, replacement and training of labor, damage to machinery, delay in schedule of delivery, fines, increase in the accident insurance contribution and payment of indemnities.

Victims, on the other hand, have expenses with medication, additional medical assistance, transportation, reduced purchasing power and trauma. When there is death, the material damage caused is immeasurable, not to mention the psychological damage to the family, resulting from the pain of loss and the lack that the person will make for the development of the family nucleus.

It is worth noting that the data contained in the AEPS are important official statistical indicators in the country with regard to accidents at work. For society, these data are important, as they call for greater inspection in aspects related to accident prevention and compliance with labor legislation. In addition, these cataloged data referring to the rates of accidents at work allow public institutions and society to discuss the social and economic issues linked to accidents at work and collaborate greatly so that the Public Power invests in public policies for safety and health at work, becoming an important tool to guide public policies related to the health and safety of the worker⁸.

Thus, despite the changes that have taken place in the world of work, the Brazilian legislation that deals with accidents at work has been in place for more than three decades. Law No. 8213, of July 24, 1991⁹, which

provides for Social Security Benefit Plans, conceptualizes an accident at work as one that occurs due to the exercise of work at the service of the company, or due to the exercise of the work of the special insured, causing bodily injury or functional disturbance of a temporary or permanent nature.

Tables 1, 2 and 3 show data from the AEPS on the average number of work-related accidents and illnesses in Brazil over a period of 20 years; status of registration and reason for the accident (2021) and liquidated work accidents, consequently (2021)¹⁰.

Decade/Year	Workers	Number of Accidents at Work				Total Accidents
		With Registered CAT			No Registered CAT	
		Typical	Path	Illness		
Middle 1970's	12,428,828	1,535,843	36,497	3,227	-	1,575,566
Middle 1980's	21,077,804	1,053,909	59,937	4,220	-	1,118,071
Middle 1990s	23,648,341	414,886	35,618	19,706	-	470,210
Middle decade 2000	32,970,507	370,205	63,549	24,002	181,727	512,275
Middle decade 2010	47,010,784	395,605	105,459	14,662	136,330	652,056
Average 2021/2022	46,236,176	322,903	61,014	33,575	48,280	465,772

* Partial data missing EC Oct Dec, RS Apr Dec, DF Jun A Dec, AC and RO Jan A Dec.

** Partial data missing MA Aug to Dec, RS Jan to Dec and DF Aug to Dec.

Table 1 - Average accidents and occupational diseases in Brazil, from 1970 to 2021

Source: MTE/RAIS, MTPS/AEPS¹⁰.

Regions	Workers	Number of Accidents at Work								Total	Accidents/ 100 thousand Jobs
		With Registered CAT						No Registered CAT			
		Typical	%	Path	%	Occupational Disease	%	Registered CAT	%		
North	2,808,709	13,687	63.08	3,854	17.76	773	3.56	3,383	15.59	21,697	772
North East	9,030,950	30,987	52.99	11,951	20.44	2,227	3.81	13,311	22.76	58,476	648
Southeast	23,877,668	188,118	66.63	52,254	18.51	10,938	3.87	31,029	10.99	282,339	1,182
South	8,722,449	85,362	67.6	19,195	15.2	3,459	2.74	18,251	14.45	126,267	1,448
Midwest	4,289,081	27,719	64.2	8,360	19.36	1,867	4.32	5,233	12.12	43,179	1,007
ignored	14	3,520	83.49	612	14.52	84	1.99	-	0	4,216	
Brazil	48,728,871	349,393	65.16%	96,226	17.95%	19,348	3.61%	71,207	13.28%	536,174	1,100

Note: Data are preliminary and subject to corrections.

Table 2 - Accidents at work by registration status and reason, in 2021

Source: MTE/RAIS, MTPS/AEPS¹⁰

Regions	Consequence														Deaths / 100 thousand Work
	Workers	Assistant		Incapacity temporary						Incapacity perm.	Deaths	Total			
		Doctor	%	- 15 days		+ 15 days		%							
				Total	%	%	%								
North	2,808,709	4,920	22.18	16,796	75.73	13,415	60.48	3,381	15.24	288	1.3	176	0.79	22,180	6
North East	9,030,950	10,920	18.3	47,599	79.77	34,317	57.51	13,282	22.26	818	1.37	337	0.56	59,674	4
Southeast	23,877,668	61,570	21.53	221,002	77.27	189,771	66.35	31,231	10.92	2,347	0.82	1,081	0.38	286,000	5
South	8,722,449	28,860	22.43	97,480	75.75	79,244	61.58	18,236	14.17	1,768	1.37	581	0.45	128,689	7
Midwest	4,289,081	9,275	21.08	33,943	77.15	28,711	65.26	5,232	11.89	443	1.01	333	0.76	43,994	8
ignored	14	349	8.17	3,875	90.71	3,872	90.64	3	0.07	-	0	48	1.12	4.2	
Brazil	48,728,871	115,894	21.27	420,695	77.22	378,041	69.39	71,365	13.1	5,664	1.04	2,889	0.53	544,809	6

Note: Data are preliminary and subject to corrections.

