Review

Clin Ter 2023; 174 (5):444-455 doi: 10.7417/CT.2023.2463

Video display terminal use and limitations according to italian legislative decree: occupational and forensic perspective

M. Salducci[1], D. Shaholli[2]

[1]Department of Sense Organs, Sapienza University of Rome, Rome, Italy; [2]Department of Public Health and Infectious Diseases, Sapienza University of Rome, Rome, Italy

Abstract

In this paper, the authors conduct a review inherent in the use of video display units considering the laws currently in force in Italy, with emphasis on critical legislative and operational issues.

Video Display Terminal (VDTs) are today an essential element in almost all work environments, from offices where they represent the fundamental work tool to production environments where they are indispensable for carrying out control functions (command stations, quantity management and flows, etc.) or for design work.

The risk due to VDTs is one of the factors considered by the Italian Legislative Decree 81/08, so its assessment is part of the employer's obligations and at the same time requires health surveillance by the occupational physician.

The new workstations have certainly not reduced visual postural demands, but they have changed them, opening the door to new disorders and imposing greater flexibility on the activity of the occupational physician, who often cannot limit himself to an annual inspection of the workplace.

The aim of this work is to examine the current critical issues and future prospects of ergophthalmology. ***Clin Ter 2023; 174 (5):444-455 doi: 10.7417/CT.2023.2463***

Key words: *Italian Legislative Decree No. 81/08, video display terminals, occupationally exposed workers*

Background

Video Display Terminals (VDTs) are today an essential element in almost all work environments, from offices where they represent the fundamental work tool to production environments where they are indispensable for carrying out control functions (command stations, quantity management and flows, etc.) or for design work. VDT identifies an alphanumeric or graphic screen, regardless of the type of display used.

The activity at the VDT involves particular risks to workers' health, which can be traced back to the components of the VDT (screen, keyboard, mouse, other peripherals), the software installed, the workstation (essentially desk and seat) and the environment in which it is placed (ambient light, microclimate, work and movement spaces, sound environment, etc.).

The risk due to VDTs is one of the factors considered by the Italian Legislative Decree 81/08, so its assessment is part of the employer's obligations and at the same time requires health surveillance by the occupational physician.

However, if in the past the risk from VDT could still be considered specific to certain categories of professionally exposed workers, recent years have seen what can now be defined as an aggravated generic risk, i.e., that which is incumbent on every citizen, but which weighs more heavily, in terms of frequency or extent, on those who perform certain work activities. The fields of application of Legislative Decree 81/08, with reference to the use of VDTs, cover both the public and private sectors, although it does provide for some exclusions; workers assigned to: vehicle or machine driving positions, computer systems mounted on means of transport and/or intended for use by the public, portable systems (if not for prolonged use), calculators, cash registers, small display devices, word processing machines without separate screens do not fall within this regulatory reference.

The risk of exposure from VDTs was also the risk most frequently represented in the companies in which the occupational physicians interviewed for the 'INSula' project worked (INAIL, 2015). In fact, 94.9% of the 1,062 health professionals stated that the risk most frequently represented in the companies in which they performed the function of competent doctor was that of the video screen, immediately followed by the manual handling of loads (92.7%) and noise (81.4%); the data confirmed the same trend even when disaggregated by geographical area.

The last twenty years have also witnessed a radical change in workstations at the video terminal. In the past, they were fixed, predefined, usually used by a single opera-

Correspondence: Prof. Mauro Salducci, Department of Sense Organs, Sapienza University of Rome, Piazzale Aldo Moro 5 – 00185 Rome, Italy. e-mail: mauro.salducci@uniroma1.it

ISSN 1972-6007

tor; today, office workers use digital equipment (desktops, laptops, tablets) much more frequently, often do not have an assigned workstation and can operate, during the working day, on more than one workstation; work is no longer necessarily confined within offices but can be done at home or even on the move. We are currently experiencing the culmination of this phenomenon on a daily basis, as the SARS-CoV-2 pandemic has amplified, for certain types of workers, the use of smart-working in an intelligent and flexible manner, within the framework of the regulations in force and on the basis of actual needs, combining the full functioning of public services and economic activities with maximum safety for workers and users.

The new workstations have certainly not reduced visual postural demands, but they have changed them, opening the door to new disorders and imposing greater flexibility on the activity of the occupational physician, who often cannot limit himself to an annual inspection of the workplace. As a direct consequence, national and supranational regulations, as well as guidelines, are no longer in step with the times and therefore an updating process is essential in a continuous chase after technological innovations.

"It seems sufficient to recall that the most recent ministerial indications for the use of video terminals date back to the year 2000 and that the latest version of the guidelines of the Italian Society of Occupational Medicine and Industrial Hygiene dates back to 2013 and is based for more than 90% on bibliographical entries prior to 2009".[1]

"When one considers that Apple's first iPhone was presented in 2007 and that tablets have been on the market since 2010, one can perceive how the scientific indications derived from the guidelines are in danger of not keeping up with the times. By now, these technologies have become ubiquitous and are used for accessing the Internet, storing data and making phone calls, sending pictures and text messages, etc., absorbing most of the functions of traditional computers.

Smartphones and tablets, with their small screens, have introduced new visual demands; users use the device at a much shorter distance than traditional computers and paper documents. Similarly, the use for the musculoskeletal system is very different, as the postures adopted by operators involve not only the various stretches of the spinal column (particularly the cervical and dorsal region), but also the small joints of the hands and forearms. Since the new computer systems are also suitable for personal use in a non-work environment, the pervasive effect in daily life of these devices on the user-worker connected 24 hours a day cannot be overlooked".[2,25]

It is in this delicate context that the activity of the occupational physician fits in, who is faced with the VDT risk in its new expressions with limited economic resources (which limit requests for specialist advice), obsolete tools (dated guidelines calibrated on parameters of little objectivity) and doubtful efficacy, bearing in mind that permanent damage to visual function is not currently proven or at any rate not yet known. The aim of this work is to examine the current critical issues and future prospects of ergophthalmology.

Main text

Since the introduction of the first video terminals in the world of work, several studies have been conducted. Several pathologies, episodically attributable to occupational exposure, have been reported, such as cataracts, glaucoma, facial dermatitis, as well as men's and women's production health risks.

However, from the current scientific evidence, no chronic pathologies emerge to recognise work exposure to VDTs. In fact, the work in question shows evidence of a correlation between exposure to VDTs and the appearance of generally transient symptoms and signs, which regress with cessation of exposure, attributable to Video Operator Distress Syndrome (VODS).

