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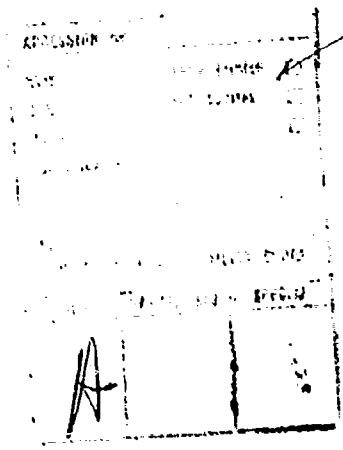

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CONTRIBUTION TO THE DOCTRINE GOVERNING HOSPITALIZATION IN NATIONWIDE DEFENSIVE WARFARE

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Factors exerting an essential effect on the dimensions, structure and territorial placement of the hospital network under the conditions of a nationwide defensive war are discussed. Types of hospital institutions are proposed. There is a pronounced need for wartime hospitalization policy to be defined in peacetime because of the inevitability of considerable restrictions in quotas and standards of the hospital service. The article presents certain problems and solutions regarding the movement and housing of hospital institutions in wartime and also views and special procedures regarding protection of hospitalized members of the armed forces and in connection with the functioning of the hospital service on portions of territory temporarily occupied by the aggressor.

Criteria of the Dimensions and Territorial Distribution of the Hospital Network

The basic problems standing in the way of working out a system of hospitalization and of establishing a hospital service under the conditions of nationwide defense arise, first, from the necessity for a considerable enlargement of hospital capacity and the maintaining of acceptable standards of treatment and care and adaptation of the structure of the hospital network to the population's wartime pathology, second, from the position and requirement that all major forms of hospital treatment always be available to the population and the armed forces on all portions of the territory thanks to appropriate geographic distribution of hospital facilities, and third, from the special circumstances of hospitalization of members of the armed forces.

The attempt to fix the size of the military hospital network with respect to hospitalization criteria that apply in peacetime would result in an enormous enlargement of hospital capacity, but since there is no possibility whatever of increasing professional medical forces as well, a drastic degradation of all standards of hospital care and treatment would inevitably ensue. It is therefore necessary to make certain changes in standards applied to hospitalization, and those changes essentially come down to making criteria stricter, that is, to narrowing the indications of hospitalization and to bringing the standard of the hospital service into line with the real capabilities of the health service.

We are dealing, then, with the necessity of restrictions in the domain of hospital treatment, restrictions which are customary practice in wartime and are implemented in various forms, such as the following: postponement of the hospitalization of the chronically ill, reduction of the time of hospital treatment, stronger orientation toward outpatient treatment, etc. Analogous tendencies and procedures are manifesting themselves with increasing strength even today in peacetime, and certain studies show that certain categories of patients occupying 50 percent or even more of hospital capacity could be successfully cared for in a system of out-of-hospital service, through outpatient treatment and home care [6]. In view of the great human casualties in a possible war, such a course would have to be given exceptional emphasis in policy governing hospitalization, considerably more probably than ever before in previous wars. This makes a well organized service for home treatment and care and a solid medical visiting service have essential importance, and comprehensive preparations in that direction are decisive to success of this concept of treatment.

Therefore it follows that one of the things that comes before the dimensions of wartime hospital capacity are determined is the definition of wartime criteria of hospitalization. Medical experts in various fields should commit themselves to this task. Once we have these criteria and an estimate of the number of injured and sick, it is possible to examine and compute the necessary minimum of hospital capacity. A comparison of the capacity determined in this way with available personnel and funds makes it possible to determine the wartime standard levels of service of the hospital service and the standards that can be achieved in hospital treatment.

Starting from the realistic assumption that even after major restrictions in indications of hospitalization wartime hospital capacity will have to be considerably larger than peacetime capacity, it is obvious that quotas concerning personnel and equipment (wartime formations) and consequently standard treatment and care must be adapted to these circumstances and must undergo corresponding restrictions. But this adaptation and those restrictions must not be viewed as a task calling for individual "resourcefulness" of medical personnel during a war, but it should be an element of the wartime policy governing hospitalization that is established in peacetime and which is built on a knowledge of both wartime needs and also wartime capability.

All measures which contribute to optimum utilization of capacity and to raising the "level of utilization" of capacity, such as the maneuverability of the system and institutions, the level of training and drilling of personnel, good organization of work, etc., also have importance for rational arrangements in this field. On the other hand, when they have been adopted the standard levels of hospitalization should not be regarded as unchanging categories, but one should constantly look for ways and means of softening the restrictions and the severity of their consequences.

The necessary enlargements in hospital capacity should be made according to an established plan of geographic distribution, and it is obvious that there will be different relations in that distribution than those that exist in peacetime. What are those relationships and what are the criteria for establishing them?

The plan governing the general enlargement and territorial distribution of hospital capacity should be an appropriate reflection of the functions of the wartime regional organization of the health service and should be in line with the wartime role that has been defined for individual regions in the domain of hospitalization. The regional system for the organization of the health service insures every region a proper degree of independence in protecting the health of the population and also insures health support of the armed services along every operational direction and in every region of national territory [4]. In the process of adaptation of the organizational structure and dimensions of the hospital network to wartime needs, then, the following measures must be carried out in every region: 1. All major types of hospital treatment must be established, 2. capacity must be developed in accordance with the estimated needs for hospitalization of the population and members of the armed forces on that territory, and 3. specific needs and requirements must be met with regard to hospitalizing members of the armed forces.

One of the bases for establishing the necessary hospital capacity in a region is the assessment of the wartime morbidity rate of the population, which in turn is based both on peacetime pathology and its possible wartime evolution, especially in the field of infectious diseases, and also the character of the threat from military actions. The needs of the armed forces, as one of the factors in determining the dimensions and distribution of hospital capacity, should be viewed from two standpoints. On the one hand, there is the desire for the total capacity necessary for hospitalization of members of the armed forces to be so distributed that most of this will be within range of the major operational directions and regions where the most serious battles and highest losses are expected, and on the other hand there is a need for hospitalized members of the armed forces to be protected from capture, and therefore that distribution of facilities for their hospitalization is most favorable which will put them out of the range of the aggressor and will offer them maximum security. In view of the character of contemporary military actions, the specific features of our theater, and our defense doctrine, it seems that the most

favorable solution to this problem lies in a combination of dispersion of the injured and sick over the entire territory and evacuation to relatively more secure regions in the interior of the country. In the context of this arrangement the armed forces would have hospital support for their injured and sick in every region, but there would be stronger orientation toward regions thought to be more secure.

Not a single region is altogether secure against the penetration of the aggressor's units, and therefore one must not create excessively large concentrations of hospitalized members of the armed forces anywhere, on any restricted space, since in case of an immediate threat to that space it would be very difficult or impossible to remove all the injured and sick from that space in good time. No region, then, should be excessively burdened, but at the same time none of them ought to be completely relieved from the obligation of hospitalizing members of the armed forces, just as it would not be correct to set quantitatively equal obligations on all regions. The competent government agencies evaluate the conditions and capabilities for hospitalization of members of the armed forces and in that manner establish the obligations of each individual region. It is certain that those regions which are in the deeper interior and which are away from the main operational routes should have greater capabilities and accordingly greater obligations.

Consequently, the principal criterion governing the distribution of hospital capacity is the established role of each individual region in the overall plan for hospitalization, and this should be based on an estimate of the needs of the population and the conveniences each region offers as a base for hospitalization of members of the armed forces. Achievement of the distribution of hospital capacity that conforms to this criterion will require a corresponding redistribution of medical personnel, above all to the advantage of regions whose role in hospitalization is being essentially increased. However, the movement of personnel from certain "richer" regions must in no cases be of such size as to put the health service of those regions in a position which is below the level of the role intended for them and which they can perform in view of objective evaluations of their capabilities and the strategic conditions of hospitalization.

The Structure of the Hospital Network and Types of Hospitals

In its internal structure the wartime hospital network should correspond to the characteristics of wartime pathology, and peacetime proportions in that structure cannot be taken as the principal orientation for wartime development. Certain types of hospitals, for example, various fields of surgery, will experience an extraordinary increase in their share in the total number of beds, while certain others (pediatrics, obstetrics, etc.) may remain at the peacetime level in quantitative terms or even decrease.

