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El Alamein: the battle in the battle. How infectious disease management changed the fate of one of the most important battle of the World War II

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SUMMARY

El Alamein, on Egypt's Mediterranean coast, was the theater of war for one of the most important and decisive battles of the Second World War.
The Allied victory in November 1942 opened the end of the Western Desert Campaign. The battle revived the morale of the Allies, being the first big success against the Axis since Operation Crusader in late 1941. The German threat to Egypt, the Suez Canal and the Middle Eastern and Persian oil fields was eliminated and the doors for Mediterranean advance were opened.
Fighting in the desert under extreme human conditions exposed all the involved armies to health hazards going beyond those arising from common battle injuries.
The outcome of the battle was influenced by a gap in morbidity and mortality derived from different approaches in infectious disease management between armies. The attention of the British for medical research, pharmacological experimentation, hygiene strategies and prevention may have been as important as warfare strategies in deciding the fate of the battle. Examples of some of these advances include wound nursing, control of endemic diseases, surveillance of difficult hygienic conditions, prevention of faecal-oral transmission diseases.
During El Alamein Battle soldiers on both fronts where engaged in two wars: the first one, vertical, was against the enemy uniform; the second one, horizontal, was against invisible enemies called pathogens. Only surviving the horizontal war meant preserve enough units and morale in order to win El Alaman Battle.

Keywords: El Alamein, history of medicine, infectious disease, military medicine, Second World War.

INTRODUCTION

At El Alamein Battle, in November 1942, three years since the beginning of Second World War (WWII), Great Britain (GB) and its allies celebrated their first decisive victory on land against Germany. In many ways, the campaigns in North West Europe between 1944 and 1945 cannot be understood without first shedding light on the processes that led to that victory in North Africa. The latter is an interesting scenario and the reasons for Allied success are controversial and still debatable. In fact, after close to seventy years, the causes of Eighth Army's success at El Alamein are still contested. Literature is full of references to the quantitative and qualitative disadvantages suffered by Axis forces that precluded them from winning the campaign against the combined strength of British Empire and United States [1]. Walter Warlimont (1894-1976), who worked as Hitler's Deputy Chief of the Operations Staff between September 1939 and September 1944, portrays El Alamein as "a typical battle of material in

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which no military genius on the part of the commander, and no amount of courage on the part of the men, could make up for the catastrophic situation brought about by the failure of the [Axis] overseas supply lines" [2]. However, here we present findings reappraising the role of elements such as leadership and morale in El Alamein's victory. As for the leadership, German general Erwin Rommel (1891-1944) made himself a folk hero for both sides in the desert, while his British opponent was changed six times. Auchinleck's reaction to this "public relations" problem was to send a letter to all Eighth Army commanders on the subject of "our friend Rommel" forbidding them to mention Rommel by name.

"I wish to dispel by all possible means [the idea] that Rommel represents something more than an ordinary German general. The important thing now is that we do not always talk of Rommel when we mean the enemy in Libya. We must refer to 'the Germans', or the 'Axis powers', or 'the enemy' and not always keep harping on Rommel ... PS. I am not jealous of Rommel [3, 4]."

In this contest the arrival of Bernard Law Montgomery (1887-1976) in the desert represented an important turning point in British leadership and morale. The incidence of NYD(N) (Not Yet Diagnosed (Nervous)), or battle exhaustion, has been taken in consideration as a medical parameter for evaluating morale among UK troops. Men suffering from NYD(N) exhibited what "psychiatrists described as acute fear reactions and acute and chronic anxiety manifested through uncontrollable tremors, a pronounced startle reaction to war related sounds and a profound loss of self-confidence" [1]. The monthly statistical reports on the health of the Eighth Army for October and November 1942 stated that the incidences of NYD(N) were much smaller during the El Alamein offensive than they had been in previous battles; with a total number of cases for the two months combined being 209. The figure is impressive if considering that the number for the sole July battles has been 557 [5].

