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Massive and Repeated Molecular Testing a Tool in the Pandemic Covid-19 Prevention Management System

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Abstract – The management of a crisis must be integrated into an ergonomic framework of the necessary measures. These measures need to be, efficient and providing the yield according to expectations, with minimal impact of the people and provide to change crisis processes to the normality. Crisis management involves applying pre-existing measures, preparatory for the entry of the crisis, for deployment (to eliminate the causes and to diminish the effects), for adaptation. In addition to generic measures, it is necessary (like the preventive system of management of occupational safety and health - OSH), to use appropriate tools: risk assessment, feedback for the measures taken, and for implementation of adaptive measures. These tools must be used periodically or updated with any change/evolution of the situation. In the situation of the COVID-19 crisis, a gold instrument. Similar with some findings in the literature, trivalent for evaluation, verification, adaptation, is the massive and periodic testing for suspects. When we have a new virus, the whole population is suspected because there is no immunity already created or administered. The paper aims, to logically associate the preventive ergonomic management system already known by OSH, with ergonomic management system of crises, through scientific research, statistic arguments, which support the massive implementation of molecular.

Keywords Crisis Management, Ergonomics, OSH, Testing, Covid-19

I. INTRODUCTION

Because we are going through a period of crisis regarding the spread and effects of COVID-19, it is topical to consider the ergonomics of the systems that deal with the necessary measures that are required to be taken in such crises, even if these measures are not always taken quickly enough and effectively [4].

To prevent the risky, unprecedented and unpredictable situations, we usually we use for the measures of Occupational Safety and HEALTH (OSH), which we inevitably met at our places of work, but here these measures, in crises transcend and in personal/civil life, of the community in which we live.

If until now, the compliance obligations regarding the generation, implementation, improvement, and accountability for preventive measures were the responsibility of the employers (Directive 89/391/CEE), then we are all in the position that in emergencies all these activities and responsibilities will be transferred to civilian life by the presidential decree regarding the establishment of the state of emergency and by observing the military ordinances, including recommendations or orders, the decisions of the authorities responsible for coordinating and managing this state.

The fundamental role of ergonomics is to coagulate interdisciplinary the conclusions of many scientific fields (including management and OSH), so that, by designing conditions of well-being in the workplace of the workers, they will be able to easily regenerate forces, to provide expected yield and productivity.

Starting from the generic and reinterpreted definition of ergonomics, related to the work process, we can reformulate this concept outside of work, observing a similarity of interests and expected effects, transposed from the workplace within our contemporary civil/private life.

Ergonomics is a preventive system for analyzing and configuring recommendations, based on interdisciplinary scientific research, which aims at the well-being of the members of the society so that they can constantly ensure a predictable and efficient return to the community of which it is part.

If at the workplace the ergonomic principles are imposed and supervised by a law of Occupational safety and HEALTH - OSH (this discipline of ergonomics as a watchdog of ergonomic principles), they cannot act in the civic life, since with the issuance of the presidential decree establishing the state of emergency. This OSH measures regard especially HEALTH, becomes an obligation and motivation for every member of the society, so that it can undergo optimal crisis and can adequately restart immediately after this crisis.

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It is important to understand the ergonomic system as such and how it works, in this unique situation, to have an overview of the measures arising from this system, the role of these measures, the application and the effects, to contribute to management or application of these perceptions.

This understanding of the system not only gives us the motivation to actively interact with the system, but it also opens the way for us to understand the necessity of foreshadowing for the future some general proactive concepts of preparation and reaction to other possible crises.

From the systemic point of view, the role of ergonomics is not only to create viable and efficient systems, but these systems must include proactive or generative concepts of prevention, even if at the time of system design the prospect of improbable events was not seen.

For crises, the ergonomically designed preventive system must protect and exploit values like the intangible ones (Know-how, procedures, intellectual capital composed of human, structural and relational, etc.). This should be considered both during the design phase of the system, during the application and immediately after the normalization of the situation.