This question will always be an urgent one: through what organizational forms and with what kinds of hospital institutions is it best to create the necessary dimensions of hospital capacity so that the internal proportions of that capacity would be appropriately related to the structure of wartime pathology?

We should bear in mind that the process of rapid reorientation of the hospital network toward wartime tasks and the rapid transition to a wartime footing, which is posed as an imperative under conditions of surprise aggressions, is fraught with a serious danger of an organizational crisis with considerable disruptions or even interruption of the functions of the hospital service at a very sensitive moment. Precisely for that reason it is a justified position that in all its essential organizational features the wartime hospital service should be as close as possible to the peacetime system and the peacetime situations, so that major changes do not have to be made in the structure, at least at first, which would jeopardize its function, so that the necessary adaptations to wartime needs and conditions would be carried out in the course of time, cautiously and gradually.

Proceeding, then, on the basis that the peacetime structure should be respected as much as possible in the transition to the wartime footing, it is logical to conclude that with regard to the organizational form of wartime hospitals it is most correct to orient oneself toward the system of general hospitals. This organizational form, that is, is dominant in the structure of our country's hospital service, and this type of hospital is favorized in development of the service, while the total share of specialized hospitals and so-called nonhospital infirmaries is gradually decreasing [2]. It is felt that this line of development has every justification from both the medical and economic standpoint: there is a saving on personnel and equipment, and more favorable conditions are achieved for comprehensive treatment of patients of all types.

Consistent with this, then, this type of institution shall be dominant in the wartime structure of the hospital service. However, this does not mean that it would be wise for the entire hospital network to be built up, say, of several hundred general hospitals of approximately the same formation, with all major specialized departments in the structure of every single hospital. It is obvious, that is, that because of the crisis of personnel in certain medical disciplines it would not be possible to develop all the major specialized departments in each of these general hospitals we have visualized in such number, and because of the expected frequency of certain types of patients, the very needs for certain specialized fields are not so great that they would all have to be provided for in every one of this large number of hospitals. It is therefore justified to think in terms of two or more variants of the general hospital, rather than just one, and they would differ from one another in the level of development of specialized services.

Which variants should be provided for, what should be the physiognomy of the individual variants, and how large should be the representation of the individual variants in the total number of general hospitals?

In view of the probable composition of wartime morbidity it is obvious that a hospital with a general surgical and general internist service that is also equipped for isolation of infectious diseases would be the most suitable for broadest use. This institution would be the principal facility for timely general surgical and general internist service, for hospitalization to meet the needs of the population and territorial defense units, and also for support of the military medical service of the armed forces with regard to an appropriate area of hospital treatment. It would have to be highly accessible from all areas of the country, which means that they would be numerous enough so as to insure the necessary density of their placement in the country, and the distribution and each individual location would have to be such as to make them as accessible as possible to patients in the area they serve.

This hospital should have a more highly developed variant of the general hospital to rely on; the latter, in addition to the services the first variant would have, would also have all other major specialties, above all neuropsychiatry, ear, nose and throat, ophthalmology, gynecology and obstetrics, pediatrics, infectious diseases, and also a good physical therapy service and appropriate forms of rehabilitation. The purpose of this variant would be to extend support to general hospitals of the first kind within their area of medical service and to expand the functions of hospital care for all other major specialties.

General hospitals developed in these two variants would be the foundation of hospital care for the general public and the armed forces at the level of specialized medical service.

The need to set up a system of highly specialized hospitals, that is, the need to differentiate hospital treatment into specialized and highly specialized, derives from the same reasons as in peacetime, and those reasons have to do with differences in the nature of the pathological condition and in the nature of the necessary medical service. Nevertheless, it seems that in wartime there is a more pronounced need for this organizational division than in peacetime, the reason being that in wartime the total number of hospitals is considerably greater, while the number of their subdivisions for highly specialized treatment cannot increase in the same proportion because of the shortage of personnel. It is therefore most suitable and rational to concentrate the scarce personnel and equipment for highly specialized treatment at just the number of highly specialized institutions that can be set up with the available manpower and equipment, instead of their being scattered around and lost in the very numerous institutions of the general type. We are talking about highly specialized institutions (clinics, institutes, centers and hospitals) for neurosurgery, plastic and conservative surgery, orthopedics,

institutions for chest injuries, burns, neuropsychiatry, rehabilitation, etc.

However, there would be certain dangers in establishing a system of more narrowly specialized institutions, since commitment of sizable funds and the exclusive orientation of highly qualified specialists toward certain narrow fields of work could be one of the reasons for their underemployment and irrational use from the standpoint of the priority tasks of the health service in wartime. These dangers require that the concept of these institutions' role be clear; they ought not to be reduced to the status of hospitals for special cases, but stock should be taken of their capabilities -- and practice has confirmed the correctness of this view -- for expanding activities (whenever and to whatever extent their facilities allow) to the general surgical and general internist level of medical service, which in itself would be a contribution to the general success in caring for the wounded and sick, but at the same time these institutions would not have to give up their own physiognomy. Moreover, the trained personnel of these institutions should also be ready to work outside the parent institution in appropriate teams.

In addition to these kinds of hospitals, the structure of the wartime hospital service would certainly also include, though in considerably smaller numbers than the general hospitals, special hospitals (centers, institutions) for physical therapy, for isolation of particularly contagious diseases, for victims of severe irradiation, for victims of combat poisons, for the mentally ill and mentally defective, etc., some of which also exist in peacetime, while others would be set up only in wartime as a result of needs.

It can be judged that building a hospital network whose structure and territorial distribution conformed to this concept and these criteria would provide the potential for all essential forms of hospital treatment in all areas or regions. However, the high morbidity rate in wartime, when there is a critical shortage of specialists, seriously jeopardizes the possibility of achieving even minimum standards of hospital treatment with the available potential if all patients for whom hospital treatment is indicated were hospitalized in the institutions we have described. It is not difficult to imagine that when there is a great influx of injured and sick the specialized services would willy-nilly have to perform tasks and work that would put essential limits on performance of their basic functions.

That is precisely why it is justifiable and necessary to set up hospitalization at the general medical level in a larger volume; it is related to institutions such as health centers and health care stations, i.e., organizations in which other health care services at the general medical level are also developed. These health care institutions are the most accessible and closest to the population and to territorial units, and they would meet a large portion of the needs for their health care,

including a considerable portion of the treatment of bed patients (in their own infirmary and through the organization of treatment at home). If the work of these local hospitals is good and proper, then a considerable portion of hospitalization would take place right at this level. This would bring hospital treatment closer to patients (to the field), and at the same time the specialized facilities of the general hospitals would be left more free for their primary purpose, which is treatment at the level of the medical specialist.

A hospital service whose structure would be made up of the institutions we have sketched (local infirmaries, general hospitals of the first and second types, highly specialized centers and special hospitals) would contain all the essential elements of wartime hospitalization, and it would not differ essentially from the peacetime structure. Except for a small number of special hospitals, this structure has no institutions that would not exist in peacetime as well, so that the transition to a wartime footing could be accomplished without essentially disrupting the existing system, and the continuity of its functioning could be insured.

This structure does not include an excessive number of types and variants of institutions, nor is it oversimplified. Along with the other bad consequences of a structural concept that would favor a system of institutions conforming to a single organizational pattern, it would also require essentially different structures and an essentially different system as a whole, which would make the transition to a wartime footing extremely difficult, with all the dangers that derive therefrom.

In principle all these types of hospitals should be represented, each with its appropriate numerical share, in the structure of each region's hospital network. Certain of the highly specialized institutions and special hospitals could not and would not need to be set up separately for each region, but would be set up on an interregional basis, but this interregional institution would have its affiliates in the various areas that would be under the regular supervision of a team of specialists from the parent institution. The regional hospitalization plan would be the responsibility of the opstinas (local communities would also participate), and each of them would have a definite share in developing the wartime hospital network.

By making a more thorough analysis of wartime needs and wartime conditions governing the hospitalization of the population and the armed forces, assuming one has the approximate (official) capacity of the institutions, one can establish the share of each type of hospital in a region's total capacity and the representation in the total number of the region's hospitals, and then the same would be done for the capacity and number of hospitals in the republic and in the Federation.