Table 3 - Accidents of work liquidated, consequently, in 2021

Source: MTE/RAIS, MTPS/AEPS¹⁰

Still on the accident at work, art. 21 of Law n° 8.213/91⁹ defines other causes that contribute to death, such as: a) temporary or permanent injury to the worker, occurring at the workplace and working hours; b) those resulting from intentional physical harm, including by a third party; c) by reason of work-related dispute; d) act of imprudence, negligence or malpractice of a third party or co-worker; e) act of a person deprived of the use of reason; f) collapse, flood, fire and other acts of God or resulting from force majeure; g) illness resulting from accidental contamination of the employee in the exercise of his activity; h) accident suffered by the insured person even outside the workplace and working hours in the execution of an order or in the performance of a service under the authority of the company, in the spontaneous provision of any service to the company to avoid damage or provide profit, while traveling on business of the company, including for study when financed by the company within its plans for better training of the workforce, regardless of the means of transportation used, including a vehicle owned by the insured,

With regard to legislation, the Consolidation

of Labor Laws (CLT) has, in Chapter V, 16 specific sections on Occupational Safety and Medicine and, shortly after the writing of this chapter, in 1977, the Ministry of Labor approved the Ordinance n. 3214, of June 8, 1978¹¹, referring to the Regulatory Norms (NR), related to the safety and medicine of the work¹², which are the set of requirements and procedures related to occupational safety and medicine, mandatory observance of private and public companies and government agencies that have employees governed by the Consolidation of Labor Laws¹³.

This way, despite the transformations that occurred with the creation of the National Policy on Worker and Worker Health, all companies, public or private, that have workers governed by the CLT must observe the Regulatory Norms (NR), related to Safety and Medicine of Labor. Among these Regulatory Norms (NR), NR-7 stands out, as it deals specifically with preventive measures of occupational medicine, establishing, according to topic 7.1.1 of the referred norm, the obligation of elaboration and implementation, by all employers and institutions that hire workers as employees,

of the Occupational Health Medical Control Program(PCMSO), with the objective of promoting and preserving the health of all its workers¹⁴.

The regulation brought by NR-7, in addition to being a legal requirement provided for in art. 168 of the CLT, is supported by Convention 161 of the ILO, which dealt with the safety and health of workers. The norm has a prevention character and allows the control of the workers' health according to the risks to which they are exposed in the execution of their tasks, early diagnosis of diseases related to work or not, respecting ethical, moral and ethical principles.technicians¹⁵.

Article 168 of the CLT deals with the obligation of medical examination, on behalf of the employer, upon hiring the worker, upon dismissal and periodically. The frequency of these exams is defined by the Ministry of Labor, according to the risk of the activity and the time of exposure of the worker to occupational risks. Although the program does not have a model to be followed, nor a rigid structure, its level of complexity basically depends on the risk existing in each company and the physical and psychological demands of the activities carried out¹². It is noteworthy that the CLT is old and the laws must adapt to the time, in order to take into account the social and economic changes that occurred in the period.

According to the articles of the aforementioned NR7 mentioned below, the minimum aspects that must be followed are verified, as well as the exams that must be carried out, since article 7, item XXII, of the Federal Constitution of 1988, says that the right to reduce the risks inherent to work, through health, hygiene and security¹⁶.

Thus, our constitution implies that the fundamental social right to health is the foundation that comprises the right to mental health of workers, corroborated and ratified

by the various international conventions and pacts on workers' health and safety.

In Convention 161 of the International Labor Organization (ILO) occupational health services are established, which designate a service with essentially preventive functions and responsible for advising the employer, workers and their representatives in the company on the necessary requirements to establish and maintain a safe and healthy work environment, in order to favor optimal physical and mental health in relation to work and, on adapting work to the capabilities of workers, taking into account their state of physical and mental health. Furthermore, this Convention, together with ILO Convention No. 155, considers the fact that health is influenced by different factors, whether in the work environment or outside it, and registers the essentiality of the mental element to achieve perfect health.worker¹⁷.

In this context, the Computerized Visual Attention Tests (TCAV) emerged in the work environment as a tool to comply with the NR-7 regarding the mental examination, allowing the tracking and monitoring of the worker's mental health by producing elements so that the company can take effective measures to treat the illnesses and is not held responsible for repairing the damage caused to workers by work-related mental illness, meeting the requirements of the legislation current¹⁸.