This syndrome is characterised by:

- **Asthenopia** or **Eyestain**: the visual apparatus and function have certainly been most studied, especially in the years immediately following the introduction of VDTs; the existence of visual fatigue with an ocular and/or visual component, defined as "the set of ocular and visual disorders caused by excessive fatigue of the visual apparatus".
- **Musculoskeletal disorders**: from an economic point of view, unsuitable workplaces can lead to poor posture and/or prolonged postural fixation. These disorders are now also prevalent due to the use of increasingly smaller (and therefore less manageable) work tools in often improvised environments; they are most frequently described as affecting the upper limbs (shoulders, arms, wrists, hands), the lower limbs and the spinal column (especially in the cervical and lumbar region).
- **Job related stress**: caused by the introduction of new information technologies in the workplace and the modification of all traditional organisational and relational models. In the years immediately following the introduction of such equipment, workers have witnessed the emergence of understandable fears, which in some cases have been experienced by considering the new technology and organisation as a threat to their health. The continuous evolution of hardware and software, unaccompanied by adequate education and training programmes, far from improving the man-work-machine relationship, has not infrequently been the reason for the persistence, in some cases worsening, of stress conditions and/or organisational constraints. The introduction of small hand-held devices has enlarged the already flourishing picture, adding further elements of organisational stress to the perpetually 'connected' worker, subject to a progressive and unacceptable pervasiveness of work experiences in the personal and family sphere.

To understand the impact of VDTs on the visual health of the worker, it seems appropriate to recall the functional mechanisms involved. In particular, the visual performance of a VDT operator can be defined as:

- close-up vision (images and/or objects to be observed are mostly placed at a distance of less than one meter);
- prolonged vision (lasting several hours, sometimes consecutively);
- static vision (distance vision variably limited in relation to tasks and characteristics of the environment), although

in the context of near vision this activity involves its own 'dynamics'. Assuming a focus ranging between 35 cm (paper text), 60-70 cm (video screen) and 100 cm (desk), the activity entails, for an emmetropic or emmetropic worker, a prolonged accommodative engagement of at least 1D (vision at 100 cm) with peaks up to 3D (vision at 35 cm). The result is a marked and concomitant accommodative convergence engagement, which is associated with consequent adjustments of the pupil diameter.

In fact, any "near view" performance implies the activation of a complex physiological mechanism known as "near synkinesia" or "fixation triad", controlled by the mesencephalic nuclei of Edinger-Westphal, whose role is essentially to allow the formation of images as sharp as possible at the bifoveal level.

It is achieved through the associated contraction of three muscles (intra- and extra- ocular):

- the ciliary muscle: to focus the image;
- the medial rectus muscles: in order to drop the image at the fovea's level in both eyes;
- the iris sphincter muscle: for greater depth of field, fewer aberrations of the optical system and containment of the phenomena of diffusion and diffraction of light.

A) Accomodation

Accommodation is the property of the crystalline lens to change its refractive power. In this way, the image of an object located at a non-remote distance (less than 5 m) appears sharp on the fovea. It is activated when foveal images become blurred (presence of 'circles of confusion'), through a reflex mechanism controlled by the occipital cortex. This mechanism, of which the observer has no perception, activates the ciliary muscle which, by contracting, decreases the tension of the zonula fibres. The tightening of these fibres allows the crystalline lens to assume a more convex shape, especially in its central portion ("fan-shaped" modification), with a corresponding increase in dioptric power.

All this occurs with great precision (in optics, a 'circle' with a diameter of less than 30 μm is normally considered indistinguishable from a 'dot') and with great speed (about one third of a second).

The difference in refractive power between the resting condition and the condition of maximum accommodation is called the accommodative amplitude. It varies, not only with individual characteristics, but also with age. The minimum physiological distance of accommodation, beyond which the image becomes blurred, is called the Proximity Accomodation Point (PPA) and ranges between 6 and 7 cm (16 D) at the age of eight, to about 100 cm (1 D) at the age of 52.

Possible ametropia also plays an important role: compared to the emmetropic, the myopic has less accommodative needs, the hypermetropic more, in the case of astigmatism more or less depending on the type (myopic, hypermetropic, mixed). In the general population, pathologies of accommodation such as accommodative spasm, accommodative insufficiency and accommodative paralysis are not uncommon.

In cases where the accommodation required for work is greater than that available, accommodative 'overload' can occur, which is called asthenopia.

B) Convergence

Convergence is a reflex movement of adduction (turning inwards), simultaneous and synchronous of the eyeballs, controlled by a nerve centre located in the occipital cortex. It is activated during close vision with the aim of making the two visual axes converge on the object observed, so that the image falls exactly on the fovea (areas dedicated to 'distinct vision' where the power of retinal separation is maximum). This is achieved through the contraction of the medial rectus, with the concomitant relaxation of the lateral rectus muscles. Convergence remains more or less altered throughout life, not undergoing the deterioration associated with advancing age that is typical of accommodation and can be increased with training.

The closest point on which the eyes can converge without the subject presenting diplopia is the Near Convergence Point (NPC); it has an optimum value of 10 cm, normally lower than the PPA, at the same age.

Convergence can be divided into four components:

- tonic: the one necessary for the eyes to pass from the super divergence position typical of sleep or narcosis (Bell's phenomenon) to the physiological one of rest (distant vision); it is produced by the tone of the extra-ocular muscles;
- accommodative: that evoked by the accommodation, to which it is closely associated;
- fusional: that which is activated in order that the image drops exactly on the fovea. In this way it allows the sensory fusion of the two retinal images; it is stimulated by the possible presence of "retinal disparity" (when the image, in the two retinas, is projected on mismatched areas);
- proximal: that caused by the awareness that the observed object is placed at a close distance.

However, it should be remembered that convergence movements represent a unitary visual response, which is reflexively and unconsciously activated based on accommodative demand.

In fact, each individual responds to a unit of accommodative stimulus with a specific amount of convergence. The individual convergence response to a unit accommodative stimulus can be expressed by the ratio between the activated accommodative convergence (AC), expressed in prismatic diopters Δ, and the amount of accommodation (A), expressed in diopters D, from which it was evoked. This ratio (AC/A) is a measure of the responsiveness of a subject's convergence fusion to one unit of accommodative stimulus.

In the myopic subject, who uses modest amounts of accommodation, the AC/A ratio is low, while in the hypermetropic subject it is high due to the excess of accommodation in place. It should also be mentioned that in the general population, especially adults, a convergence abnormality called 'convergence insufficiency', of unknown aetiology, is quite common and is considered the most common cause of 'muscular asthenopia'. In subjects with this pathology, but also in those with heterophoria tending towards decompensation, work applications for close ranges more frequently give rise to early and intense disturbances.

C) Pupillary dynamics

The pupil responds to three types of stimuli:

- ambient light (photomotor reflex);
- near vision (reflex myosis, associated with convergence);
- impulses of a psychic, sensorial and sensitive nature (emotions, noises, solicitations to the ocular adnexa, etc.).

The photomotor reflex is activated when one or both retinas are subjected to increased light stimulation. The response is a pupillary constriction that occurs in approximately 0.2-0.5 seconds, depending on the intensity and quality of the light stimulus as well as the state of retinal adaptation.