Field hospitals, mobile hospitals and specialized hospitals called for as essential elements in the hospital service in some conceptions are

not provided for in the structure of the hospital service we have presented. In this regional system of organization there will ordinarily be no need for entire hospitals to move (field and mobile hospitals) in order to provide timely aid and hospital care, since the hospitals exist from the outset in all areas and within range of all routes, and when their capacity is inadequate at a particular moment, they can be sent reinforcements in the form of mobile teams. It is also unjustified for hospital care in the domain of the narrowly specialized fields to be based on temporary solutions (specialized hospitals!), when more permanent organizational forms providing that care already exist within the regional system.

However, one must not exclude altogether the possibility of organizational procedures such as more narrow temporary specialization of certain general hospitals or, say, making a certain number of general hospitals of the first type mobile, but it would be a mistake to adopt these organizational arrangements as the foundation of hospital care. Mobile elements (hospital teams, surgical teams, etc.) which have been provided for in the official structure of individual institutions or as reserves -- modest in their staff size and equipment, but on the other hand very numerous -- could be the basis for mobility (maneuver by movement) in the system of the hospital service set up in the spirit of the concept of health care in nationwide defense. They would go outside the parent institutions to carry on their activity and would rely on local personnel and equipment. It would be irrational and beyond our realistic capabilities to base that mobility exclusively or predominantly on the required number of mobile hospitals set up and equipped according to criteria of functional autonomy.

Certain Forms of Maneuvering

The scheme we have proposed of the structure and territorial distribution of hospital facilities would in principle resolve the question of the organization of hospital service at the general medical, specialized and highly specialized levels within the framework and spirit of the regional health care system. However, the dynamics of the wartime situation and the different nature of regional needs and circumstances will not tolerate rigid and unvarying blueprints, but call for freedom and the possibility of adapting size, structure and territorial distribution of hospital facilities to the situation as it develops.

It is precisely for that reason that one cannot insist on always equal and the same capacity and the same structure of individual types of institutions: the facilities of each institution can be adapted to given needs and circumstances, the general hospital can be developed in various intermediate variants, and the local hospital can also develop on its territory auxiliary infirmaries, particularly when there are compelling reasons for greater dispersion.

Since the inflow of the injured and sick will not be uniform along all routes and in all regions, temporary reinforcements will be required

at places where needs have increased greatly, which is why there must be various mobile units such as surgical and other teams in the structure of the service. The question of maneuvering hospital capacity can be resolved in the form of tactical reserves included in the hospital structure (mobile hospital teams that would be part of the structure of the more highly developed general hospitals) and also by closing or reducing certain facilities, say, on a threatened territory, and by using some of its personnel to expand facilities in another area.

There are special procedures and forms of maneuver related to cases of temporary occupation of larger or smaller parts of the territory by an aggressor. In this connection we should refer to certain positions formulated in the Guidelines for Defense of the Socialist Federal Republic of Yugoslavia Against Aggression: "There are no parts of the territory that would be left to an aggressor without a fight, nor are there parts of the territory which an aggressor would temporarily occupy and where combat would not be waged and where the people would not offer massive resistance," and then further on: "It is especially important that our sociopolitical system maintain itself and function permanently with all its structures on temporarily occupied territory." [1]

It is obvious that the population and units of the armed forces on these territories must be provided definite conditions for health care, including appropriate elements of hospital treatment. The resolution of this question should not be left to spontaneity, but the realistic assumption that in the spontaneous course of events some medical personnel would think it best to evacuate and flee outside the aggressor's immediate range, while others would stay in occupied places suggests the direction to take in seeking procedures that would be planned.

In any case the system of hospitalization on such areas ought to be sufficiently flexible and adaptable to momentary circumstances and to the character and degree of control of the territory by the aggressor so as to be able to maintain itself and function continuously. In fact every region ought to have the relevant plans and maintain a constant readiness to set up such a system on its territory in good time should the need arise.

Hospitalization of Members of the Armed Forces

Hospital treatment of members of the armed forces would be provided in nationwide defense as part of the unified hospital network set up to meet the needs of the entire population. However, there are certain circumstances that require certain specific procedures and measures in organizing hospitalization for members of the armed forces. Among these circumstances it is of no small importance to the overall dimensions of hospital capacity that members of the regular armed forces could not be cared for through treatment at home, and this could be done for members of territorial defense units only to a limited extent. It is therefore necessary for appropriate institutions to be set up over the entire territory; these

would be centers for light wounds and light cases of illness and for convalescents; they would have a soundly organized service for physical therapy and rehabilitation so as to enable patients to return to their units as fast as possible.

The problem of the physical protection of these wounded and sick is nevertheless the most difficult one. Without neglecting preparations to take advantage of international conventions concerning protection of wounded military personnel and military medical institutions, there is still a necessity for full preparedness to protect the wounded and sick should the aggressor trample on those conventions.

Secret hospitals and secret underground shelters were one of the principal means of protecting immobile wounded and sick in the National Liberation Struggle. It is realistic to assume that in a possible war there would be considerably more casualties than in the National Liberation Struggle, and only a small portion of the wounded and sick could be "concealed" in a manner like that. On the other hand, it would not be wise to concentrate all the wounded and sick in the depths of liberated territory, since the security of even parts of that territory is only relative.

In the Guidelines for Defense of the Socialist Federal Republic of Yugoslavia Against Aggression we also find the following views, which have special importance relative to this question: "The struggle to hold and control space, including the space which the aggressor has temporarily occupied, is a constant task of our armed combat and of all other forms of resistance," since "the creation and holding of liberated territory in temporarily occupied regions would have exceptional military and political importance," and this presupposes combat over the entire territory of Yugoslavia and the holding and creation of several liberated zones on temporarily occupied parts of the territory." [1]

As we have already emphasized, a combination of dispersing the wounded and sick over the entire territory with evacuation into the interior is one of the foundations for protecting them. This presupposes establishment of sizable facilities for hospitalization in the more secure areas in the interior, but one would not allow the wounded and sick to be excessively concentrated in these areas, which makes it necessary that conditions also be found and created for hospitalization of members of the armed forces in all other parts of the territory, including those which are in the rear of the aggressor's forces. With regard to the use of these territories the concept of defense set forth in the passages of the Guidelines we have quoted suggests certain fairly concrete procedures.

The system of dispersion would also be applied as broadly as possible on territory in the rear of the enemy forces, using in particular areas liberated and areas under weak control by the aggressor, bearing in mind that the aggressor is not capable of constantly maintaining every settlement, every house and every foot of territory under his effective control.

In case of an immediate threat, the wounded and sick would be gathered up and moved about on this territory, might possibly be housed in secret shelters, and if necessary territorial and other units would be committed to their protection.

On whatever part of the territory they are located, in the deep interior or on territory temporarily occupied by the aggressor, hospitalized members of the armed forces should always be in an appropriate state of readiness and should always have a plan of measures and procedures should they be exposed to an immediate threat. So that these measures can be carried out more easily, wounded and sick military personnel should if necessary be placed in separate hospitals or in separate departments within joint hospitals.

Buildings Used to House Hospitals

Because of the considerably greater need for hospitalization and because of wartime devastation, which unquestionably would also affect hospitals, it is obvious that only a minor portion of the facilities needed could be provided for in the remaining peacetime hospital structures. For that reason a major portion of hospitalization would have to be organized in various public buildings and also apartment houses. Sizable settlements and cities offer considerable conveniences in this regard with their hotels, garrisons, schools and other structures, but there is a question whether it is wise to have major hospital facilities in cities in view of the threat to them and their exposure to air attacks. Certainly the cities should not be deprived of their own hospital service. On the contrary, the needs of the very population of the major settlements and cities and the large number of casualties because of bombing and active defense would require that there be appropriate hospital facilities within reach. Large building structures in cities, various underground structures, shelters, and so on, offer considerable possibilities for developing infirmaries with the necessary hospital operations under relatively good conditions of protection and security.

Nevertheless, even assuming that sizable hospital facilities will be developed in cities, there will still be a need to take advantage of other possibilities, such as, say, hotels in tourist areas and also numerous villages; incidentally, during the National Liberation Struggle the latter were in many regions of the country the basic foundation for the organization of partisan hospitals. In certain regions that have a shortage of suitable public buildings it will not be possible to achieve the planned capacity without making extensive use of villages. In spite of the objective difficulties in finding buildings for housing hospitals, the village also offers certain unquestionable advantages, such as, for example, the use of local manpower and local resources to meet various needs. In World War II it was not uncommon for even the regular armed forces to set up hospital facilities that were based on the local population and its dwellings [5], and in North Vietnam in the years of American aggression the principal hospital facilities were developed in rural villages [3].