While it is possible to evaluate the effectiveness of a leadership by studying the incidence of NYD (N), other health parameters can also be adopted to understand the efficiency of the military strategies applied. Among these, we found particularly relevant the study of how the management of the Health sector and the tackling of infectious disease have influenced the outcome of the battle.

The importance of infectious disease at the front

Throughout history, the deadly comrades of war and disease have accounted for a large proportion of human illness and death. Since ancient times infectious diseases have exploited the conditions created by war, affecting both armies and civilians. History is full of wars bred with disease with a lot of them being well studied. During the Napoleonic wars, in the British army eight times more people died from disease than from battle wounds. In the American civil war, two-thirds of the soldiers' casualties were caused by pneumonia, typhoid, dysentery, and malaria, and this death toll led to a 2-year extension of the war. These diseases became known as the "third army". In the Crimean War (1854-1856) 60,000 and 130,000 units respectively died from battle injuries (BI) and other diseases, with diagnoses of cholera and typhus fever being recorded as particularly important causes. The ratio of deaths from disease and those from missiles and bullets was much the same in the British Army in its first big 20th century war – the South African War (1899-1902). For many years, typhoid fever has been the greatest scourge of armies mobilized for war and it was not just a British phenomenon. In the 10 week Spanish-American war (1898), 2192 US soldiers died from typhoid while only 379 died in combat [6]. The WWII was the first conflict where the historical trend showing disease non-battle injuries (DNBI) overcoming BI mortality was reversed with BI deaths accounting for 75.2% of WWII's total deaths [7]. However, the low mortality recorded was the other hand of a very high morbidity that, during the battle of El Alamein, played a fundamental role in the victory of the Eight British Army. The present study aims to analyze the scientific literature registered on PubMed and Google Scholar concerning health management in the Battle of El Alamein. Since the existing literature available is predominantly Anglo-American no statistics and scientific studies that describe directly the health status of the Italian-German troops have been found and included in the paper. Thus, some Italian military reports have been studied and confirm the poor hygienic conditions described by British health personnel [8, 9]. Nevertheless there are numerous researches carried out by Allied military physicians, that describe in detail the onset and the management of diseases and injuries during the battle of El Alamein.

Invest in medical research to win a war

Two state entities played a crucial role in GB technical and medical advances during WWII: The Medical Research Council (MRC) and The Emergency Public Health Laboratory Service [10]. MRC was a British institution of the State financed by the Government. The MRC, contrary to the Ministry of Health, was not a large self-contained department, but rather a board of men with expertise in different branches of medical science that would meet once a month. The goal of this body was to help and coordinate medical research generally, much of the work was done in the universities and hospitals of the country, by the professors, lecturers, and medical men on the staff of these institutions. About 40 research committees on different war problems had been formed covering a broad spectrum of medical science disciplines. During the WWII great remodeling of research avenues took place, with long-term projects being largely replaced by short investigations addressing immediate practical objectives. Against this backdrop the advisory functions of the Medical Research Council increased greatly during the war and a number of important actions of Government had been guided by the Council. Furthermore, MRC made arrangements before the war for the pooling and distribution of emergency immunological agents to meet the partial needs of the fighting services and the anticipated requirements of the civil population. MRC played a critical role acting as a central distributing agency and provisioning of large stocks of agents such as: tetanus antitoxin, gas-gangrene antitoxin, diphtheria toxoid, and various vaccines (including typhoid-paratyphoid, typhus vaccines and other sera) and in doing so it saved much expense to the country. Furthermore, properly controlled distribution was obtained, a strict eye was kept on the potency and excellence of the products and new discoveries of importance were quickly brought into use. Supply of drugs was an essential aim of the apparatus; during First World War the Medical Research Council learned its lesson in the case of arsphenamine (salvarsan), an essential substance for the treatment of syphilis discovered by Ehrlich and imported entirely from Germany. There were hardly any stocks in the country at the outbreak of the previous war. Before WWII the Council initiated a program, which ensured that all essential drugs, imported from foreign countries, would be manufactured in UK if war had broken out. The Emergency Public Health Laboratory Service selected laboratories all over the country (mostly in public schools and universities) in order to make them ready with qualified staff and equipment in case of the onset of war. Fifteen new laboratories were started, and 28 other working laboratories were brought into the scheme. It is not possible to disclose all the reasons for this new service, but it will be obvious that one good reason was the expectation that large-scale bombing of industrial centers would necessitate mass movement of the population, and that this, together with the interference with water and other supplies, might well result in epidemics.