Retinal adaptation plays an important role in photopic conditions (daylight); adaptation of retinal sensitivity occurs through two mechanisms:

- alpha adaptation: rapid, involves the entire retina even if the stimulation is localized in one part of it, and is due to a modification of the nerve response;
- beta adaptation: slow, affects only the stimulated retinal area and is produced by the exhaustion of photosensitive pigments.

The combined action of pupillary constriction and retinal adaptation allows efficient vision to be maintained even in environments where there are areas of high luminance differences. The reflex miosis, which is generated in the context of synkinesis for near, as well as that of sensory and sensitive derivation, in any case both completely independent and with different physiological characteristics than that produced by light stimulation of the retina (photomotor reflex), are a further reason for pupillary constriction-dilation. Frequent, continuous and intense stresses of the physiological mechanisms of pupillary motility and retinal adaptation can give rise to phenomena of pupillary reflex fatigue (prolonged latency, reduced contraction, deficient dilation, paradoxical reactions), with possible decreases in visual performance as a whole.

Oculo-visual pathophysiology

In an operator "systematically and habitually assigned" to VDT devices, the neuromuscular systems, which preside over the activation of the convergence accommodation control, must guarantee and maintain performance characterized by:

- high precision (the minimum size of the details to be observed requires ideal focusing of the image on the retina);
- high speed of response during fixation (for optimal and comfortable viewing of the screen, keyboard and any documents, latencies within fractions of a second are required);
- excellent resistance over time (the system must ensure remarkable levels of efficiency for several hours a day, even in the presence of prolonged isometric contractions of the extrinsic and intrinsic ocular muscles).

Pupillary reflexes and retinal adaptation mechanisms are subjected to continuous light stimuli of widely varying intensity and origin. In this regard, it is fundamental to define the concept of luminance (expressed in cd/m2) as a vector photometric quantity that derives from the ratio between the luminous intensity emitted by a source in the direction of the observer and the apparent area of the emitting surface, as seen by the observer. This quantity is indicative of the glare that a light source can induce.

In particular, it should be emphasised that the VDT operator performs his work while maintaining a posture that is constrained by the structural characteristics of the workstation, as well as by the location of the screen and any document in question. In this context, the field of vision, which can be defined as the 'professional field of vision', is delimited and persistent throughout the performance of the work task.

Furthermore, the light emission of the screen has a modest and little variable luminance (10-100 cd/m2), whereas in workplaces, whether industrial or office, natural or artificial light sources are often identifiable and highly variable of thousands of cd/m2.

Because of the above, the possibility of repeated retinal stimulation, particularly at foveal level, is caused by 'parasitic' light vectors (i.e., not coming from the objects and images under observation), with a luminance significantly higher than the average present in the occupational field of vision.

These light stimulations disturbingly interfere with the visual and perceptive physiological mechanisms, as well as with the operator's cognitive processes. In this regard, it is worth mentioning that glare conditions can be one of the causes of incongruous postures in ergonomically designed workstations.

It is possible to state that two main factors are responsible for the discomfort and visual disturbances of VDT operators:

- those caused by overloads of accommodation and convergence (related to visual engagement for neighbours);
- those caused by overloads of pupillary motility and retinal adaptation (related to lighting and technical conditions of the workstation).

These factors can exert their action in a particular way in the presence of uncorrected or inadequately corrected refractive and/or ocular motility defects or pathologies that can reduce or disturb the vision required to perform the visual task (maculopathy, cataracts, pseudophakia, keratoconus, etc.).

In addition to the main overload factors for the visual apparatus, there are also complementary factors, such as chemical agents irritating the ocular surface and/or microclimatic conditions that can facilitate, by synergetic action, the onset of discomfort and possible alterations to the visual apparatus.

Chemical irritating agents to the ocular surface

Numerous studies on indoor air quality have found a high prevalence of eye disorders (eye irritation) in office workers. These disorders appear to be caused by numerous airborne substances that have an irritating effect on all mucous surfaces of the human body, including the ocular surface.

Among these the most active:
- aldehydes (especially formaldehyde and acetaldehyde, acrolein);
- volatile organic compounds (VOCs);
  tobacco smoke (ETS);
- zinc oxide (NOX);
- ozone (O3);
- powders and fibers.

These substances, commonly present in indoor work with higher internal concentrations than external ones, coming into contact with the ocular surface can cause, with different frequency and severity depending on the patho-physiological conditions of the operator and the possible concomitant presence of other (environmental and work) factors, alterations such as:
- conjunctival hyperemia;
- decrease in physiological foam formation under forced blinking;
- reduction of tear film stability (Tear Break-up Time, TBUT alterations);
- changes in the corneal-conjunctival epithelium (altered fluorescence staining capacity).

It is also important to emphasise that the TLV 'threshold limit values' for airborne concentrations of these substances, although having recognised validity for the effects induced on the upper respiratory tract, have not been drawn up considering the anatomo-physiological specificity of the eyeball.

Microclimatic conditions

In indoor work environments, both industrial and office, it is not uncommon to find microclimatic conditions characterised by low relative humidity (below 40%) and high air velocity (above 0.15 m/sec), mostly produced by fan-coils, air conditioners, cooling systems of various equipment, fans, photocopiers, printers, etc.

These microclimatic conditions can cause an excessive evaporation of the tear film, especially in the presence of unidirectional air flows directed towards the operators' face (air velocity of the Anglo-Saxon authors), favouring the formation of corneal areas that are not adequately and constantly humidified. This can cause conjunctival inflammation and pain for the corneo-conjunctival epithelium. Under these conditions, while spectacle wearers are at least partially protected, special attention must be paid to contact lens wearers, whose ocular surface obviously tends to develop irritative states more easily.

The main and complementary factors act, albeit with differentiated mechanisms of effect, in a joint and concomitant manner, giving rise to highly differentiated symptoms and clinical-functional pictures. Disturbances of asthenopia may occur in the short (minutes), medium (hours) or long (days) term in relation to the onset of objective changes. However, these disturbances are generally non-specific and, above all, not clearly and immediately attributable to their causes. They therefore constitute an 'alarm bell', which, although random and often only momentary, may be indicative of the presence of pathological processes, mostly irritative and/or dysfunctional, in progress whose aetiopathogenesis must in any case be examined based on the work and environmental parameters of exposure, in relation to the ophthalmic, clinical and functional characteristics of the operator considered.

In conclusion, if what is reported in the oculo-visual physiopathology appears to be entirely in line with what has long been affirmed by the WHO (1990) and by the SIMLII 'Guidelines for the health surveillance of workers with VDTs'[3], it must however be emphasised that the investigations available in the literature, mostly based on valid subjectivity analyses (self-completed questionnaires) and on unreliable assessments of exposure conditions, have never ascertained the existence of permanent damage to the visual apparatus, certainly connected to the professional use of VDTs. However, also in the light of the results described in recent longitudinal epidemiological investigations concerning the ophthalmic effects caused by 'close work', it would certainly seem advisable to stimulate attention and future research on the subject, given the forecast of the use of optoelectronic equipment in constant and progressive increase in the world of work.