Moreover, the use of the village has special importance from the standpoint of the protection and security of hospitalized members of the armed forces. The basis of this protection would be evacuation to the interior of the territory, accommodations in relatively secure areas away from major military directions and communication routes, and in dispersion over the entire territory. It is precisely this dispersion and evacuation to more secure areas away from the major military directions and routes that come down in practice to quartering the wounded and sick in numerous villages.

The use of the village for this purpose would be considerably easier if at least minimal preparations were made in peacetime: for example, sketches as to the housing of parts of an infirmary and an inventory of what could be procured from local sources would be prepared in every village where there are basic conditions for setting up infirmaries (suitable location, good housing conditions, enough water, favorable circumstances as to food supply, and so on); a certain number of persons would be designated and trained for work in the infirmary; prefabricated structural elements would be prepared at various points so that certain structures could be rapidly set up, etc. On a site prepared in this way the appropriate team (a hospital team -- the core of the future hospital) might set up a hospital for the needs of the armed forces and the local population in a relatively short time, relying on local manpower and materials. If these preparations were made in the [illegible] of general social campaigns in local communities, in which citizens would show voluntary initiative and the Red Cross, young people and women would have a particular share, there would be no doubt whatsoever of their complete success.

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WARTIME MILITARY MEDICAL EQUIPMENT FOR CARE OF THE SICK

Medical Colonel Aleksander Hranilovic, docent and graduate pharmacist, and Medical Colonel Ivan Palmar, docent and doctor

The process of caring for the sick encompasses two basic actions: diagnosis and treatment. Diagnosis is a precondition for expedient treatment, and when there are large numbers of sick people, especially in wartime, it is also a precondition for professional triage. It is characteristic of present-day medicine that diagnostic methods are experiencing unheard of developments and new means of treatment are constantly being discovered and produced, especially drugs. Very complicated equipment (artificial kidney, electronic devices for monitoring vital functions, and so on) is being used in the process of treatment. Present-day diagnosis frequently requires complicated apparatus that requires special operating conditions and the help of highly qualified collaborators: chemists, biochemists, physicists, pathophysiologists, pathologists, and so on. Under wartime conditions it will be the exceptional case to have these highly qualified collaborators in various fields and also to have the complicated equipment and opportunities to use it. It is quite clear that this kind of equipment and also many drugs manufactured abroad are being omitted from wartime military medical equipment, since their use under wartime conditions would be brief, uncertain and uneconomical. In wartime, then, the military medical service and the health service use in principle those diagnostic aids which yield the maximum results, which can be used with the available personnel and which are generally recognized and reliable. The assortment of drugs is also being limited and includes drugs whose reliable effect has been verified, primarily those which the domestic industry can supply.

Wartime military medical equipment for the care of the sick is usually divided into the following:

a. equipment for diagnosis;

b. equipment for the treatment and care of the sick.

Equipment for Diagnosis

The equipment and supplies (aids) used in diagnosis are to be found in military medical kits which are part of individual and group medical equipment, and some are classified as individual articles, since in view of their size and purpose they cannot be made part of the content of a medical kit. The types and quantities of these aids which are issued to individual medical personnel or the medical institution depend on the types of medical service being rendered to the sick, on the professional competence of the medical person, on the specialization and capacity of the medical institution, etc. For example, in wartime every physician would possess the basic medical supplies for conducting a medical examination within the limits of general medical service (thermometer, stethoscope, blood pressure apparatus, tongue depressor, etc.). These aids in diagnosis are to be found in the medical kits for this medical station which are in the possession of the physician (see VOJNOSANITETSKI PREGLED, Vol 31, No 3, 1974, pp 186-190). At higher medical stations of the armed forces and in hospitals diagnostic aids are usually grouped by specialties or branches of medicine, and subunits and institutions are equipped with specialized medical kits which offer the capability for broader diagnosis and for rendering a higher form of medical aid. Since the principle of functionality is applied in making up these medical kits, the desired capabilities are created for a particular branch of medicine by combining military medical kits and individual articles.

The basic medical kit for this purpose is the "Outfit for Diagnosis and Work With Outpatients," which is intended for the work of the internist or specialist in general medicine. This kit is also adequate for the work of an ophthalmologist, ear, nose and throat specialist, dermatologist and specialist for infectious diseases; that is, it makes it possible for a physician in one specialty to conduct a basic examination in these other specialties.

This kit contains diverse medical supplies, instruments, gear and rubber articles, and because of the capabilities it affords, it is issued to all specialized outpatient clinics and those hospital departments or subdivisions of higher military medical stations of the regular armed forces where a medical specialist is working.

The medical kit labeled "Drugs and Outfits for Neuropsychiatric Work" is intended for the diagnosis and treatment of the sick by a neuropsychiatrist, above all under field conditions. The contents of this kit make it possible to conduct a neuropsychiatric examination and basic diagnosis, and the drugs are used to treat light ambulant cases of mental trauma in the sense of tranquilization and psychotherapy. Since the

purpose of this medical kit is limited, it contains tranquilizers, basic supplies and gear, syringes, a sterilizer for instruments, a percussion hammer, an apparatus for measuring blood pressure, etc.

Even in wartime present-day diagnosis cannot be imagined without reliance on a laboratory whether the physician is working in a clinic or in the field. It is certain that laboratories in hospitals and medical institutions in the area will have a larger volume and broader scope of clinical and chemical work than will be the case in the military medical stations of the armed forces. This difference results not only from the division of labor agreed upon, but is also an inevitable reflection of the conditions under which the relevant specialist will work in the very mobile military medical station by contrast with those under which biochemists will perform their professional activity in health centers, medical centers and hospitals. Therefore the methods, laboratory gear, reagents and equipment used for clinical chemistry under field conditions are adapted as much as possible to those conditions and represent simple, rapid and satisfactory solutions with regard to the accuracy of the standard methods used.

Two medical kits have been developed for work under field conditions: "Biochemical Laboratories, Basic" and "Biochemical Laboratories, Supplemental," the first of which also contains a section called "Instruments for the Work of the Microscopist," which can also be taken as a separate medical kit.

The basic biochemical laboratory is a medical kit used to determine the number of leukocytes in the blood, the leukocyte index, to detect protein, sugar and urobilinogen in the urine, and also for conducting certain specific reactions in the blood related to the organism's reaction to combat poisons.

The supplemental biochemical laboratory is used to carry out the following analyses:

a. in the urine: detection of protein, sugar, acetone, urobilinogen and bilirubin, and also to differentiate the sediment of the urine;

b. in the blood: determination of the number of leukocytes and erythrocytes, the leukocyte formula, sedimentation, hemoglobin, urea and sugar;

c. in the spinal fluid: determination of protein and the number of elements;

d. in punctate: determination of protein.

The laboratory methods are adapted to the working conditions and the professional level of the laboratory person, the medical technician. Most of the reagents used in peacetime in the form of solutions are in the

form of tablets or paper strips in these kits, so that work can be done quickly and with minimum gear, nevertheless retaining adequate accuracy.

The principles of the chemical reactions are in principle adapted to standard methods taken from medical biology, and the only difference is in the form of the reagents and the manner in which the procedure is carried out.