Examples of approaches include both the forms of preventive measures and those of the actions and tools needed to carry out the measures It is not enough to take a measure if there is no appropriate action or tool to implement it properly. Actions and instruments need to be checked to see if they have sufficient adaptive versatility to achieve the purpose of the measure.

II. EXAMPLE OF COVID 19 CRISIS STRUCTURES REACTIVITY

The timeline shows the dynamics and adaptability / one-point guided reactions from World Health Organization (WHO) vs. national RO:

- 31.12.2019 China warns WHO about unknown pneumonia
- 02.01.2020 WHO activates the incident management system at the regional level
- 10.01.2020 WHO recommends the first travel prevention practices
- 12.01.2020 China internationally distributes the genetic sequence of the new coronavirus discovered on 07.01.2020.
- 20.01.2020 China officially declares 278 cases of COVID-19, the majority in the Wuhan - Hubei Province. The first cases appear in Thailand, Japan, and South Korea
- 22 and 23.01.2020 WHO takes the first intervention and coordination measures, creating intermediate guides for diagnosis, clinical management, and infection prevention
- 11.02.2020 RO approves GEO 11 for emergency medical stocks and quarantine measures
- 26.02.2020 RO announces the first case of infection with COVID-19
- 04.03.2020 RO meets the Strategic Communication Group made up of specialists, which proposes to the Committee for Special Emergency Situations headed by the Minister of Interior to take measures.
- 11.03.2020 WHO declares pandemic for 118,000 cases in 114 countries and constantly updates recommendations and restrictions
- 16.03.2020 RO establishes a state of emergency with restrictions of constitutional rights and the empowerment of the Ministry of Interior to take measures through Military Ordinances to manage the situation. The measures concern mandatory social distance through travel restrictions, isolation, quarantine, verification, and sanction for non-compliance.
- 16.03.2020 WHO - The Director-General recommends testing.
- 25.03.2020 RO in the Military Ordinance 3, the army receives prerogatives of security, support of law enforcement and borders, and all subsequent measures will be more restrictive [5] to ensure and verify the social distance and stop the spread of the virus.

These developments and measures conclude that the actions for treatment must have as preventive actions guided in two basic directions Fig. 1:

- For NOT spread social distance (incl. isolation and quarantine), hygiene, and personal protective equipment (PPE),
- For Identification: early prevention testing [6] and continuous testing.

Failure to comply with the parameters of one measure requires a counterbalance to increasing the other. If it were possible, in the ideal case, all people should stop circulating for 14 days (if the virus evolves) and at the same time, all of them will be tested to quarantine those already infected, for which an epidemiological investigation will be carried out establishing contacts to be extracted from the community and preventively isolated.

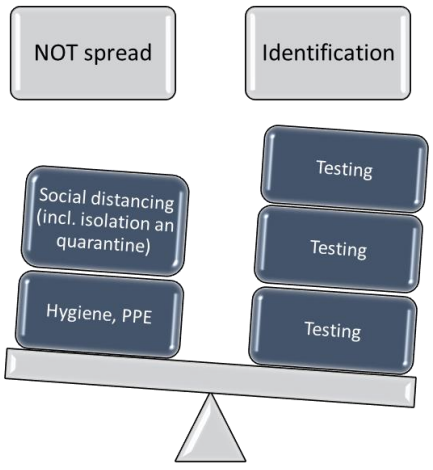

Fig. 1 Basic prevention directions for pandemic treatment.