Occupational asthenopia

One of the most historically remote definitions of asthenopia is probably that of Duke-Elder (1949), according to whom asthenopia means "that sensation experienced when one becomes aware of the work of the ocular apparatus to make a vision clear through sometimes ineffective accommodative adjustments".

This definition is limiting in referring only to the accommodative aspect of the problem, but it emphasises a fundamental character of the phenomenon, namely its essentially subjective nature, linked above all to the overloading of the ciliary muscle.

A more modern definition refers to "a set of functional disorders that arise when the visual apparatus tries to obtain functional results that exceed its physiological possibilities by resorting to stressful devices". Studies carried out on VDT workers tend to report specific definitions such as the one cited by Bergqvist (1994): 'the presence of any subjective visual symptom or disorder arising from the use of the visual apparatus'. The SIMLII Guidelines consider occupational asthenopia to be a syndrome "caused by environmental factors and work tasks that, in association with the subject's ophthalmic characteristics, favour the onset and recurrence of a set of ocular and/or visual symptoms that, in the most serious cases, may also be accompanied by general disorders".

Occupational asthenopia has the following characteristics:
- clinical manifestations to which a shared definition does not correspond internationally ("disability / veiling glare" for lighting technicians, "visual fatigue" for psycho-percectologists, "eye irritation" for occupational hygienists);
- causes are difficult to identify;
- non-specific symptoms associated with rapid reversibility;
- high diffusion among VDU workers and in the general population, in the latter case in the absence of exposure to occupational factors;
- significant psycho-emotional component;

its objective quantification is not currently possible;
- there is no evidence that it can become chronic.

The main manifestations of asthenopia may be visual and ocular changes and general non-specific symptoms (headache, asthenia, nausea, dyspepsia, vertigo).

According to the literature, 40-80% of workers experience asthenopia disorders occasionally, while 10-40% report them as persistent. They generally appear after at least two hours of work, especially in female workers, VDT workers who perform this work unwillingly or with data-entry tasks and subjects with previous visual disturbances.

However, it should be reiterated that all experimental and clinical epidemiological studies in VDT workers have not shown the occurrence of ocular pathology attributable to occupational risk.

The Italian Society of Occupational Medicine itself has reiterated that asthenopia must be considered non-specific and functional, transient and reversible, not correlated in significant terms with seniority or duration of activity at VDT. Therefore, asthenopia cannot be considered an occupational disease.

The role of the occupational doctor: health surveillance

Article 176 of Legislative Decree No. 81/08 provides that it is the competent doctor at the outcome of the health surveillance of video terminals who expresses the judgement on suitability for the specific task. Useful elements for diagnostic guidance can be gathered with the contribution of specialists such as: the ophthalmologist, the orthopedists or physiatrist, the dermatologist and possibly the psychologist.

To formulate the suitability judgement, it is necessary to examine the following conditions in an integrated manner: the workplace, the type of activity carried out, the environment (as it emerges from the risk assessment) and the clinical picture.

Based on the elements collected, the occupational physician expresses one of the following judgments concerning the specific task:
- eligibility;
- partial, temporary or permanent suitability, with prescriptions or limitations;
- temporary unfitness;
- permanent unfitness.

Workers classified as fit with prescriptions or limitations and workers who have reached the age of 50 must be visited at least every two years, while for the others the frequency will normally be every five years, or possibly shorter based on the results of the risk assessment.

The SIMLII guidelines of 2013 (reference point for current literature) offer the following methodological indications:

"In addition to the assessment of asthenopia, the following should also be considered before making a suitability judgement: alterations in visual acuity and refraction, ocular motility and ocular surface pathologies".

As things stand, the occupational physician must assess any temporary or permanent unfitness based on two criteria:
- ophthalmological characteristics of the individual;
- environmental characteristics of the work performed (as emerging from the risk assessment and the outcome of the inspections).

The possible prescriptive and/or limiting modulations of the suitability judgment are listed below.

VISUAL ASPECTS		
MAIN	MINOR	CLINICAL OBJECTIVITY (referable)
discomfort / disturbance to light (photophobia); blurred vision; double vision; pain / discomfort around the eyes	colored halos; Mac Collough effect	reduction of visual acuity (near and / or far); reduction of visual width; removal of the PPA; appearance / increase of phorias; transient myopia
EYE ASPECTS		
MAIN	MINOR	CLINICAL OBJECTIVITY (referable)
teardrop; itch; burning; dryness; redness (reported by third parties), gritty feeling in the eyes; periorbital and / or retrobulbar pain	changes in blinking frequency, feeling of heaviness of the bulbs	conjunctival inflammation; abnormalities of ocular secretion; qualitative and quantitative alterations of the tear film

Eligibility with more frequent health surveillance

Surveillance always involves the occupational physician, who must also involve the ophthalmologist if necessary. This is the case for workers suffering from eye diseases that progressively reduce visual acuity. Therefore, the frequency of assessment must be evaluated on a case-by-case basis.

These pathologies include keratoconus, glaucoma, cataracts, degenerative myopia, uveitis, developmental retinopathy (diabetic, hypertensive, maculopathy, retinal degeneration) severe pathologies of the optic nerve (glaucoma, optic neuritis) and pathologies due to alterations in binocular function (neurogenic or myogenic paralysis).

In this case, it is essential to provide for a more rigorous assessment of workers and environmental characteristics, also considering rules and canons of good technique.

Eligibility with time limitation of the length of working time (increase the number of ordinary daily breaks).

Based on the assumption that there is a certain relationship between the duration of the VDT suitability assessment and the occurrence of asthenopia, possible prescriptions include those that tend to limit exposure. This is endorsed by Legislative Decree 81/08, when it stipulates that the worker is entitled to 'an interruption of his activity through breaks or changes of activity'. The modalities of these interruptions are established by collective and company bargaining. In the absence of contractual action, the worker is still entitled to a break of 15 minutes for every 120 minutes of continuous application to the VDT. It is also stipulated that the modalities and duration of the breaks may be temporarily determined at individual level, where the occupational physician highlights the need.

Therefore, the requirements for limited fitness are framed in this context, increasing the number of breaks already provided. Everything must consider the characteristics of the activities and working environments. This type of limitation must be formulated in the presence of significant symptoms of fatigue and/or visual discomfort. These may result from significant environmental and workplace deficiencies, the worker's oculo-visual status and the assistance of other contributing factors, both work-related and non-work-related.