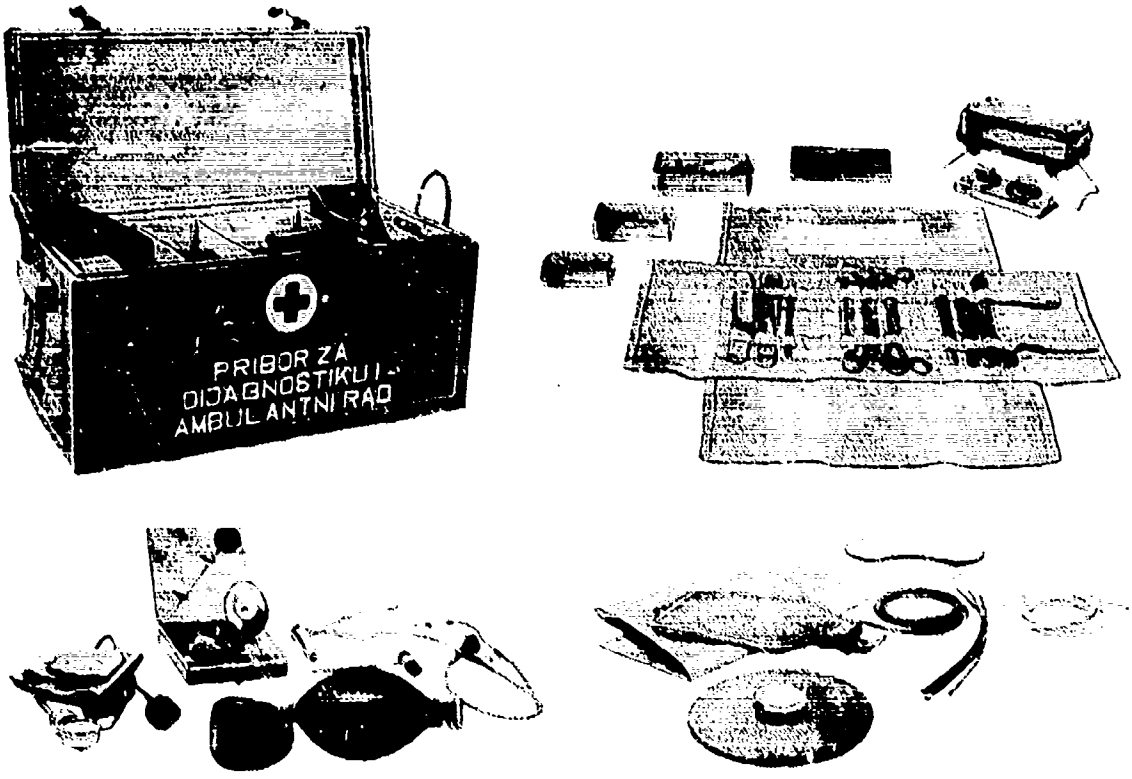

Figure 1. The Medical Kit Labeled "Outfit for Diagnosis and Work With Outpatients."

The "Field X-Ray Apparatus" is a piece of military medical equipment consisting of X-ray apparatus, a photolaboratory and an electric generator. The X-ray apparatus can be used for either roentgenography or fluoroscopy, which develops 30 MA and 85 KV, and it can be connected to the regular power supply or can be used with its own generator. It is packed in crates, and it takes about half an hour to set up the equipment for work. It also has a table on wheels so that the patient can also be examined with a Bucky diaphragm.

This medical kit makes it possible to perform the following diagnostic procedures:

Figure 2. The Medical Kit Labeled "Biochemical Laboratory Basic" and "Biochemical Laboratory Supplemental."

a. fluoroscopy of lungs and heart;

b. roentgenography of the skull, bones and joints;

c. fluoroscopy of the stomach and duodenum using barium sulfate;

d. natural photography of the abdomen and urinary tract.

Equipment for Treatment of the Sick

In addition to the medical kits already described, the "Physician's Bag," "Drugs for General Medical Aid," "Drugs and Gear for Neuropsychiatric Work," etc., several types of medical kits containing medical supplies and drugs and kits intended for care of the patient are used in treatment of the sick.

The medical kits "Pharmacy, Field" and "Pharmacy, Basic" contain drugs and chemicals and instruments and equipment for preparing drugs.

The field pharmacy is issued to those military medical stations and health institutions where general medical service is offered, since it contains drugs intended for the work of a general practitioner. This kit is handled by a pharmaceutical technician, and the contents include antibiotics, sulfonamides, analgesics, bronchodilators and other drugs necessary for emergency aid and treatment of the most common illnesses.

The military medical kit referred to as "Pharmacy, Basic" is handled by a pharmacist, the content of drugs is more diverse, it makes it possible to meet needs which arise out of the work of a medical specialist, and it also makes it possible to prepare certain basic magnistral drugs (eyedrops, powders, ointments, solutions, etc.).

The military medical kit referred to as "Drugs for the Sick" is intended for treatment of a certain number of patients in medical institutions and military medical stations where an internist is working. The assortment of drugs is broader, and in combination with the military medical kit referred to as "Pharmacy, Basic" it can meet the wartime needs of most medical institutions where specialized aid has been given to the sick.

The military medical kit referred to as "Drugs for Infectious Diseases" has been made up in a similar way; it contains a broader specific assortment of antibiotics, sulfonamides and other drugs used in treating the most common infectious diseases in Yugoslavia.

The military medical kit referred to as "Outfit for Care of the Sick" and "Hospital Equipment" are indispensable for the care and attendance of patients under field conditions, and they contain articles such as bedpans of various types, garbage buckets, cans for washing the hands, a device for heating water, pots, brushes, glasses, etc.

Very up-to-date equipment for diagnosis and treatment, usually in the form of portable apparatuses, are also used in wartime medical institutions and military medical stations: electrocardiographs, defibrillators, pacemakers, etc. The types and numbers of these apparatuses depend not only on the physiognomy and capacity of the health institutions, but also on the conditions under which it will be operating in wartime. That is, if operation under stationary conditions is provided for with a guaranteed source of electric power, the available peacetime equipment can be used without limitations. On the other hand, operation under field conditions and in movement affect the selection of the type of apparatus so much that the correct orientation is exclusively toward portable apparatuses which use batteries or storage batteries for their operation. The experience from the peacetime emergency medical aid service will certainly help every medical institution to find the appropriate solution for its own conditions.

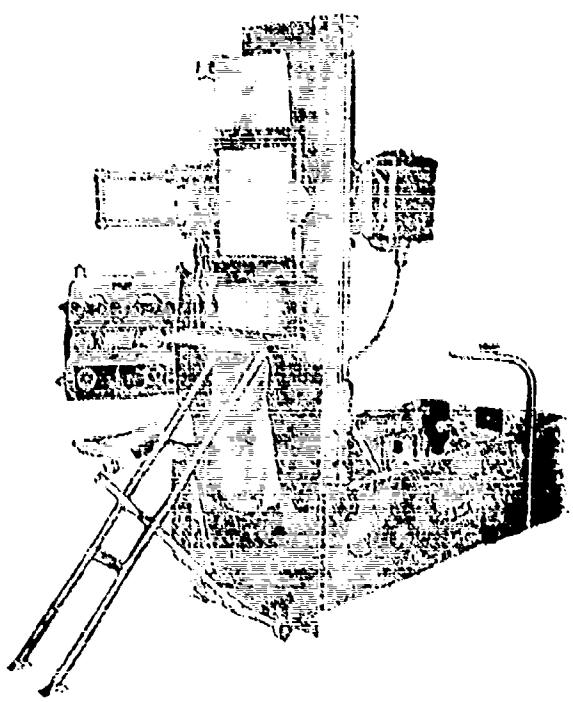

Figure 3. The Neretva X-Ray Apparatus in the Military Medical Kit Called "X-Ray Machine, Field."

It appears that the most correct orientation is toward medical kits and individual medical articles (electrocardiograph, defibrillator, etc.) in equipping wartime medical institutions and military medical stations with wartime medical equipment for diagnosis. This method, which is based on familiarity with the features of medical equipment, makes it possible

to carry out sound preparations. Medical supplies and drugs for treating the sick are prepared in the form of medical kits, and they represent the simplest and easiest solution in the preparations of the health service, although every medical institution, analyzing its own capabilities, needs and wartime assignment, may also form reserves of those supplies as part of its pharmacy or the subdivisions of the medical institution, maintain the appropriate level and assortment of its peacetime inventories.

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[pp 343-344] UDC 355.01:623.458.2.459.4:159.943"312"

PRESENT-DAY TRENDS IN DEVELOPMENT OF CHEMICAL WEAPONS

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The use of poisonous chemicals as weapons dates from ancient times. However, the modern history of chemical weapons begins with World War I, when phosgene, mustard gas and other poison gases were used. Since that time, as technology and organic chemistry have developed, chemical weapons have also been developing. An important factor in this development has been the synthesis of the very toxic organic phosphorus compounds sarin, tabun and soman, which Schrader and his coworkers synthesized in 1937 in the laboratories of I. G. Farben (Germany). The discovery of these compounds marked a new stage in the modern history of chemical weapons, and there are some who regard April 1942 (when mass production and stockpiling of tabun began) as perhaps a more important date in the development of chemical weapons than July 1917, when mustard gas was used as a combat poison on the front.