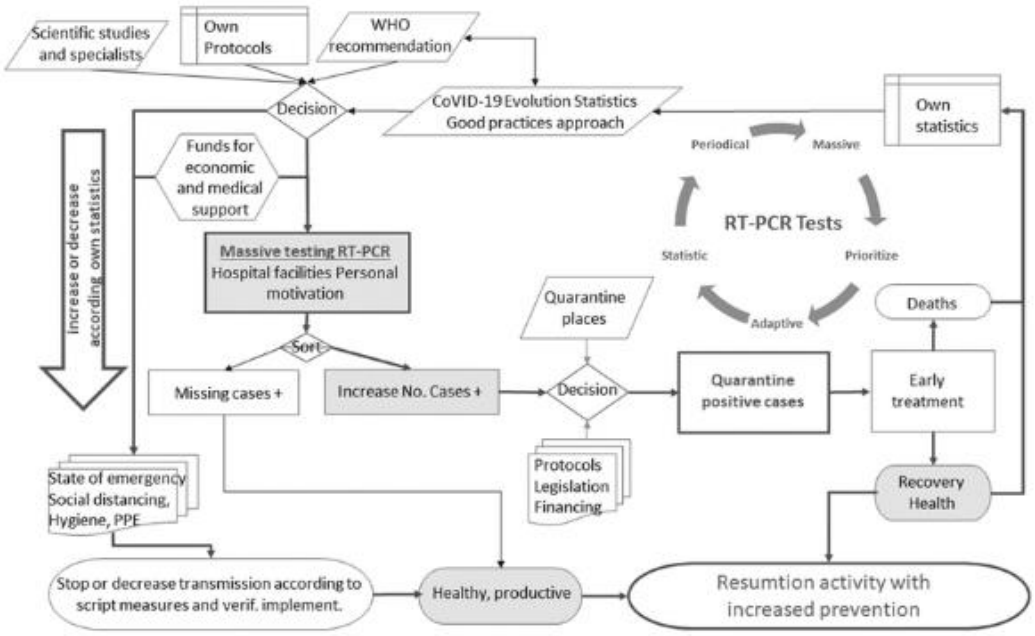

Fig. 2 The logical scheme for COVID-19 pandemic management with the testing measure.

II. OBJECTIVES

The following objectives have been followed during the development if the study (they will be explained in deep in this chapter):

a) Revealing good practices and attitudes for crisis management of Covid-19 pandemic

b) Analysis of international data on the evolution of the Covid-19 pandemic, to identify the role of molecular tests in the prevention management system.

A. *Revealing good practices and attitudes for crisis management*

For a clearer picture of the preventive context applicable to the COVID-19 pandemic situation, we outlined in a logic scheme which means designing the measures insisting on testing, as a multivalent tool in the logic of ergonomic prevention, and we will then discuss the issues related to this scheme.

B. *Structuring a crisis management scheme*

The logical scheme in Fig 2, to be viable and efficiently applied, contain three directions:

- Information/communication, legal regulations, financial support,
- Social distancing, hygiene, PPE, and testing,
- Treatment and again testing.

In this image we can see the role of molecular testing as a sorting tool in the ergonomic management of prevention as well as a reference point for creating new tailored measures. We see how the massive test measures are counterbalanced (increase or decrease) with those of social distancing, hygiene, or PPE. At the same time, do not forget the important role of information, statistics, good practices, scientific papers and scientists specialized in the field, because all these are involved in the decision-making and continuous adaptive process.

C. *Increasing the level of culture and civilization through*:

a) Preventive education or training for a crisis, disaster, war; OSH in school disciplines, hygiene, first aid [7],[8];

b) Correlation of the level of civilization with the level of understanding and application of prevention.

Understanding and compliance of restrictive legislative measures cannot be achieved, if there is no culture regarding the need for such measures at any given time. The members of the society must know and develop attitudes and reactions appropriate to situations that they have been familiar with at least. Metaphorically, we cannot expect a seed thrown on barren land to sprout and bear fruit.

The ability to understand and react is based on culture [9] and the level of civilization. If the state does not consider education towards increasing the level of civilization, as a preventive measure, each of us must lose from a financial perspective.

c) Legislative training:

Policies of application, awareness, implementation and continuous training [10] differentiated between the ordinary laws (no one can invoke the ignorance of the law), compared to the preventive legislation for which there must be the certainty that the entire population was informed and aware.