In the most sensitive individuals, clinical conditions that may favor the onset of the asthenopia disorders include the following:

- partial amblyopia with vision less than 6/10 (even unilateral);
- alteration of extrinsic ocular motility: such as easily decompensated heterophorias, nystagmus and neurological deficits;
- chronic inflammatory pathologies of the annexes (such as blepharitis, conjunctivitis);
- ocular surface diseases (dry eye syndrome);
- changes in the transparency of the cornea;
- keratoconus;
- cataracts;
- aphakia-pseudophakia;
- high refractive defects (regardless of the vision obtainable with correction);
- degenerative retinopathies;
- maculopathies with alteration of central vision function (metamorphopsia);
- alterations in the visual field.

Temporary ineligibility

It can be formulated in the case of ocular pathologies in which the acute phase causes a reduction in vision below the limits necessary for the performance of the usual visual task; significant subjective discomfort due to pathologies such as keratitis, conjunctivitis, uveitis, alterations of the tear film. However, these situations must be assessed on a case-by-case basis.

Permanent non-suitability

In the experiences to date, eye conditions leading to total and permanent unfitness have very rarely been recorded among workers assigned to VDTs. It is also emphasised that the use of such a judgement to resolve particular cases appears inadequate and limiting for the solution of ergo-phthalmological problems. In fact, this intervention would force the adoption of criteria and limits that are at least partly arbitrary, would not protect suitable workers from inadequate ergonomic and environmental factors, and would impose rigidity in the organisation of work, sometimes even damaging the worker.

There remains, however, the need to provide for the rare eventuality of permanent unfitness, for example in the case of a vision of the better eye of less than 2/10 with the best possible correction. This vision value obviously refers to the quality of vision at a distance, whereas in VDU work the vision conditions are equivalent and lie between near vision (reading at 33 cm) and intermediate vision (music at 50-70 cm).

With a vision of about 2/10 using the best correction, it is difficult and probably uncomfortable to grasp details and distinguish the most commonly used characters for professional activities. When defining the suitability of a specific worker for the job, an exact definition of the visual discrimination required for visual tasks is obviously necessary.

It is also worth mentioning the possibility of special software-hardware aids that can enable even severely visually impaired people to discriminate suitably modified (amplified) characters.

Although it is not entirely orthodox to express the visual power required for close observation in tenths for a distance, which should instead be quantified by reference to the characters of the De Wecker (D.W.) table, the assessment is nevertheless sufficiently reliable and meaningful.

In fact, even with the best correction, it is very unlikely that workers with 2/10 visual acuity (corresponding to the 6th-7th character of the D.W.) will have comfortable and prolonged near vision equivalent to the first or second DW character. Only in some pathologies (nuclear cataract with high index myopia; forms of nystagmus with convergence blockage) is this correspondence not so linear.

Therefore, in the complex process of formulating the judgment of suitability, the assessments of the occupational physician must initially take into account at least three

general evidences of the visual ocular condition, characterized by:

- ocular pathologies with or without alterations (refractive of ocular motility of the ocular surface) that are not correctable/curable, **incompatible** with the required visual commitments and work tasks (possible non-suitability judgment);
- ocular pathologies with or without alterations (refractive, ocular motility and ocular surface), not correctable / curable, **compatible** with the visual commitments required of work tasks, but which give rise to a significant correlated **asthenopia** (possible use of prescriptions and / or limitations);
- ocular pathologies with or without alterations (refractive, ocular motility and ocular surface), which cannot be corrected/cured, **compatible** with the visual commitments required by work tasks, which do **not give rise to significant**, but possibly evolving **asthenopia** (possible recourse to close health checks).

Therefore, for the purposes of making a suitability judgement, an ophthalmic assessment is essential to obtain a complete and meaningful evaluation of the ocular-visual condition of workers with impairments.

However, it must be emphasised that the finding of eye disorders in a worker is not sufficient to make a limited suitability judgement.

Above all, the connotations of this condition in relation to the functional limitations it is capable of causing must be carefully weighed. The following must be considered: the visual deficit dependent on ocular pathology and refractive alterations, ocular surface motility and the evolution of the disease; last but not least, asthenopia.

As already mentioned, the occupational physician must pay great attention to the presence of asthenopia in relation to environmental characteristics and the work performed.

In fact, asthenopia is only an aggravating circumstance if it is clearly related to the type of ophthalmic disorder found and if it is work-dependent (occupational asthenopia).

In addition, occupational asthenopia must not be identified merely as a generic (exclusive or predominant) occupational causation or concomitance, or presence during work, but the specific type of causal relationship must be ascertained as far as possible, since it may not depend on the oculo-visual disorder but may also or exclusively be due to environmental pollution causes (physical and chemical agents) or psycho-emotional aspects.

Therefore, if asthenopia can lead to the determination of suitability-limiting measures or prescriptions, it must be a relevant expression and closely linked to the ocular-visual pathology in question. In fact, the use of more frequent health checks, or recourse to more breaks during daily work, only have a productive function if the asthenopia being assessed is actually determined and aggravated, exclusively, by the oculo-visual affection considered in the context of the habitual visual commitment.

An epidemiologically validated quantitative assessment of asthenopia still appears to be impossible. Therefore, for decision-making purposes as part of the assessment of fitness for work, a definite concept of 'significant' asthenopia does not appear to be feasible at present. However, it is considered that a parameter of significance must still be available and considered differently depending on the area in which it is used.

For the purposes of assessing the degree of significance of asthenopia, depending on the possible measures that the occupational physician should take, the following classification is indicated:

FREQUENCY (Number of episodes/week)	SERIOUSNESS	MEDICAL ASSESSMENT
<1	Negligible	None
1-2	Mild	Possible
3	Moderate	Necessary
4-5	Intense	Necessary and urgent

In the past, "guideline tables" were given to the legal provisions for formulating the suitability judgement solely based on the existence of visual dysfunctions.

To formulate the suitability judgement for specific work, in relation to suitability judgements with prescriptions for close and prolonged visual limitations, a partially modified approach is proposed that derives from the criteria formulated at the 61st National Congress of the SIMLII.

This approach required the presence of at least two ocular visual symptoms (frequency of onset of at least three times a week and duration of at least one hour), in the presence of at least one objective sign related to the symptoms (to define moderate or intense levels of asthenopia).

The above is of particular importance for defining and quantifying asthenopia in the logical-sequential process that the occupational physician must follow to formulate the judgement of specific suitability for VDT operators.

It can certainly represent not only an aid in ensuring greater homogeneity and uniformity in the expression of suitability judgements, but also a valid support in the complex process of assessing suitability.

The visual acuity value to which it is proposed to refer is that obtained (with the best possible and tolerated correction) for a distance. In fact, for the purposes of assessment, apart from very special cases or the concomitant presence of presbyopia, the visual acuity value obtainable for distance vision with adequate correction does not differ significantly from that for near vision.

In the case of significant differences between obtainable distance and near vision (indicatively greater than 2/10, when near vision is also measured in tenths), a specific assessment of intermediate vision at 60 cm is recommended and should be referred to.