Preventive medicine: the management of the hygienic conditions at the front

The management of the hygienic conditions at the front played a fundamental role in military tactics [11]. The hygiene story of the El Alamein victory began in the misfortunes experienced during the retreat of the Eighth Army (Gazala, June 1942) and ended with the advance of Oct. 1942. During this time the hygiene organization of UK army was entirely reviewed. Innovative strategies were made for dealing with lousy prisoners of war and for cleaning up captured enemy areas and towns. Previous experience in the Western Desert revealed that the previous hygiene organization was too rigid. Field hygiene sections were run on a strict divisional and lines-of-communication basis. Such rigidity could not cope with fluidity of desert-based warfare and often resulted in dispersion and changing constitution of formations, and smaller groups often had no field hygiene section assistance. The new scheme produced some excellent results: sanitary assistants were sent where there was need and a steady flow of apparatus was guaranteed to supply troops moving forward into new areas. Once active operations had started there was little interest about hygiene, but this changed when the Axis broke early in November with the anticipated problems arising in captured territory. Hygiene officers were included in each area of administration and they promptly organized a series of necessary measures including: cleaning up fouled areas, purifying water supplies, delousing prisoners of war and pushing forward apparatus to ensure cleanliness. Further-

more, the challenge of providing food to the army was reappraised afresh by devising new ration scales and methods of cooking. The return to co mpany cooking also assisted in the improvement of the conditions. Wastewater from field units in desert areas did not cause difficulty, partly because the water ration was so low that no large accumulations could occur, and also because the absorptive and evaporative capacity of the desert was so large [11].

The Axis lines and camps at El Alamein and the bases at Matruh, Tobruk, Derna, and Benghazi were revolting in the masses of human faeces and camp debris lying everywhere. It follows that the prevalence of the most common infectious diseases was high; especially between the Italo-German soldiers serving the Axis [7, 12]. To quote one of UK hygiene reports: "It has, however, been heartening to observe the difference between the enemy sanitation and dysentery/diarrhoea rate and our own. The enemy appears to have no conception of the most elementary measures and has a dysentery/diarrhoea rate so very much higher than ours that it is believed that the poor physical condition of his troops played a great part in the recent victory at El Alamein [11]."

On the other hand, a picture of well-being within the UK troops is described by some authors and is reflected by the fact that even during the ruffled months of El Alamein battle (Sep-Nov 1942) the hospitalization rate was inferior to 2 per 1000 [11]. In the aftermath Rommel was accused of negligence, failing to promote public hygiene strategies and not having forecast the inauspicious consequences of a high morbidity among his troops, example of this is the fact that between October and November 1942 for every German leaving the front for BI 3 abandoned it because of illness. Moreover, the Axis troops had a probability of getting sick 2.6 times higher than the English counterpart [13]. Mark Harrison has estimated that nearly one in five Germans were listed as sick during the battle, with elite 15th Panzer Division suffering a sickness rate as high as 38% [14]. The most common infectious diseases recorded during West Africa campaigns, and specifically during El Alamein battle, were: diarrheal and dysenteric forms, fevers of unknown origin, gastroenteritis, skin and soft tissue infections (SSTIs) and hepatitis; which we will further describe in detail [11]. An example could be traced by Brigadier T.C. Hunt in his hospital in West Africa during the winter of '43: 1000 cases of hepatitis, 1000 respiratory tract infections, 600 cases of malaria, 600 dysenteric forms and 250 cases of diphtheria [12]. Conversely, the three well known epidemics of former times: plague, typhus and smallpox, which were endemic in the Middle East during World War II, did not appear in Allied records of El Alamein battle. Thus, Cairo typhus epidemic, plague at Haifa and different sporadic cases of smallpox are well documented [15]. As said before, protection by inoculation was given to the troops before leaving GB against typhoid and paratyphoid fevers, cholera, small-pox, tetanus, and yellow fever [10].