Legislative awareness (as they were made public - through the media the legislative bodies, forcing them to be remedied to the public);

In recent times, SARS, MARS, Ebola or H1N1 [11], [12] or other pandemics have also been reported and they will likely that they will occur again, and the preparation is not necessarily necessary for those who

have gone through such a crisis, but preparation and awareness for the next generations.

D. *Specialization of programs and training of crisis and intervention personnel [27]*

The operability of a national medical and managerial statistical platform related to the world statistics [28], with software programs for analysis and generation of mathematical predictions using algorithms used by artificial intelligence within learning machines and prescribing decisions, symptoms and clinical predictors of the states light and severe depending on the risk of the associated diseases, protocols based on the already existing cases and the histories up until then.

Applying to a unitary platform for informing, directing and managing crises applied to the department, agency or relevant ministry dealing with the crisis [29], interconnected according to needs with other online platforms, for example for volunteering as a medical volunteer [30] or for centrally managed [31] offers or donations [32]. Bilateral link and collaboration for global pandemic management with WHO - World Health Organization and other international organizations or states.

WHO provides the latest publications and scientific research on COVID-19 [33], with the possibility of searching and filtering?

The entire scientific world can be connected to the latest data discovered or analyzed in scientific articles, information, correspondence, reports or other articles (even audio), some journals specifying the lack of the pear review before publication.

Design and regulation of ergonomic preexisting systems, reaction, and attitude during the crisis period. Applying to computational prediction systems for study the evolution of unpredictable events with the help of mathematical algorithms [13, 14], artificial intelligence and learning machines, IT and mathematicians' specialists' communication resist [15].

Forecasting of pandemic COVID-19 is based for SEIR algorithm (Susceptible → Exposed → Infected → Removed) [17]. The most important indicator regarding the spread of the pandemic is the Ro - reproduction number. A sampling of the estimates for epidemic Ro parameters are presented in Table 1.

Table 1 – Parameter of reproduction number depending on which pandemic evolution is predicted – source https://gabgoh.github.io/ - epidemic calculator SEIR

ISSUER	Location	Reproduction Number (Ro)	Incubation Period	Infectious Period
Kucharski et. al	Wuhan	3.0 (1.5 — 4.5)	5.2	2.9
Li, Leung and Leung	Wuhan	2.2 (1.4 — 3.9)	5.2 (4.1 — 7.0)	2.3 (0.0 — 14.9)
Wu et. al	Greater Wuhan	2.68 (2.47 — 2.86)	6.1	2.3
WHO Initial Estimate	Hubei	1.95 (1.4 — 2.5)		
WHO-China Joint Mission	Hubei	2.25 (2.0 — 2.5)	5.5 (5.0 - 6.0)	
Liu et. al	Guangdong	4.5 (4.4 — 4.6)	4.8 (2.2 — 7.4)	2.9 (0 — 5.9)
Rocklöv, Sjödin and Wilder-Smith	Princess Diamond	14.8	5.0	10.0
Backer, Klinkenberg, Wallinga	Wuhan		6.5 (5.6 — 7.9)	
Read et. al	Wuhan	3.11 (2.39 — 4.13)		
Bi et. al	Shenzhen		4.8 (4.2 — 5.4)	1.5 (0 — 3.4)
Tang et. al	China	6.47 (5.71 — 7.23)		

E. *Implementation of digital epidemic control tools*

This is where artificial intelligence (AI) with learning machines (LM), far from reaching human capabilities, can be mentioned, can help identify and diagnose patients, useful in disinfecting infected areas, or even helping to accelerate the process of obtaining treatments. The concept that computer vision algorithm used to authenticate owners to self-driving cars, is already contributing to China's identification of body temperature using infrared sensors applied to the cameras of a train station in Beijing.

The application is made by the Baidu technology giant. The system scans more than 200 subjects, signaling those who exceed the temperature of 37.3 degrees Celsius, the margin of error being 0.5 degrees Celsius. Another Chinese technology giant, Alibaba, has developed a system with 96% accuracy in identifying Coronavirus at chest scan with a CT scan, being able to distinguish between common pneumonia and a COVID-19 infection.