In the case of coexisting mild-to-moderate presbyopia (≤2D), the necessary correction of this defect makes it likely that a visual quality similar to that measured at a distance, even for near vision, can be achieved.

On the other hand, intermediate visual acuity must be considered in the case of presbyopia of a non-mild-to-moderate degree (>2D), or in any case of visual defects with differences between distance and near vision >2/10.

In cases where standard near or distance corrections are

unable to provide adequate intermediate action, ad hoc lenses for VDT activity may be appropriate in some situations. A total standardisation of the procedure described above is not possible, however, because of the complexity of individual characteristics that require the ophthalmologist to prescribe "reasoned" optical corrections on a case-by-case basis.

Pursuant to Article 176 of Legislative Decree 81/08, paragraph 6, concerning the economic burden of optical correction means, 'the Employer shall provide workers, at his own expense, with special visual correction devices, in relation to the activity carried out, when the outcome of the examinations referred to in paragraphs 1, 3 and 4 shows the need and it is not possible to use normal correction devices'.

In this regard, it is deemed appropriate to provide some useful clarifications to understand what the legislator probably means by 'special vision correction devices'. In technical-scientific terms, it is possible to assume that the intention was to refer to special types of glasses, which the worker does not use at all in his 'normal daily activities', but which are instead indispensable for carrying out his work tasks with VDUs. An example could be the case where ad hoc lenses are made necessary by the characteristics of work tasks that also require intermediate vision, which cannot be obtained with normal means of correction. A more complex case might be that of a myopic operator, suffering from aniso-pharsia, who needs progressive lenses to be able to focus on multiple "professional lenses" (various screens, texts and displays, placed at different distances).

Current problems and future prospects

The rapid change in types of work and the goals achieved by technological innovation influence ergophthalmology, perhaps more than any other branch of occupational medicine. At European level, studies in this field are expanding, while there is less attention at national level. However, a clinical research study was opened at the Policlinico di Milano about a year ago.

In his daily work, the occupational physician is called upon to deal with this problem and to respond to the demands of an increasingly informed and demanding clientele. It should be remembered that according to Legislative Decree 81/08 can put the health professional in a disadvantaged position, with the risk of being the weak link between employer and employee.

According to Legislative Decree 81/08 (Art. 39), the occupational physician is an employee or in any case paid by the employer under a free professional relationship or convention through a public or private structure and is therefore particularly monitored by the Health Surveillance Authority since specific criminal and administrative sanctions are envisaged for each violation of the rules referred to by the Law.

The occupational physician must also comply with the International Code of Ethics for Occupational Health Professionals (ICOH). This code affirms 'the importance of professional ethics and it is certainly the first time in Europe that voluntary standards (such as ethical standards) have been included in a piece of legislation that is mostly backed by criminal sanctions. Certainly, this procedure has suggestive aspects because it strongly indicates to occupational medicine practitioners the need for irreproachable behaviour and an ethical analysis of their own behaviour. In fact, "occupational physicians must concern themselves with the health of workers, their ability to work, and must set themselves the objective of protecting it, maintaining it and promoting it, taking care to organise health promotion activities in the workplace, also taking into account human needs and social problems in a global and coherent perspective".[16]

From an operational point of view, the ICOH code also insists on the quality of services when it states that 'biological tests and other assessments must be provided based on their validity and relevance to the health protection of the worker concerned, taking due account of their sensitivity, specificity and predictive value. They must not be based on unreliable tests or on assessments with little predictive value in relation to the characteristics of the work performed. Where possible, preference shall be given to non-invasive methods and tests that do not pose a risk to the health of the worker concerned.

According to the Legislative Decree (Art. 41), the occupational physician must plan and carry out health surveillance by means of health protocols defined according to the specific risks and considering the most advanced scientific guidelines' (Art. 25 c. 1 lett. b).

All in all, this is a not inconsiderable commitment, especially if knowledge is constantly evolving as in the case of VDT risks.

First of all, the problem concerns the type of workers who must be subjected to health surveillance, as previously mentioned, in Title VII of the Consolidated Law on Safety at Work (TUSL).

In the definition in Article 173, the video terminal worker is one who 'uses equipment with video terminals, in a systematic and habitual manner, for 20 hours per week, excluding breaks'. In the legislator's intentions, it is not the daily workload that is relevant, but the number of hours per week carried out at the visual display unit, considering only those tasks that, for the purposes of recognition, are not to be considered occasional or episodic.

It should be noted that the threshold of twenty hours per week is not present in all national legislations of the European Union states. Directive 90/270/EEC itself does not provide any reference in this sense, in fact, the VDT worker is the worker who regularly uses a VDT during a significant period of his or her normal working activity (to compare the Italian legislation with that of other countries, there is no threshold number of hours in Great Britain, nor in France or Germany).

A further observation that highlights the antiquity of the legislation in question is contained in its objective scope of application (Art. 172). In fact, according to Art. 172, workers employed on 'equipment fitted with a small device for displaying data or measurements, which they are not capable of displaying' are excluded. 172 excludes workers employed on 'equipment fitted with a small device for displaying data or measurements, which is necessary for the direct use of such equipment'.

The consideration to be made here concerns the minimum size of the display device that allows its exclusion from

the scope of application. At the time, however, there were no devices similar to today's smartphones and tablets, which have increasingly become work tools, especially with the strong work demands of mobility and connectivity.

In fact, looking at what the legislator used as examples of small devices (Article 172, paragraph 2, letter d) and lists calculating machines and cash registers.

Since the European directive dates back to the 1990s and the display technologies of that time were very different from those of today (small displays were essentially liquid crystal displays, but they were certainly not the same as today's LCDs), it is conceivable that the Legislature wanted to exclude devices with displays comparable to portable calculators (sound level meters or other measuring instruments) with displays much smaller than those of today (which typically have diagonal sizes ranging from 4" to 10") and whose prolonged use constitutes an ergonomic risk.

However, it is clear that a worker is unlikely to interact with a smartphone screen for more than 20 hours a week at the workstation. At the same time, it is legitimate to ask whether the working time spent performing this activity (interacting with a smartphone screen) should be added to the total number of hours spent in front of a normal computer screen.

In any case, the employer must carry out an assessment of the risk arising from work with a video display screen, because of his responsibility for health and safety in the workplace.[4,17]

In this regard, some authors suggest going beyond the regulatory identification, including in the health protocol all subjects with significant exposure (or in any case such that the risk to the target organs is real). A second critical issue concerns the method and therefore the health protocol.

According to current legislation and the SIMLII guidelines, a specialist eye examination is not essential, although it is strongly recommended as a first and second level assessment.

In practice, also for economic reasons (specialist examinations are paid for by the employer, as explicitly indicated by Legislative Decree 81/08), as a first level the ophthalmic assessment is replaced by an ophthalmological screening carried out by the occupational physician with or without the aid of an orthoanalyser.