Infectious disease at El Alamein: the battle in the battle

HEPATITIS: Historically, infective hepatitis (or epidemic jaundice) has been defined a wartime disease (WD) due to its high incidence in war scenarios. The great epidemic of hepatitis occurred between Allied and Axis troops during the battle of El Alamein and it followed the advance of the front line. It was probably caused by parenteral and oro-faecal transmittable major epatotropic viruses [16]. Oro-faecal transmittable hepatitis was called *infective hepatitis* and known from centuries; while the so-called *serum jaundice* described the features of parenteral transmittable hepatitis and was described for the first time in 1937 by Findlay and MacCallum. At the time it was already known that: i) incubation times were different, ii) that one was transmitted parenterally and the other not and that iii) the acquisition of one did not protect from the other [17]. As already depicted for DNBI in general; the problem of hepatitis during WWII was not a high mortality rate but the long hospitalization and convalescence times that drastically reduced the availability of soldiers to send at the front. In the 8th British Army the prevalence of hepatitis reached 8-10% of the entire regiment and 1/3 of the officers were affected by this disease; presenting a risk 4-5 times higher than the other grades [18]. The situation among Axis troops was even worse given the poor sanitary conditions in which they used to live. It is remarkable that Rommel himself was evacuated twice from the continent because of this pathology, and it is thought that this had a negative influence on his leadership [7, 11, 12]. Moreover, the

spread of parenteral transmittable hepatitis has been probably facilitated by the massive use of blood transfusions. Transfusion medicine debut in the military field during the First World War and had a notable expansion during the WWII; but it was not until the Battle of El Alamein, in July 1942, that blood transfusion was attempted on combat causalities on large scale [19-21].

Infective hepatitis and *serum jaunduce* played in WWII the role that flu played during First World War and this was the reason that in 1940 an assiduous research was driven to find their etiological agent. The modes of transmission of infectious hepatitis were not well known and the hypotheses proposed were many:

1) via droplet;
2) oro-faecal;
3) through arthropod vectors (mosquitoes, flies and bed-bugs);
4) contact with blood or parenterally [12].

An example of novelty, both in US and in Germany, was the use of humans as cavies for the study of the transmissibility of hepatitis. The contagiousness was assessed through human oral intake of urine, bile and serum from infected patients. Cargo planes transported infected faeces, frozen in nitrogen dioxide, from the Middle Eastern front to US laboratories in order to be orally administered to human volunteers [18]. This trial helped to clarify in the early post-war years the etiopathogenesis of the two hepatitic forms, their transmission routes, their incubation times and their differences in chronicization rate; but at the same time their clinical and laboratory similarities [16, 17].