In the first postwar years there was little talk about chemical weapons, probably because the world was still greatly impressed by the destructive power of nuclear weapons. Thanks to the intensive progress of technology, improvement in the synthetic capabilities of organic chemistry and the technical revolution in general, an enormous number of biologically active compounds have been synthesized. Many of them have drawn the attention of military researchers because of the possibility of their use as potential combat poisons.

Present-day research in the field of combat poisons in military chemistry and toxicology is aimed in two directions: toward finding more effective chemical compounds within a existing groups of combat poisons (nerve gases, tear gases, etc.) and toward the development of new types of

combat poisons (for example, psychochemical poisons, "ethnically selective poisons," etc.). We will cite V-poisons which belong to the group of nerve combat poisons, as an example of the development of more effective weapons within the limits of existing combat poisons. That is, the "conventional" nerve gases sarin, tabun and soman (or G-poisons as they are otherwise called), because of their physicochemical properties -- good volatility and the lack of odor and color -- were envisaged primarily for poisoning by inhalation, and inhalation of the fumes of these poison gases could be entirely prevented by putting on a gas mask in time. Research was therefore aimed at finding compounds in this group of poison gases which would effectively penetrate the organism by some other means even though the gas mask was put on. This led to the discovery of the V-poisons, which, first, are considerably more toxic than the G-poisons, and second, because of the low tension of their fumes they are not very volatile and they very easily penetrate through clothing and skin in the form of minute droplets. We will cite the psychochemical poisons, various means of temporarily incapacitating human beings, poisons used by commandos, etc., as an example of the development of new types of combat poisons which at the same time created opportunities for a new mode of chemical warfare. In general it can be said of most of the more recent "incendiary" and other weapons that they are essentially chemical and that their effect is based on the creation of a biochemical lesion in the organism. Thus various "incendiary" weapons (napalm, white phosphorus), gas, and weapons used to destroy plants or to defoliate forests (herbicides) and chemicals used to alter weather conditions are in a sense chemical weapons, since they have a toxic effect on the organism all the way to a lethal outcome. All these weapons have been used in the more recent military conflicts (Korea, Vietnam, the Arab-Israeli conflict). However, the true chemical weapon is only that weapon which produces direct and exclusively toxic effects on the living organism.

The present-day tactical classification of combat poisons divides all combat poisons into two categories: lethal, intended to destroy manpower, and nonlethal, which are used to temporarily incapacitate human beings (Schell, 1962; Hersch, 1970). This division fully reflects the present-day trend in development of the chemical weapons and indicates the polarization of combat poisons. On the one hand we see the emergence of extremely toxic compounds with a highly deadly effect (nerve gases), and on the other we see compounds with a temporary toxic effect on manpower that do not harm the organism irreversibly. This division of combat poisons cannot, of course, be accepted from the medical standpoint since it is difficult to predict to what extent any poisonous substance will be effective in causing only reversible and temporary pathological disturbances. This division is therefore more important from the standpoint of military tactics.

The idea of temporarily incapacitating an enemy in war is not new. It is well known that many chemical compounds, drugs and so on can selectively cause isolated disruptions of certain physiological functions which would temporarily paralyze people for a time without leaving permanent

pathological changes. This kind of temporary incapacitation can be achieved by blocking certain physical and mental functions of the organism. That is why the incapacitating poisons (or "incapacitants") can be divided into those which primarily affect somatic functions and those poisons which dominantly affect the mental functions of the organism.

The following somatic effects which would come into consideration for temporary incapacitation of human beings are most frequently mentioned in the military literature: paralysis and disruptions of the tonus of the skeletal musculature, disruption of the coordination of movements, surprise changes in blood pressure (especially orthostatic hypotension), various disturbances of the gastrointestinal apparatus (intensive vomiting, diarrhea, etc.), temporary blindness and deafness and intensive tearing, sneezing or coughing (Robinson, 1968; Stade, 1963). Even though a large number of chemical compounds or drugs (undesirable effects) can cause those somatic injuries, only a few combat poisons have become standardized in the form of chemical weapons. These are the so-called upsetting agents such as orthochlorbenzylidene-malononitrile (CS-poisons), and then chloroacetophenone (CN-poisons) and adamsite (DM-poisons). In small concentrations they severely irritate the skin and mucosa and cause intensive tearing, strong cough, sneezing and headaches. Using higher concentrations, the toxic effect of the upsetting agents may even last several hours after the end of the contamination. Under exceptional circumstances, depending on the manner of use, these poisons also cause permanent damage to vital functions with a lethal outcome. It is well known that they were used in large amounts and in various ways in the Vietnam war. Moreover, the CS-, CN- and DM-poisons are also called "police" poisons ("riot control agents"), since they are used to suppress mass unrest and demonstrations. The most effective poison in this group is CS, because it has a wide gap between the incapacitating dose and the calculated lethal index. Effective incapacitation of human beings is achieved with contamination of the air with aerosols (size between 1 and 3 microns) in a concentration of 10.0 mg/min/m^3; the lethal index, i.e., the relationship between the concentration of CS in the air and the exposure time which would cause death is between 40,000 and 75,000 mg/min/m^3. In other words, CS comes close to the type of the "ideal" incapacitating poisons: even under varying conditions of application it ought not to cause the death of the victims of the poisoning.

We should also include in this group of poisons the previously known conventional poisons like mustard gas (iperite, nitrogen mustard), phosgene, and so on, which can also temporarily incapacitate people when used in nonlethal concentrations.

The other group of poisons which temporarily incapacitate people includes those chemical substances which cause in human beings disturbances of normal mental activities. By contrast with the previous group, especially the CS-poisons, the harmful effect of these psychochemical poisons lasts even after contact with them. Intensive research in this field began in late 1950, and the public was first informed about them in 1958 when

the United States declared the so-called policy of "war without death." There are unofficial data (Neilands, 1973) to the effect that these poisons were used in Vietnam. One such poison has been standardized as a chemical weapon in the United States Armed Forces under the code name BZ-poisons (Hersch, 1970). The BZ-poisons cause disturbances of higher nervous activity and of the vegetative nervous system; these disturbances are manifested by psychomotor excitation, dysphoria, hallucinations, and disorientation in that the victims completely lose contact with the external world. It is well known that along with the BZ-poisons there are also many other compounds or drugs that can cause similar disturbances of mental and vegetative functions, whether it is a question of taking the so-called "true" hallucigenic substances (LSD, amphetamine derivatives) or, on the other hand, of accidental or suicidal poisoning with toxic doses of many drugs (scopolamine, atropine, phencyclidine, etc.). These psychomimetic compounds are used in experimental psychiatry to evoke various types of "model psychoses" and are of importance as potential combat poisons.

In short, according to the information from the literature, the present-day arsenals of chemical weapons consist of the following: extremely toxic nerve gases (G-poisons: sarin, tabun and soman and V-poisons) and poisons for temporary incapacitation of human beings: CS-, CN-, DM-, and then nitrogen mustard and BZ-poisons.

The bibliography can be obtained from the author.

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[pp 345-347] UDC 615.01.099:623.459.446 (CS, CR)

PHARMACOLOGICAL AND TOXICOLOGICAL PROPERTIES OF PRESENT-DAY COMBAT POISONS WHICH CAUSE MALAISE (CS, CR)

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The group of agents that cause malaise which have been standardized and which are in the arsenals of chemical weapons is made up of the following: orthochlorbenzylidene-malononitrile (CS), chloroacetophenone (CN) and adamsite (DM) [8]. According to the most recent information, the recently synthesized poisons with the code name CR [3], which still has not been standardized as a chemical weapon, should also be put in this group. In any case, agents that cause malaise belong to the group of poisons for temporary incapacitation which have an irritating effect on the skin and mucosa most probably through stimulation of sensitive nerve endings. This irritative effect causes a number of painful and uncomfortable feelings such as intensive tearing, blepharospasm, severe cough and sneezing. By and large these combat poisons have a short-lived effect, their toxic effect occurs almost instantaneously, and it lasts only so long as it is in contact with the organism. Agents that cause malaise were used on a large scale in the Vietnam war [6, 10, 13]. By way of illustration we can say that in 1967 alone 580 tons of these poisons were used, and by 1969 the production of about 2,900 tons of agents that cause malaise was planned. Aside from their use in war, the poisons in this group are used to quell mass disorders, demonstrations and strikes, which account for their being called "police poisons."