This is a generally accepted methodology - also used by INAIL[5,18] - which assumes that the ophthalmologist does not have the elements to study the eyes in the specific work context, both environmental and organisational, as required by the regulations. Moreover, as is the case in other areas of occupational medicine, 'the objective of screening does not consist in the diagnosis or treatment of ophthalmic pathology, but in the selection of cases in which reversible alterations are still present, predictive of possible future pathological states in their own right, connected in part to work.[6,19]

On the other hand, second-level ophthalmological assessment can be very useful in cases of worsening eye diseases, with residual visual deficit after correction and significant asthenopia. It must be emphasised, however, that workers with significant eye pathologies are very often subjected to specialist follow-up protocols for clinical reasons, which do not prevent the occupational physician from also expressing an opinion based on the certification produced by the worker.

From this point of view, it is essential to refer the worker to the occupational physician's trusted specialists when one wants to refute the indications contained in a certification issued by the worker's treating specialist that would impose a different judgment from that suggested by the results of the ophthalmological screening.

Another problem concerns the use of the ortholaser, commonly used by most occupational physicians, which could overestimate some visual disorders.[7]

Failure to adhere to the guidelines, which are not peremptory in this matter, could nevertheless constitute an element of (negative) judgement for the occupational physician with respect to the hypothesis of professional liability, also considering the recent regulatory changes set out in Law 24/2017. Inevitably, this issue recalls the scientific validity of the current guidelines on the subject. In this regard, it is fair to mention that a study has questioned the scientific consistency of some European guidelines (English, Spanish and French) supporting evidence-supported supranational recommendations.[8]

Even the Italian Guidelines (promulgated by SIMLII in their latest version of 2013) appear, as mentioned, to be rather backward with respect to the use of smartphones and tablets and the management of mobile workstations.

The renovation work still in progress is proceeding at a slow pace, given that the solidity of the same must respond from a scientific point of view to the standards of Evidence Based Medicine required by the National Guideline System for the well-known repercussions in the criminal, but also civil, sphere introduced by Law 24/2017.

Moreover, beyond the age, some operational indications contained in the current guidelines raise some perplexity.

In particular, the importance assigned to asthenopia in directing the request for second-level assessments or even in influencing the suitability judgement may appear excessive and potentially used instrumentally by the worker. The occupational physician must have the ability to interpret the symptoms reported by the worker and to assess their actual extent by comparing them with the characteristics of the worker, the type of work and the working environment.

On the other hand, the other critical issue takes the form of a paradox. The rare judgments of permanent unfitness seem to be essentially anchored to conditions of medium to severe visual impairment. In other words, visually impaired people who can most benefit from specific technological aids to overcome their disability risk being excluded from clerical activities that now invariably require the use of VDTs.

In these cases, considering that scientific studies currently rule out that the use of VDTs may aggravate pre-existing visual defects, a limited suitability through the use of specific technical aids (speech synthesisers, magnifiers) would be desirable.

This awareness begs an important question. If the long-term effects of VDTs and thus potential occupational diseases have not been demonstrated, does it make sense to continue indiscriminate health surveillance in workers exposed to VDTs?

Could it be ethically correct to shift economic resources to the study and prevention of occupational noxae that we

have known about for years, perhaps by implementing health protocols?

This is a rather complex problem that arises at a European level, so much so that a recent study observed that in Spain 54% of the expenditure on health protocols for workers exposed to VDTs is higher than necessary. In fact, a lot of money is spent on unnecessary clinical tests to formulate the judgement of suitability.[9]

The increased exposure to risk outside of work, the intensive use of work tools whose effects on health are still little studied (tablets and smartphones),[10,20] but also the emerging scientific work on blue light damage, late myopia[11,21] and dry eye syndrome advise against eliminating worker health protection even where this is expressed through the adoption of rather crude measures (increased breaks, reduced hours of exposure, more frequent visits).

From another point of view,[12,22] there are those who believe that health surveillance, especially if well conducted, must go beyond the prevention of illness (as indicated by the code of ethics), in order to achieve a condition of occupational well-being for the VDT operator.

The decrease in cases of asthenopia would be one of the tangible results, in fact even the national literature of the 1990s put the prevalence at 40-50% and now in some studies it drops to 20% and even much lower percentages. At the same time, a concrete benefit for VDT could come from research and the implementation of preventive measures to reduce asthenopia, which in most cases recognise psychosomatic reasons. Furthermore, in order to verify possible worsening of refractive disorders in workers exposed to VDTs, one study[13,23] found that the perception of anxiety was of paramount importance with respect to environmental factors, lens wear, time of VDT use and psychosocial factors.

Therefore, according to the authors, VDT use is not harmful to vision, but it is necessary to promote workers' well-being by focusing on interventions to reduce anxiety, increase good worker relations and promote psychosocial well-being.

From the same point of view, one study by Garzaro *et Al.*[14] shows that VDT workers can concretely benefit from a healthy lifestyle and the organisational and ergonomic interventions implemented by the employer. Starting from the positive experience of the car manufacturer BMW, which recently created an innovative system specifically for older workers by introducing a total of 70 improvements (installation of special chairs to be used during breaks; night shift rotation) increasing productivity by 7 per cent in one year, the authors conclude that the promotion of healthy lifestyles could also preserve and improve work capacity. For younger workers, these solutions should be considered a form of primary prevention, while for older workers they should be considered a form of secondary or tertiary prevention.

Furthermore, the findings call for greater efforts to strengthen welfare policies aimed at supporting women in maintaining a work-life balance (opening crèches or kindergartens) and at supporting older workers in managing elderly relatives. Finally, other recent studies point out that the well-being of VDT operators can also derive simply from the correct use of breaks.[15,24]

Conclusions

Once considered relatively easy, the activity of the occupational physician in the health surveillance of workers exposed to VDTs presents specific difficulties. In particular, the introduction of tablets and smartphones, which are also increasingly being used in the workplace, makes a radical change in approach essential, both because the health effects of these devices are not yet known and because breaks, which seem to be one of the few effective ways of reducing occupational asthenopia, are being considerably reduced or almost completely abolished.

These devices and the changed working conditions of smart working now make the recommendations of the guidelines, which are calibrated on an almost exclusively work-related exposure and on fixed workstations, obsolete.

The guidelines themselves, which nevertheless represent the operational reference tool for healthcare also from the point of view of professional liability, appear rather ambiguous (such as the actual need for specialist ophthalmological advice) and in other circumstances extremely weak due to the methods and judgements dependent on subjective symptoms used.

In addition, some operational indications give rise to many perplexities: the risk of exclusion from the world of work (through a judgement of permanent unfitness) of visually impaired workers; the prescriptions and limitations sometimes boil down to indications of more frequent periodic checks without bringing any concrete benefit to the VDT's work. However, although no permanent damage to health has been demonstrated, it still appears ethically reasonable to maintain health surveillance of workers exposed to VDTs pending more specific studies on the subject.