EPIDEMIC TYPHUS. In the 8th British Army the vaccination coverage for exanthematic typhus was low-grade because of scarce availability of the vaccine itself. However, no major epidemics were recorded thanks to the efficient system of toilets and mobile laundries that guaranteed good control of the louse infestation in UK troops and among the German prisoners. The latter were known to have a very high infestation rate [11]. Exanthematic typhus, which has changed the outcomes of great historic battles, is not mentioned by the Allies as one of the main WD of El Alamein battle. The causative agent and its transmission route were known from several decades; nevertheless, Cox vaccine was only discovered in 1939 (with initial doubts about its effectiveness) and massively produced and distributed in 1942. US registers highlight that between 1942 and 1945 Maghreb was the war zone with the highest prevalence of epidemic typhus, counting several tens of thousands of cases; many of which registered among the native population. The introduction of pesticidal powders for military use, in addition to hygiene programs, has also helped maintenance of a louse-free 8th British Army. After the ineffectiveness of previous powders from 1942 many efforts of both US Department of Agriculture and Rockfeller Foundation were invested in the discovery of an effective louse-killer product. The same year the FDA approved the use of DDT (dichlorodiphenyltrichloroethane), already discovered in 1874 by a German student, and promoted its large-scale military use through the well-known "duster guns". The Allied troops stationed in Maghreb were also signed since 1943 for the first trials testing PABA (para-amino benzoic-acid) as anti-rickettsia agent [22].

DIARRHOEA. Traveler's diarrhoea has always been an important cause of morbidity and mortality in war scenarios; playing a central role both as an endemic and epidemic form in the Africa campaigns of WWII. The bad sanitary conditions at El Alamein produced a worrisome plague of flies. The emergency was something hardly seen before, therefore a special Fly Control Unit was created by the British army. This unit consisted of five officers, some 200 or 300 soldiers from other ranks, African pioneers, together with several Non-Commissioned Officers (N.C.O.s) as supervisors. The unit took a brief course in fly-control methods to later be dispatched to clean the El Alamein area by fly-breeding sources. The work was thorough and effective, extending even to "no man's land", where corpses and other organic matter made one of the worst fly-breeding sources. The unit patrolled the area, clearing unit lines of waste, debris, and bodies and co-operated with field hygiene sections and unit personnel. This temporary unit was so successful that it more than justified its creation, knocking down the diarrhoea rates between British and Axis. Indeed - as described by prisoner medical officers captured by the British - it is estimated that 40-50% of Italian-German troops suffered from diarrhea during the conflict of El Alamein [23]. Excremental diseases had a peak of incidence in 8th British Army while Axis forces were withdrawing. The reason

was the unhealthy condition that enemy troops and natives had left during the occupation period. In this warfare contest incineration was accepted as the simplest and most practical method of refuses removal. Persistent education to improve unit behaviors were adopted, and units gradually became more careful in clearing tins completely, burning them out, and disposing of them systematically [11]. This precautions probably helped to decrease transmission of oro-faecal diseases. On the one hand etiological agents of the dysenteric forms were well known (*Entamoeba* spp., *Shigella* spp., *Salmonella* spp.), on the other hand the pathogenesis of diarrhea not as well. As a matter of fact, diarrhea was believed to depend by climatic and chemical-physical changes in water; while the pathogenicity of *E. coli* was still unknown [24]. Intravenous sulfonamides were introduced in the Middle East in 1941 for the treatment of shighellosis and subsequently they were widely used also in bacillary dysentery [10]. Typhoid fever was widespread in West Africa as well, both in general hospitals and in hospitals for prisoners of war (POW). There were two major epidemics: the first registered in summer 1941 and the second in winter 1942. The level of endemicity was higher among German-Italian troops and prisoners, probably due to a T.A.B. vaccine less effective [11, 25]. Specifically, the English vaccine was rich in Vi antigen unlike the one produced in Italy which was obtained from non-virulent colonies of the enterotoxigenic germ [10]. "When the Italian and German prisoners were inoculated with our vaccine, typhoid fever ceased abruptly, and the endemic level remained low thereafter. It is undoubted that our T.A.B. vaccine made from strains rich in the Vi antigen has proved much more effective than the Italian vaccine made from non-virulent strains. It will be remembered that the Vi antigen was a discovery of a British research worker [10]".