F. *Facilities and policies to ensure buffer funding for crisis situations*

These could be causes by:

a) Food stocks and their transport insurance;

b) Sanitary personal protective equipment (PPE) and hygienic materials, medical devices for life support and medical testing (devices, materials, specialists);

c) Support and protection for production, population, and strategic economic branches and defense.

G. *Correct reporting*.

It is need for finding adequate preventive measures and evolutionary calculation [16], estimating the consequences in time [18] on the safety, financial aspects, before any estimation of the psychological-moral consequences, as well as creating stimulant measures for accurate reporting. The quality of the reported data is important because because of these data, one goes from one stage to other measures. If the reporting is deficient or inaccurate, the measures are ineffective. Possible causes for inexact reports are:

- The historical appetite for interpreting reports according to interests, which can lead to
- Intentional fraud (fraudulent and incriminating) of reporting to maintain leadership positions (politically supported and not meritocratic)
- Manipulation, truncation of reports through psychological justifications.

H. *Continuous reporting of cases identification*

Test, test, test [19], with accurate and immediate reporting of their results can give a clear picture of the cases and implicitly the preparations needed for prompt and effective response. An effective reporting must be accurate, contributing to the analysis and dimensioning of the gravity of a situation from several points of view, or relationships between the reported data, the following list is exemplary and non-exhaustive:

1. To know the extent of the phenomenon, there must be as many tests as possible - it is the primary measure regarding prevention [20], namely evaluation.

2. Through a massive test, knowing the actual number of cases, they can be isolated, and healthy or cured ones [21] can contribute to restarting the economy.

3. If there are certain assessments [22] and appropriate measures can be taken for different stages of data evolution, and if there is no reliable data based on the risk assessment following the test, there certainly cannot be adequate preparation for the intervention or preventive action.

4. If the data are as close to the truth, that is, the evaluation is as accurate as possible [35], we can find out exactly the rate of recovery of the patients confirmed positive and cured. If there is no comprehensive testing, this recovery report is false, without being able to estimate the mortality rate or illnesses so that the structures, materials and specialized personnel can be optimally dimensioned.

5. The nominal value of the data is not relevant if this value is not related to the population number of a country.

6. By reporting to correct statistical data, several indicators can be evaluated, such as:

a. The efficiency of the health system (system, doctors, treatment schemes, etc.), by relating the number of infected cases to the number of cured cases.

b. The efficiency of the organization system (measures to stop the pandemic, purchase of sanitary materials, etc.) by limiting the number of infected people to the number of the population, accelerating certain specific measures that distort this report.

7. The last aspect, which seems to be propagated by the authorities to hide the situation, is the psychological aspect against panic, but this unconscious approach only harms in the future, the unknown cases of the infected leading to widespread and implicitly widespread many more deaths.

III. METHODS

The study started from the empirical observations regarding Table 1, where variations of the statistical data it was revealed by scientific papers regarding the spread rate of COVID -19 especially in China.

The methodology for achieving the objectives is related to the investigation and analysis of statistical reports on the evolution of Covid-19 cases in European Union countries, compared to the number of molecular tests per 1 million inhabitants of each country, as seen in the data of the Table 2.

For the analysis of the results, we performed mathematical calculations (equation) by reporting the values in Romania with other countries in the European Union that have significant data.