In this article we will present the principal pharmacological and toxicological properties of only the most recent poisons, i.e., of CS and CR, since chloroacetophenone (CN) and adamsite (DM) were used in World War I and there is quite a bit of information about them [2]. Moreover, CS and CR poisons differ considerably from CN and DM poisons in that with respect to their toxicological properties and tactical use they come close to the type of the "ideal" poisons for temporary incapacitation. We are thinking here primarily of those poisons which have a large gap between the dosage which effectively disables and the lethal dosage, i.e., they have a broad "safety" zone. According to the figures we give in Table 1, it is obvious that the CS poison is the most suitable, since the gap between the dose which is the threshold of irritation and the lethal index is great (0.1:75,000 mg/min/m3).

Table 1. Toxicological Properties of Discomforting Agents

	Type of Poison		
	CN	DM	CS
Threshold of irritation (mg/m^3)	0.3-0.1	0.1	0.05-0.1
Maximum tolerance (mg/m^3)	5-15	2-5	1-5
Disabling dose ($mg/min/m^3$)	80	20	10
Lethal index ($mg/min/m^3$)	8,500-25,000	15,000-30,000	40,000-75,000

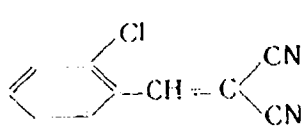
Note: The figures were taken from a 1969 publication of the United Nations [18].

Like CS, CR causes blepharospasms after local application of just a few drops of a 0.0001-percent solution, while the mean lethal doses for mammals are between 0.6 and 7.0 g/kg of body weight. Consequently, even in this case we are dealing with a strong irritant with relatively low toxicity.

The Toxicology and Pharmacology of CS Poisons

CS was synthesized by Corson and Stoughton back c. 1928 [4], and the abbreviation CS comes from the initials of the last names of the discoverers. The English classified it as a combat poison only in 1950 [16], while the Americans used it for the purposes of war on a Vietnam battlefield in 1964.

The chemical formula of this poison is as follows:



Orthochlorbenzylidene-malononitrile is a white crystalline substance which melts at 95° C and boils between 310° and 315° C. It is practically insoluble in water and dissolves well in various organic solvents such as acetone, dioxane, methylene chloride, ethyl acetate and benzol. It is less soluble in alcohol. In water it rapidly hydrolyzes and decomposes.

General Toxic Effect of CS on Experimental Animals

The results of experiments concerning the acute toxicity on rabbits showed that intravenous or subcutaneous administration of doses between 6.0 and 9.0 mg/kg of CS brought about the death of the animals in 10 minutes [15]. The lethal doses for mice and rats are much higher and amount to between 200.0 and 800.0 mg/kg of body weight. As for the toxicity of CS when administered orally, the present data indicate that the lethal doses for rodents are between 200.0 and 300.0 mg/kg [7].

The systemic signs of poisoning with CS poison are manifested by unrest, rapid breathing, tachycardia and convulsions. Pathomorphological studies of the dead animals showed very slight changes in the form of congestion of lung tissue, while no sort of pathological changes were found in other parenchymatous organs.

We should stress that the intensity of the general toxic manifestations and also the magnitude of the lethal dose of CS in experimental animals depend equally on the manner of administration and on the type of solvent used.

Effect of CS on the Eye

Local application of CS dissolved in methylene chloride (0.05 ml of a 10-percent solution or 0.1 ml of a 50-percent of CS) very rapidly causes severe blepharospasms and unrest in animals. Moreover, intensive hyperemia of all parts of the conjunctiva is noted, along with seromucous tearing typical of the rabbits. The hyperemia was later accompanied by edema of the conjunctiva. At times one can also note a strong swelling of the nictating membrane accompanied by ptosis of the lower eyelid.

The blepharospasm and tearing completely disappear 20 to 60 minutes after local application of CS in the eye of a rabbit, while the hyperemia of the conjunctiva last considerably longer. This hyperemia may be complicated by suppurative inflammatory changes which persist even more than 48 hours after drops containing CS are put in the eyes.

Effect of CS When Inhaled

Inhalatory application of CS in the form of an aerosol also causes intensive tearing and salivation just a few seconds after exposure (inhalation). However, along with these signs, immediately after inhaling the CS aerosol the animals become restless and hyperactive, and between 5 and

10 minutes later signs of impeded respiration and occasional apnea appear; these disappear only about 20 minutes after the animal has been removed from the contaminated area.

Pathological anatomic findings in these cases of poisoning show hyperemia and edema of lung tissue and then necroses and hemorrhages in the gastrointestinal and respiratory tracts.

Effect of CS on the Skin

CS has an irritative effect on the skin of experimental animals, causes erythema, necrotic ulcerations, edema and depilation at the place of application [7]. It is interesting to mention that decontamination with water and soap does not prevent the development of these changes. Complete recovery of the injured parts of the skin occurs only 5 weeks after contamination. In this connection we should emphasize the fact that the solvents also have an irritative effect on the skin in their own right.

Aside from the fact that in large concentrations CS has a directly toxic effect on the skin, it has been demonstrated that this substance also possesses a sensitizing effect [17]. The skin is sensitized following repeated applications (intradermal or on the skin itself) or suberythemal doses of CS poison and is manifested by erythema, edema and necrosis of the skin at the place of application.

Pharmacological and Biochemical Effect of CS

Judging by the chemical structure of CS poison, one can easily conclude that this substance, since it is a very active alkylating agent, reacts very quickly and easily in the organism with SH groups and inhibits the activity of those enzymes in the blood which depend on these biologically active chemical groups. The results of experimental research has indeed shown that CS acts in a very manifold way, disrupting the activity of various biochemical systems in the organism. For example, it has been established that CS causes disruptions of saturation of the blood with oxygen, inhibits the activity of pyruvic decarboxylase, and so on [5]. It is also thought that CS and its derivatives affect the activity of biological systems in the organism of experimental animals such as bradykinin, histamine, etc. CS diminishes the activity of nonspecific esterases in the sebaceous glands of the skin of mice, which in turn pointed to a possible carcinogenic effect of CS [1]. CS did not display embryolethal and teratogenic effects in the several species of mammals studied [19].

This composite effect of CS poison in the organism indicates an unknown mechanism of pharmacodynamic effect and deserves particular attention in further research.

Metabolism of CS Poison in the Organism of Experimental Animals

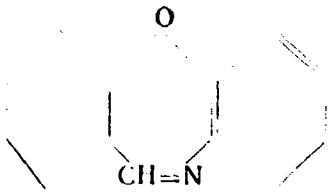
The results of experimental research have shown that particles of CS aerosol can be resorbed from the pulmonary alveoli into the bloodstream depending on the concentration of aerosol in the air [11]. This can also explain certain systemic toxic effects of CS poison. It is interesting to mention, however, that CS is not detected in the blood following peroral application, and it appears that considerable quantities of this poison have to be administered for it to be resorbed from the digestive tract [11].

The CS resorbed from the alveoli into the bloodstream disappears from the blood very quickly. This has been proven on the basis of the short half-life in the blood, which for human blood is 5 seconds and for dog and cat blood is 7 seconds [11].

As for the metabolism of CS poison in the organism, little is known so far about its biological transformation and secretion. It is known with certainty that CS reduces to both orthochlorbenzyl-malononitrile and orthochlorbenzaldehyde [12]. The further fate of these metabolites is unknown. The results of research have shown that this reduction takes place in the blood with the help of enzyme of erythrocyte cytoplasm in which NADPH serves as a specific coenzyme.

Toxicology of CR Poison

CR poison differs chemically from orthochlorbenzylidene-malononitrile, as can be seen from the formula below:



The first data on the irritative effect of this derivative of oxazepine were published back in 1962 [9]. By contrast with CS, which rapidly hydrolyzes in an aqueous medium, CR poison, though insoluble in water, retains its irritative properties even in an aqueous medium. This property of CR poison is important from the standpoint of military toxicology, since this makes it possible to use CR even when atmospheric conditions are unfavorable (humidity, rain, etc.).