WOUNDS: The greatest number of wounds were caused by fragments of H.E. shells, mines, grenades or bombs. Many studies have been done to improve war surgery, gangrene treatment (one in two lethal complications at the time) and burn management [26-32]. The general approach involved debridement, washing, removal of foreign body and drainage, a sprinkling of "sulfa powder" (contained in the salt shakers), eventual intake of sulfanilamide per os and promptly or deferred closure of the wound by first intention. A cornerstone of the healing of wounds was the time of closure; for which the WWII battlefields on the shores of the Mediterranean had been an excellent training ground. A high sensitivity of a combined approach between clinical and microbiological tests was demonstrated; in particular the aspect of the wound and the culture tests were taken in consideration to decide the time of suture [33]. Among 500 battle casualties from the second battle of El Alamein, 30 were thoraco-abdominal or abdominal wounds while 65 were wounds penetrating the pleural cavity. In the desert cases of burns were frequent and came from fighting in tanks; with outcomes inferior to peacetime. During the battle of El Alamein, topical and systemic sulphonamides were widely used also for the treatment of burns together with transfusion and morphine administration [12, 33]. It is important to consider wounds and burns because SSTIs are listed among the most frequent infections during El Alamein Battle and because of consensual discoveries in antibiotic therapy, a promising field of further research. The success of local treatment depended on the discovery of new antiseptics: the sulphonamides, especially sulphanilamide and sulphathiazole; also, penicillin, propamidine, and the amino-acridine compounds, of which proflavine (2:8diamino-acridine) is the best-known. It is interesting to note that, except for the sulphonamides, the development of these drugs and the knowledge of their antiseptic properties in wounds had been mainly done in UK [10]. Penicillin, discovered in 1928 by Alexander Fleming (1881-1955) and applied to medicine by Howard Walter Florey (1898-1968) 10 years later, was used for the first time on US troops stationed in Africa in 1942. Penicillin was talked about as far away as the Middle East "We now began to hear about the new drug Penicillin, at that time in extremely short supply on all fronts" [34]. The first supplies reached the Middle East about August 1942 in the Central Pathological Laboratory housed in the Fifteenth (Scottish) General Hospital at Cairo, commanded by the then-Major Robert J. V. Pulvertaft (1897-1990), Assistant Director of Pathology. His work was reported briefly in the Lancet of July 1943 and, with details of 15 cases, later in the year [35]. The success of the innovative molecule was such that American and English production grew by 21 billion UI in 1943 to 6.3 trillion UI in

1945 [36]. Penicillin had important effects even in staphylococcal septicaemia, a condition which previously had not responded to treatment even with the sulphonamide drugs. In a large US series of such cases treated by penicillin, previously nearly always fatal, the mortality rate came down to 20%. In chronic bone infections also, which had historically resisted all treatment for months or years, the curative effect of penicillin proved to be very great. Penicillin had also the advantage of curing infections by many sulphonamide-resistant micro-organisms [10]. Of interest is the story of Aulo Donati (1916-2007), an Italian medical officer and prisoner of war employed in Allied hospitals and services. During his imprisonment in Cairo, serving as a medical doctor, he knew and learned the use of penicillin with enormous professional advantage back home in 1948; when the drug began to be available [37].

It is interesting to report the fact that, while the American army was introducing penicillin into the world of medicine opening the antibiotic era, Colonel Henri Fruchaud, professor of surgical clinic in Angers, in March 1942 reproposed the "Maggot Therapy" technique for curing ulcers and osteomyelitis. This therapy which had been used for the first time by Ambroise Paré in 1500 was repeatedly adopted and forgotten in the History of Medicine. Volume II of the Fruchaud war surgery, where the method of larval therapy was described, was not published and the arrival of antibiotics has once again immersed this practice in oblivion. But if the twentieth century had been the century of antibiotic therapy, the twenty-first century is the century of antibiotic resistance and "larvatherapy" is re-emerging as a therapeutic alternative [38].