IV. RESULTS

From Table 2 several reports and results can be drawn, regarding the following aspects:

A. *The test rate for Romania*

The rate is 2008 tests per 1 million inhabitants, being the lowest in the EU according to Table 2 and Fig. 3, with the following details:

Table 2 – Extract from COVID-19 statistics of number of tests at 1 Million pop. for 05.04.2020
Source wordometers.com

Country	Population	Total cases	Total Deaths	Total Recovered	Tot.Cases (1Mil. pop.)	Deaths (1Mil. pop.)	Total tests	Tests (1Mil. pop.)
Luxembourg	625.978	2.729	31	500	4360,0	50,0	22.793	36.412
Malta	441.543	227		2	514,0		10.358	23.459
Estonia	1.326.535	1.097	15	62	827,0	11,0	21.004	15.834
Slovenia	2.078.938	997	28	79	480,0	13,0	27.764	13.355
Austria	9.006.398	11.930	204	2.998	1325,0	23,0	108.416	12.038
Latvia	1.886.198	533	1	1	283,0	0,5	20.680	10.964
Germany	83.783.942	97.351	1.479	26.400	1162,0	18,0	918.460	10.962
Italy	60.461.826	124.632	15.362	20.996	2061,0	**254,0**	657.224	**10.870**
Lithuania	2.722.289	811	12	7	298,0	4,0	23.645	8.686
Denmark	5.792.202	4.369	179	1.327	754,0	31,0	49.249	8.503
Portugal	10.196.709	11.278	295	75	1106,0	29,0	86.370	8.470
Cyprus	1.207.359	446	9	33	369,0	7,0	10.154	8.410
Spain	46.754.778	130.759	12.418	38.080	2797,0	266,0	355.000	7.593
Czechia	10.708.981	4.475	62	78	418,0	6,0	80.304	7.499
Ireland	4.937.786	4.604	137	25	932,0	28,0	30.213	6.119
Belgium	11.589.623	19.691	1.447	3.751	1699,0	125,0	70.000	6.040
Finland	5.540.720	1.927	28	300	348,0	5,0	31.714	5.724
Netherlands	17.134.872	17.851	1.766	250	1042,0	103,0	75.415	4.401
Sweden	10.099.265	6.830	401	205	676,0	40,0	36.900	3.654
France	65.273.511	89.953	7.560	15.438	1378,0	116,0	224.254	3.436
Slovakia	5.459.642	485	1	10	89,0	0,2	15.155	2.776
Croatia	4.105.267	1.182	15	125	288,0	4,0	10.847	2.642
Greece	10.423.054	1.735	73	78	166,0	7,0	25.453	2.442
Bulgaria	6.948.445	531	20	37	76,0	3,0	15.899	2.288
Hungary	9.660.351	733	34	66	76,0	4,0	21.250	2.200
Poland	37.846.611	3.834	84	134	101,0	2,0	80.757	2.134
Romania	**19.237.691**	**3.864**	**148**	**374**	**201,0**	**8,0**	**38.623**	**2.008**