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Availability of data and materials
Bibliography available inside the paper.

Competing interests
All authors declare no competing interests.

Funding
Not applicable.

Authors' contributions
The authors contributed equally to the composition of the manuscript.

Acknowledgements
None

References

1. Salducci M, Shaholli D. Assessment of workplace bullying in Italy by INAIL: forensic and occupational medicine considerations. Clin Ter. 2023 Jan-Feb;174(1):93-96. doi: 10.7417/CT.2023.2503. PMID: 36655651
2. Salducci M, Evangelista JJ. The role of the ophthalmologist in forensic medical judgement for videoterminalists. Clin Ter. 2022 Apr 4;173(2):187-194. doi: 10.7417/CT.2022.2415. PMID: 35385044
3. https://www.repertoriosalute.it/wp-content/uploads/2017/02/Linee_Guida_VDT_SIMLII.1.pdf
4. Salducci M, Maiorano F, Maione CR, et al. Retrospective study on the incidence of pseudoexfoliatio lentis and related complications in a cohort of patients from the Island of Ischia: medico-legal and ergophthalmology considerations. Rom J Ophthalmol. 2021 Jul-Sep; 65(3):230-234. doi: 10.22336/rjo.2021.46. PMID: 35036642; PMCID: PMC8697796
5. Salducci M, Deandri A. Medical legal validity of the use of the anomaloscope in the dyschromatopsia of aspiring civil and military aircraft pilots. Rom J Ophthalmol. 2020 Apr-Jun; 64(2):153-157. PMID: 32685781; PMCID: PMC7339684
6. Shahbaz R, Salducci M. Law and order of modern ophthalmology: Teleophthalmology, smartphones legal and ethics. Eur J Ophthalmol. 2021 Jan; 31(1):13-21. doi: 10.1177/1120672120934405. Epub 2020 Jun 14. PMID: 32544988
7. Totaro B, Assini R, Consonni D, et al. (2007). Adeguatezza e affidabilità dell'ortoanalizzatore Ergovision nel giudizio di idoneità specifica. GIORNALE ITALIANO DI MEDICINA DEL LAVORO ED ERGONOMIA, 29(3), 250-251.
8. Mar Seguí MD, Ronda E, Wimpenny P. Inconsistencies in guidelines for visual health surveillance of VDT workers. J Occup Health. 2012; 54(1):16-24. doi: 10.1539/joh.11-0186-oa. Epub 2011 Dec 10. PMID: 22156323
9. Gerassis S, Abad A, Taboada J, et al. A comparative analysis of health surveillance strategies for administrative video display terminal employees. Biomed Eng Online. 2019 Dec 11;18(1):118. doi: 10.1186/s12938-019-0737-z. PMID: 31829225; PMCID: PMC6907276
10. Lee M, Hong Y, Lee S, et al. The effects of smartphone use on upper extremity muscle activity and pain threshold. J Phys Ther Sci. 2015 Jun;27(6):1743-5. doi: 10.1589/jpts.27.1743. Epub 2015 Jun 30. PMID: 26180311; PMCID: PMC4499974
11. Santucci P. Miopia tardiva, miopia occupazionale?, in Ufficio e Salute, Medico competente Journal, 4/2015
12. Santucci P, Gioffrè PA. L'utilità della sorveglianza sanitaria del videoterminalista, Medico Competente Journal, 1/2016
13. Larese Filon F, Drusian A, Ronchese F, et al. Video Display Operator Complaints: A 10-Year Follow-Up of Visual Fatigue and Refractive Disorders. Int J Environ Res Public Health. 2019 Jul 13;16(14):2501. doi: 10.3390/ijerph16142501. PMID: 31337021; PMCID: PMC6678724
14. Garzaro G, Sottimano I, Di Maso M, et al. Work Ability among Italian Bank Video Display Terminal Operators: Socio-Demographic, Lifestyle, and Occupational Correlates. Int J Environ Res Public Health. 2019 May 12;16(9):1653. doi: 10.3390/ijerph16091653. PMID: 31083621; PMCID: PMC6539947
15. Fujita H, Sano K, Baba T, et al. Blind working time in visual display terminal users. J Occup Health. 2019 Mar;61(2):175-181. doi: 10.1002/1348-9585.12027. Epub 2019 Jan 22. PMID: 30866126; PMCID: PMC6499340
16. Paone G, Leone V, Conti V, et al. Blood and sputum biomarkers in COPD and asthma: a review. Eur Rev Med Pharmacol Sci. 2016;20(4):698-708. PMID: 26957273
17. Arrico L, Migliorini R, Bianchini D, et al. Ocular motility alterations in orbital fractures: pre-post evaluation in maxillofacial surgical treatment. G Chir. 2018 Nov-Dec; 39(6):363-367. PMID: 30563599
18. De Felice F, Pranno N, Marampon F, et al. Immune checkpoint in glioblastoma multiforme. Crit Rev Oncol Hematol. 2019 Jun;138:60-69. doi: 10.1016/j.critrevonc.2019.03.019. Epub 2019 Apr 4. PMID: 31092387
19. Di Muzio M, Giannetta N, Figura M, et al. Perioperative nutritional support or perioperative fasting? A narrative review. G Chir. 2019 Sep-Oct; 40(5):377-380. PMID: 32003715
20. Salducci M, La Torre G. COVID-19 emergency in the cruise's ship: a case report of conjunctivitis. Clin Ter. 2020 May-Jun;171(3):e189-e191. doi: 10.7417/CT.2020.2212. PMID: 32323704
21. Salducci M. Current Trends in Treating Acanthamoeba Keratitis: A Brief Narrative Review: Doi:10.36351/pjo.v36i4.1068. pak J Ophthalmol [Internet]. 2020 Jul. 28 [cited 2023 May 31];36(4). Available from: https://pjo.org.pk/index.php/pjo/article/view/1068
22. Salducci M, Pacella F, Malvasi M, et al. Medico legal considerations on refractive surgery. Clin Ter. 2020 Nov-Dec;171(6):e476-e480. doi: 10.7417/CT.2020.2260. PMID: 33151244
23. Pacella F, Pacella E, Trovato Battagliola E, et al. Efficacy and safety of intravitreal Fluocinolone Acetonide microimplant (ILUVIEN®) in patients with chronic diabetic macular edema: 1 year follow-up. Eur J Ophthalmol. 2021 May 24:11206721211020203. doi: 10.1177/11206721211020203. Epub ahead of print. PMID: 34030511
24. Comberiati AM, Graziani M, Malvasi M, et al. Effectiveness of diagnosis and early treatment of ocular motility alterations in premature infants. Clin Ter. 2023 Jan-Feb;174(1):48-52. doi: 10.7417/CT.2023.2496. PMID: 36655644