CR causes severe irritation of the eyes and then painful irritation of the skin and mucosa of the mouth and nose in very small concentrations (a few drops of a 0.001-percent solution). It is distinguished by instantaneous effect, intense blepharospasm, pain and tearing, which last about 20 minutes.

The mechanism of the toxic effect is unknown.

Way in Which Discomforting Agents Are Used in Warfare

Like most incapacitating agents, CS and CR and other agents that cause malaise are most frequently used in the form of aerosol contamination produced by various means, all the way from the hand grenade to especially designed frayers. The particles of the aerosol can be produced in several ways (thermal evaporation by pyrotechnic means, etc.).

CS is used in various preparations (CS-1, CS-2) which are in fact a mixture of CS with various additives either to improve its penetrative power into lung and other itssue (CS-1) or to increase the stability of particles on contaminated terrain (CS-2).

A special method of using CS poison which was practiced in Vietnam is to throw the poison into closed areas (bunkers, tunnels, and so on) with various pumps and sprayers. Used in this way CS poison can cause the death of a large number of the victims because of asphyxiation and pulmonary edema [14].

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CLINICAL ASPECTS AND CARE OF PATIENTS OF ACUTE POISONING WITH PRESENT-DAY POISONS THAT CAUSE MALAISE (CS, CR)

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Present-day combat poisons that cause malaise, like CS and CR, whose chemical, pharmacological and toxicological properties were presented in the previous article, are among the nonlethal combat poisons along with the poisons of this group that are already well known: chloroacetophenone (CN) and adamsite (DM). Acting as irritants, the poisons of this group temporarily render people incapable of carrying out combat actions or exhaust them by forcing them to use protective equipment. Extensive use of CS poison in South Vietnam and Ireland [1, 2, 3, 4, 5] clearly confirmed the suitability of its use and its effectiveness for temporary incapacitation, which also pointed up the possibility of the future use of the poisons in this group.

Regardless of differences in their chemical structure and specific preparation (CS 1, CS 2) the poisons of this group act as alkylating agents on the organism, causing through a manifold mechanism (by means of enzyme and biological systems) biochemical lesion [6, 7] which shows up clinically in the form of the same or similar manifestations. Knowledge about injuries to human beings with CS and CR poisons, which is not so abundant as the knowledge gained in experiments on animals, comes from wartime use of these poisons in South Vietnam, their use in quelling demonstrations, from

accidental poisoning of workers in industrial production and from experiments on volunteers [2, 8, 9].

The poisons CS and CR are odorless and tasteless crystalline substances which can be used in the form of a solution and aerosol, but the most frequent use is in the form of an aerosol created by explosives, by special devices on aircraft, by sprayers (M-106, "Mighty Mite"), etc. [2]. Poisoning can occur through inhalation, through the skin and mucosa, by ingestion of contaminated water and food, and through a wound. In all these cases we distinguish the local and general (resorptive) effect of the poison.

The clinical manifestations of injuries caused by CS and CR poisons depend on the form and dose of the poison and on the manner and place of their entry into the organism, but in all cases the irritative character of these injuries is dominant.

Clinical Aspects of Poisoning

Depending on the concentration of the poison in the air and the length of exposure, i.e., on the dose of the poison received, we distinguish light and severe degrees of poisoning in the clinical aspects of poisoning of human beings with poisons of the CS and CR type. A light degree of poisoning is caused by concentrations of 1-5 mg/m3/min of the poison [8, 10], and severe poisoning results from concentrations that are several times higher. Cases of death, which can occur when the poison is used in a closed space (tunnels, shelters), have been described at concentrations of 40,000-70,000 mg/m3/min [2, 11]. These doses indicate the large gap between the incapacitating dose and the lethal dose.

The appearance and strength of the signs of poisoning are also affected by great individual differences in sensitivity toward these chemical substances as well as by atmospheric conditions (humidity, air temperature, wind, etc.) [4].

Poisoning with CS and CR poisons is manifested by instantaneous appearance of the following symptoms.

a) Eye: tearing, pain in the form of inflammation, conjunctival injection, photophobia and blepharospasm. Redness and swelling appear on the eyelids. Regenstorff [12] noted a transient reduction of the sharpness of vision. It has also been found that trioctyl phosphate, which is the solvent for CS in containers, has an extremely irritative effect, causing conjunctivitis without damaging the cornea [13].

All of these signs disappeared more or less in 5 to 30 minutes following termination of the poison's effect, except for edema of the eyelid and a certain fatigue in the eyes, which lasts for 24 hours. A transient elevation of intraocular pressure has also been noted in a case of injury with CR poison [14].

In severe poisoning all the signs of eye injuries are more intense and persist for 5-7 days [3].

It is thought that the human eye is more sensitive to aerosols than to solvents, probably because of the physical properties of the agents [15].

b) The respiratory tract: sneezing, severe cough, abundant secretions from the nose, salivation and retrosternal pain accompanied by a feeling of constriction in the chest.

All these signs are from direct irritation of nerve endings in the respiratory tract, which temporarily incapacitate people, and disappear 20-30 minutes after they leave the contaminated atmosphere or put on a protective mask.

In severe cases of poisoning these signs are joined by dyspnea, disruption of the respiratory rhythm and cyanosis. In exceptionally severe cases which ended in death there was pulmonary edema and asphyxiation. One case has been described of a 4-month-old baby which was accidentally exposed to the effect of CS and in whom recurring pneumonia developed [16].

c) The effect on the skin results from particles of the poison staying on open parts of the skin and is manifested by signs of skin irritation: acute pain, burning and erythema at the place of contact with the poison. Vesicules also appear in the severe cases, and in a tropical climate the erythema and vesicules lead to bullous changes [4]. The effect of the poison is intensified if the skin is wet [17].

In light cases the changes in the skin disappear in a few hours, and they disappear in 5-7 days in the more severe cases. Residual pigmentation and decoloration of the skin are not left at the injured places [17], but manifestations of allergic contact dermatitis and eczema have been noted in workers employed in the production of CS [4].

Punte et al. [8] and Weigand [4] have noted that rinsing injured parts of the skin with water can intensify the pain at the place of contamination and can cause recurrence of the signs of skin irritation.

d) The resorptive effect of poisons of the CS and CR type are manifested by headache, tachycardia, nausea, vomiting and diarrhea, and then by hemorrhaging from the nose and a transient elevation of arterial blood pressure, which changes along with the symptoms of poisoning. The fear which is aroused in the victims accentuates the other symptoms of poisoning, and it appears that it is a consequence of the stress caused by the poisoning itself [9]. The concomitant leukocytosis is explained in the same way.

Complications

The most frequent complications related to injuries with CS and CR poisoning are suppurative infections of the eye and respiratory tract. A disposition toward hyperergic reactions is possible in connection with repeated exposure to these agents.

Exposure to CS and CR poisons of persons who suffer from bronchial asthma or chronic bronchitis tend to worsen their principal disease [18].

Care of Victims of CS and CR Poisons

First aid to victims consists of placing a protective mask, inhalation of antismoke mixture (under the mask) and withdrawal from the contaminated area (contaminated zone). In most cases other therapeutic measures are not necessary.

Immediately upon withdrawal from the contaminated area the eyes, mouth and throat are decontaminated with a 1-2-percent solution of sodium bicarbonate, and the contaminated parts of the skin are rinsed with the same solution or an alcohol-water solution of sodium sulfite [10]. Clothing is decontaminated by simply shaking it out. Chlorinated lime is not recommended, since its irritative effect is intensified in a mixture with CS [8]. Rinsing the eyes with water is also not recommended because of the undesirable effects we have described [19].

In severe cases therapy is symptomatic both as part of general medical aid (battalion medical station and regimental medical station) and as part of specialized medical aid (divisional medical station): local anesthetics, antibiotics and corticoids [4], especially when there are injuries to the mucosa and skin. Antihistamines are also recommended [4, 17], and Jones and Israel [19] cite good experimental results of sodium thiosulfate (10 ml of a 30-percent solution, i.v.), basing this on the assumption of the cyanide effects of CS. Cardiotonics, diuretics and oxygen are given according to indications. Bullous changes on the skin should be opened and treated like burns.

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