TCAV are modern mechanisms and have been used for the analysis of neuropsychological capacity in different areas of knowledge. This ability is measured by neuropsychological assessment, a procedure that aims to investigate cognitive functions (complex knowledge) and fine motor activity, seeking to elucidate attention, memory and sense of perception disorders, in addition to specific cognitive alterations such as gnosis, abstraction, reasoning, calculation and planning capacity, as well as their differential

diagnoses¹⁹.

Different studies in different fields of knowledge use TCAV. In an important study carried out in 2003, 30 volunteers without cognitive complaints and 15 with cognitive complaints, attested by caregivers, were chosen. The research volunteers with complaints presented lower responses than the normal volunteers, therefore, it is possible to differentiate those who presented attention deficits through computerized tests, which allowed them to conclude that the computerized evaluations identified significant effects in the detection of attentional deficit²⁰.

Another important application is the use of computerized tests in the detection of patients with Mild Cognitive Disorder (MCI). The sensitivity and specificity of computerized tests in these patients were also evaluated in studies by Loewenstein et al. (2000)²¹ and De Jager et al. (2003)²². Fifty-one control patients, 29 patients with MCI and 60 patients with possible or probable Alzheimer's disease (AD) were selected. Comparing the patients, the influence of age and level of education on the performance of the tests was demonstrated, in addition to an inversion between the speed of responses to stimuli and increasing age. This same finding related to fluctuations in response speeds was also demonstrated in the study by Cabral (2004)²³.

More recently, Inoue et al. (2009)²⁴ applied computerized tests to detect Attention Deficit (AD). The selection consisted of 174 individuals, including patients with AD and normal patients without AD, who underwent computerized neuropsychological tests that contained four tasks, subdivided into: three-word memory test; temporal orientation test; three-dimensional visual-spatial perception test; and recall memory test. The results identified that there was a great difference in the total score of the four parameters between

the groups and in each of the tasks, with a sensitivity of 96% and specificity of 86%, as verified by the ROC curve.

Cabral (2004)²³ evaluated elderly people with cognitive complaints, whose purpose was to clinically assess and identify the TCL, through computerized tests of attention. It was shown that schooling can be a predictor of dementia and that the computerized tool is as effective as the Mini Mental State Examination (MMSE). significant in Brazil, since the country still has a considerable illiteracy rate.

There are numerous advantages of using the TCAV, such as the absence of errors by the applicator regarding the quantification of correct answers, the possibility of developing automated reports, with faster generation of results, the ease of application, in addition to allowing the measuring the response time of those who perform the test is more accurate²⁵⁻²⁸.

A great example of the use of computerized neuropsychological assessment tests is the one that occurs in the Neurophysiology and Neurobehavioral Assessment laboratory at "Universidade Estadual do Rio de Janeiro", UERJ, with several publications^{23,29-38}.

Studies using computerized tests have been important and have shown significant results that various authors have suggested the use of these tests to screen for population with cognitive impairment in general, as can be seen in the study by authors Inoue et al. (2009)²⁴ and also in the study by Cole and Tak (2006)³⁹, who used computerized batteries to analyze attentional capacity, and emphasized the need for greater use, due to the ease of application, as also described in the works by Twamley, Ropacki and Bondi (2006)⁴⁰ and Rapp and Reischies (2005)⁴¹.

Mayrink (2015)¹⁸ was the first to use computerized attentional tests on chemically dependent workers in order to assess cognitive

performance (memory and attention). 82 young adult workers with chemical dependency underwent computerized tests, compared with workers who did not use drugs. The performance of the attentional parameter was confronted with that of normal young adults and memory with that of normal elderly people. The author wanted to know whether chemically dependent young adult workers would have lower attentional performance than normal young adults when submitted to the Computerized Test for Readiness Assessment (FOCOS/Prontos System) also called attention tests or fitness for duty assessments.

Recognizing the importance of the various impairments related to attention deficit, a study is warranted that seeks to track it, as well as the use of methodologies that help in the assessment of these impairments, allowing greater awareness of the population and targeting of therapies oriented according to the deficits observed in the work environment, given the high number of work accidents caused, above all, by attention deficit, a fact that may suggest declines in physical and mental conditions so truncated with the origin of work accidents. There are many case studies available demonstrating that the adoption of technologies reduce accidents but more robust studies are needed to prove that this is in line with Brazilian legislation and regulatory standards. One must also highlight the pioneering value, since it is an innovative methodology.

CONCLUSION

A tool such as the Computerized Readiness Assessment Test (FOCOS/Prontos System), already implemented in numerous companies of different sectors, has many case studies already demonstrating accident prevention and reduction and is promising in preventing countless deaths due to accidents at work.

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