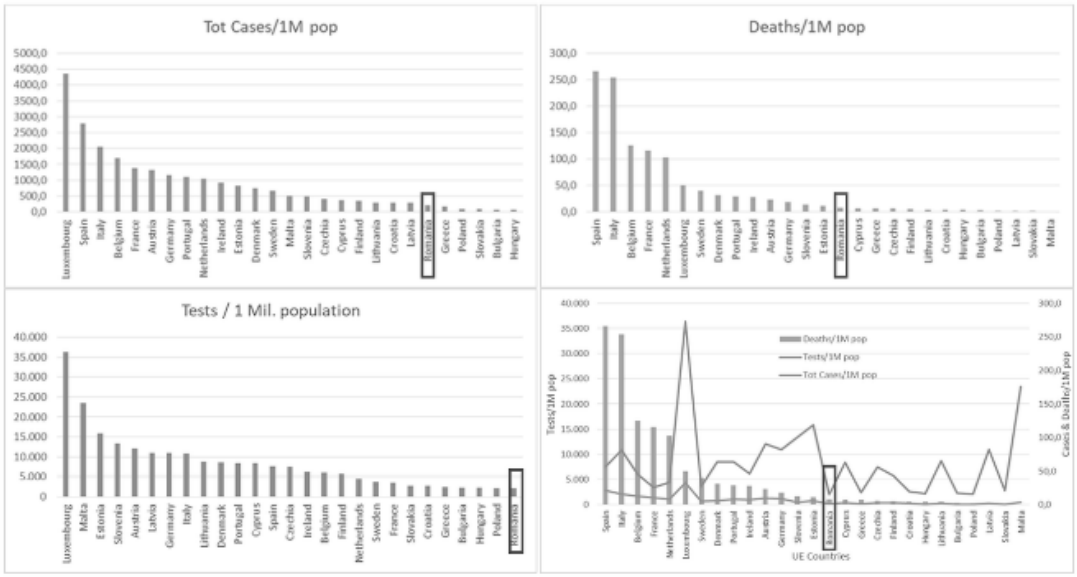

Fig. 3 Graphical situation of COVID-19 data in RO vs. EU on 05.04.2020, regarding testing related to cases and deaths at 1 mil / pop.

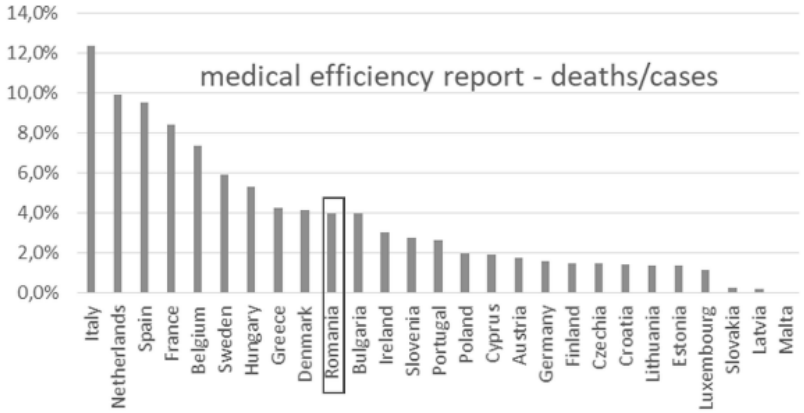

Fig. 4 Medical efficiency graphic indicator.

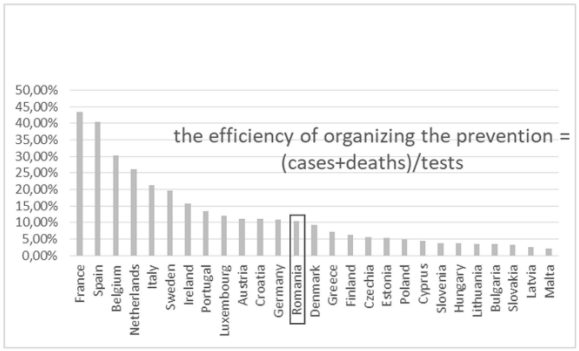

Fig. 5 Prevention test efficiency graphic indicator.

a) Even though in Romania there are the fewest tests, in Italy which has a 5 times higher rate, which is 10,870 tests per 1 million inhabitants, Italy has 254 deaths per million inhabitants compared to Romania which it has 8, mean almost 32 times less;

b) The previous finding excludes the proportionality of the tests with the death rate;

c) As Romania has the lowest test rate, at the opposite pole we observe Luxembourg which has the highest rate of EU tests 36,412 tests per one million inhabitants, 3 times more than Italy and 18 times more than RO. However, Luxembourg has 50 dead/1 mil. pop. compared to 8 dead/1 mil. pop. of RO, mean 6 times less;

d) Both comparisons give totally different death rates, which reinforces the observation that the test rate is not proportional to the number of tests.