In the case of tetanus, fair to say that a high incidence of this was not expected in the Western Desert, active immunization by tetanus toxoid has also worked well. The incidence among British troops in the Middle East was 0.013%, whereas in the South African force, in which active immunization had not been carried out, the incidence of tetanus was 0.16%, or twelve times as great. Unfortunately, we do not know German epidemiology of SSTIs as Axis records are lacking. Thus, it is hard to say if different antibiotic availability and innovative wound management could have changed the fate of El Alamein Battle as seen for gastroenteric infections [10].

SAND DISEASES: Some Australian and German authors reported balanitis, secondary to extreme climatic conditions and poor hygiene, to be endemic among troops stationed in Africa. According to Australian authors, circumcision was a practice widely used in Africa campaigns while Manfred Rommel (1928-2013) - son of the well-known Erwin Rommel - negated such use in Afrika corps. References to this practice are only anecdotal thus it cannot be concluded that balanitis was an emerging disease during the battle of El Alamein or more generally in Africa warfare during WWII [39]. Despite the sandy scenario in the literature conjunctivitis and keratitis were predominant in the military operations in the Middle East front but not so much in El Alamein Battle [40].

By the time of El Alamein standardization in traumatic abdominal surgery was taking shape. Surgeons realized that the time lag since abdominal wounding was not as an important factor as it had been held out. The idea that it was of no avail to operate after 12 hours was still prevalent. Patients with colonic tears have been successfully dealt with even after 48 hours. In the desert particularly, the large-bowel content was frequently solid and pollution of the peritoneal cavity relatively slow [29].

MALARIA: Early in 1942, Egypt was threatened with two invasions; one from the west across the Libyan Desert, the other from Wadi Halfa. The first invader was repulsed and thoroughly defeated at El Alamein. The second, *A. gambice*, was stopped at Asyut and eradicated by 19 February 1945 [41]. Malaria was endemic in North Africa and, although the research was active, chemoprophylaxis was not yet available [42]. In North Africa both benign tertian and malignant tertian malaria were reported; consisting in many relapsing cases; some of them severe, persistent, and resistant to treatment. As described by British Brigadier Hunt, thanks to intravenous quinine, between over 1,000 patients admitted to his UK division not a single death was registered [12]. Diagnosis was simple, being necessary only one blood sample. Therapy, named QAP (Quinino 5 days, Atebrin 3 days and Plasmoquin 3 days), was recommended at GHQ Cairo and was widely available with free pamphlets on dosage [15]. From the available reports' malaria is often cited at El Alamein but it does not seem have affected the

morbidity of the troops stationed at the front. This is probably due to several factors including: good control of the carrier, availability of effective therapy and prompt recovery; the role of the plasmodium in the Italian campaign will be different. It is of interest the fact that malaric *Anopheles* spp. have been mentioned in one commentary as possible biological weapon during El Alamein Battle [43].

CONCLUSION

The scenario of El Alamein is interesting because the reasons for Allied success are still debatable. Our position is that its history was strongly influenced by the morbidity and mortality of infectious diseases. The attention of British about hygiene strategies and prevention, innovative research and new drug available could have been as important as warfare strategies in changing the fate of the battle. The limit of the present study is reporting mainly Allies references. Literature describing medical conditions of Axis from their point of view during El Alamein Battle is scarce if not absent. Fortunately, some indirect information is present in British reports tanks to the attention on POW experience and a capillary data collection about the opposite front. Undoubtedly, the unbalanced availability of literature may have depicted a biased picture of warfare conditions of the two armies taken in consideration. To conclude, from the picture described above it is clear that during El Alamein Battle there was a battle into the battle. A vertical enemy - the opposite army - and a horizontal enemy - infectious disease - coexisted in both fronts. Winning the horizontal war meant preserve enough power for winning the vertical one. That was clearly understood by British and the outcome of that battle are known to all.

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