B. *Medical efficiency*

According to Fig. 4, as the percentage ratio between the numbers of deaths compared to the number of confirmed cases, with follow characteristics:

$$Med.eff = \frac{N^{\circ}\ of\ deaths}{N^{\circ}\ of\ cases} \quad (1)$$

Equation 1 proposed a coherent way for the medical efficiency measurement:

a) The lowest values denote medical efficiency, and the high values express the outbreak of the pandemic

b) Here we see an average of 3.66% in the EU, compared to 3.84% in the world, Romania having a medical efficiency ratio of 4%, compared to the extremities in the EU - Italy of 12%, respectively Malta of 0 % (without any death)

c) It is significant to note that the EU countries that reached and exceeded the 6% threshold of this report had an exponential evolution of deaths, as can be seen in the graph in Fig. 3 how the columns with the number of deaths exceed the line with the number of tests in the following countries (Belgium, France, Spain, Holland, Italy),

d) exceeding 6% in conjunction with crossing the line, at significant tests - above average, demonstrates that once the capabilities of the healthcare system are exceeded, it collapses and no longer has the same yield, testing cannot stop the evolution

e) tests do not stop the evolution but only prevent it, crossing a certain limit is too late for testing and everything is based on the organization and power of the health system.

4.3. Organizational efficiency for prevention

According to the representations in Fig. 5, as the ratio between the number of tests (organizational and financial capacity) and the sum of cases and deaths (isolation and medical management) with the following characteristics:

$$Prevention\ eff = \frac{N^{\circ}\ cases + N^{\circ}\ deaths}{N^{\circ}\ tests} \quad (2)$$

Equation 2 proposed a coherent way for prevention test efficiency

a) The highest values attest the lack of organizational efficiency, and the small ones express the immediate organization with major evidence in the chapter on prevention and minor effects for citizens.

b) The extremes are owned by France with a score of 43.48%, the best stand in EU Malta, with a score of 2.19%

c) The EU average score is 12.24, and Romania is below average. With 10.41%, demonstrating a preventive organizational attitude like Germany, and Denmark, which are near Romania's position.

d) As Denmark and Germany are in the top of the tests, due to their financial power, it remains as a conclusion that Romania has compensated organizationally in prevention through measures of social distance and hygiene, established quickly and drastically, even if it does not have financial funds for effective prevention through testing.

e) It is important that the social distance measures are continuous and drastic in the absence of mass testing.

V. CONCLUSIONS AND FINAL REMARKS

If generic ergonomics uses preventive work rules to streamline and sustainably maintain the workforce and institutional system, similarly, the Covid-19 crisis management system use like a tool the molecular testing, which fulfills the main ergonomic goal of prevention and continuous verification for adaptability and efficiency of results.

It is important to organize the prevention in the aspect that the tests must be able to be done preventively to identify and stop the transmission and before the explosion of this transmitter, after that the tests having only the role of keeping under control.

Basically, within an ergonomic prevention management system, RT-PCR testing is used as a trivalent tool: firstly, and significantly for the early prevention, verification and control of the pandemic.

In the prevention management system, the principles of ergonomics dictate maintaining a balance between the measures taken and the efficiency of the expected results. Considering this postulate, the number of tests must be in balance with social spacing, in the sense that, if from the beginning we were not taken massive testing measures, these should be supplemented by more drastic social spacing, or vice versa, if from in the beginning, massive testing measures were taken, other measures can be more relaxed.

If it is not possible, financially or technically reaching an effective preventive testing rate is compulsory to compensate with measures supported, verified and sanctioned drastically by social distance and hygiene.

The most important conclusion is that testing does not stop the virus unless it is massively applied from the first case according to the epidemiological report with all contacts or those in the contact area, but it must be accompanied by social distance, hygiene and PPE (mask, gloves), to a degree counterbalanced by balance.

Now, in Romania, is a real tendency to increase the number of tests, which shows three aspects:

1. Achieving the benefits of mass testing by the best results method Reverse Transcription-Polymerase Chain Reaction (RT-PCR) [24] and control spreading [25];

2. Strengthening the organization and breaking of bureaucratic inertia in procurement and professional dedication in treatment;

3. Overcoming the lack of funds, this can be linked to the necessary priority organization, obviously influenced by the obscurity of the benefits of mass testing, as it is already outdated.

Another short briefing is that:

- The virus could only survive in those who are untested [23];

- The biggest danger is that asymptomatic people could infect others;

- To understand the global pandemic, we need global testing [26].

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