The efficient and speedy transport of wounded, sick and injured, is a major factor affecting the mobility and morale of an Army in the field.

The history of warfare witnesses a continuous evolution in the technique of transporting casualties by human portage, by animal or animal-drawn vehicles, motor vehicles, boats, trains and hospital ships.

Prior to 1792 humanitarian motives rather than therapeutic indications regulated the speed of collection and evacuation of casualties.

Napoleon's great surgeon, the Baron Larrey, initiated research into the surgical aspects of transportation. His introduction of light, fast-moving, two-wheeled ambulances ("ambulances volantes") effected a more rapid evacuation of the wounded and sick. This, combined with his surgical skill, saved many lives, particularly after the sanguinary battles of Aboukir and Borodino.

With the conquest of the air all nations commenced building aircraft with one eye on transport and the other on their potential military value.

The recognition of the value of air transport of casualties has evolved slowly. In 1869 Jules Verne, in his novel "Robur le Conquerant," forecast the use of airships to rescue injured explorers stranded in Arctic (and other) remote areas.

During the siege of Paris in 1870 over 160 patients were evacuated over the Prussian lines by balloon.

In the British Army until 1912 all military aviation was carried out by the Royal Engineers, but in that year the Royal Flying Corps was formed, and at the Aldershot Army Exercises, Medical Officers of the R.A.M.C. drew attention to the possibility of Military patients being transported by aircraft.
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1914–1918, World War I

During the 1914–1918 War comparatively little use was made of aircraft for transporting casualties.

The French Air Force claim that in 1915 one of their pilots successfully flew a wounded Serbian airman to base during the retreat through Albania.

In 1916 the Royal Flying Corps carried out the first recorded air evacuation of a military patient from Palestine. 1918 (the year in which the Royal Air Force was formed) saw extensive operations by the French Army in Morocco; during these the French Air Force made progressive use of aircraft for transporting wounded and sick over lengthy desert communications, and provided valuable experiences in the selection criteria, and technique of flying casualties.

1918–1938

The period between the two World Wars saw the progressive development of civil aviation all over the world, particularly in the U.S.A., Canada and Australia.

In Great Britain air-ambulances were developed and used, especially between the Scottish mainland and the outlying islands.

In Spain in 1923 Cierva made the first successful flight by autogyro, with its vertical take-off and landing.

Meanwhile, from 1919 to 1937, the Royal Air Force, using both land-based aircraft and flying-boats, evacuated a total of approximately 3,000 casualties from operations in Somaliland, Iraq, Palestine and Waziristan; also from the Quetta earthquake in 1935.

In Great Britain the possible uses of air-ambulances were studied by the Joint British Red Cross and St. John's Ambulance Societies. Major-General Sir Ernest Cowell, K.B.E., was active in promoting such studies and himself flew to Budapest in 1937 to the International Medical Congress at which British civilian air-ambulances were demonstrated.

1939–1941

In spite of over twenty years' Service and civilian experience of transport of casualties by air, the second World War commenced without any organized system of air transport of casualties available for use by the British Army. Nor was the provision of air-ambulances hastened; on the contrary, in nearly all theatres of operations Medical Staff Officers encountered resistance (if not blank refusal) to their repeated requests for air-ambulances.¹

¹It is extremely interesting to note from War Diaries, Quarterly War Reports and personal experience that the provision of air-evacuation as a standard method progressed through the same stages in each main theatre of war.

At first there was actual refusal to requests for aircraft or even for transport in any available aircraft; then from the forward areas pressure was exercised by Field Ambulance Officers or R.M.O.s on friendly air pilots; then V.I.P.s and an increasing number of senior Officer or Other Rank severely wounded or acutely sick were carried by any aircraft available; then gradually all supply aircraft took sick and wounded on their return trips; until finally daily evacuation of all or nearly all casualties by empty
By contrast, in 1939, the German Army, during its invasion of Poland, was equipped with medium-sized aircraft which flew casualties directly to the vicinity of base hospitals in Germany.

**Western Desert and M.E.F., 1941-1943**

In the Western Desert campaign the earliest record of air-evacuation was the flying of cases of malaria by Valencia aircraft from Siwa to Cairo in 1941. Subsequently, Australian “D.H. 86” Air-ambulances, and South African “Lodestars” evolved an improvised shuttle flight for collecting casualties from forward air-strips in the Desert.

Group-Captain O’Malley, P.M.O. of the Desert Air Force, devised a scheme for utilizing returning transport aircraft for the carriage of casualties. Aircraft used for this purpose by the Royal Air Force included “Bombays” carrying 12 lying cases and later “D.C. 3” aircraft capable of being loaded with 18 lying cases in approximately twenty minutes.

The scheme was for medium-range aircraft to carry out the first lift from the M.D.S. or forward C.C.S. to the L. of C. C.C.S. at Advanced Air Transport supply aircraft became the standard authorized method, and special aircraft were set aside for special cases. *Pari passu* with this development Evacuation-medical-units were formed for receiving, holding the casualties and dispatching patients; the early *units* being detachments of Field Ambulance, later replaced by specially formed units.

To end this note here is an illuminating quotation from the Quarterly Report from the D.D.M.S. of a British Corps in North Africa when 8th Army was preparing for the Mareth Line battles.

“(F.) Air Evacuation.—In the light of recent experience, I make no apologies for resurrecting this red herring. My liaison with the R.A.F., and the use of the Air Evacuation Service is certainly short, but I have seen sufficient to convince me that in the Air Ambulance we have probably the finest machine for the transportation of our casualties hundreds of miles to hospitals where the wounded man can receive everything that medical science can possibly do for him, subject always to the proviso that air supremacy is with us. Between March 26 and March 31, 284 patients were evacuated by air from a forward Fd. Amb. to the nearest C.C.S., situated at MEDENINE. The ease with which the Air Ambulances landed and took off on a locally made runway showed conclusively what a future Air Evacuation holds for the Medical Services as compared with the Road. Had we a squadron of aircraft at that time in place of the odd machine, little or no evacuation by road would have been necessary, and the terrible journey through the MATMATA HILLS to the Medical Area at MEDENINE via HALLUF never even contemplated. I will have more to say on Air Evacuation in my next quarterly report, which will cover the operations in TUNISIA which ended on May 13, 1943.

“Our aim should be nothing less than a squadron of Ambulance Aircraft operating with each army in the field, and the whole Air Evacuation Service under D.M.S. Force. The M.A.C. has done excellent work forward, but with the air ambulance coming gradually into its own, the evacuation of casualties from forward Landing Grounds, sited near C.C.S.s and/or Fd. Ambs., must be our goal. The days of the Corps M.A.C. are numbered, except for local ‘taxi-duties’ and this might be circumvented by C.C.S.s having a few ambulances on their establishment and increasing the number of ambulances with Fd. Ambs.”—Ed.
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Centre; thence other Transport Aircraft flew cases back to the C.C.S. group, Advanced Base Hospitals, or Base.

During the successive advances of Field Marshals Wavell, Auchinleck and Montgomery, an appropriate total of 50,000 patients was flown by air. The Allied advances in Italy were also served by air transport of casualties, both in Italy itself and from Italy to North Africa.

Operations in North-West Europe, 1944–1945

During the period June 6, 1944, until May 8, 1945, covering the landings and operations in France and the Low Countries, the break-through and pursuit, the crossing of the Rhine and the invasion of Germany, a total of 118,000 casualties were transported by air, 40,000 within the theatre itself and 78,000 from the theatre to the United Kingdom.

During the initial assault, air evacuation commenced on D+6 from an airfield near Bayeux; the journey by air to the U.K. took two hours as opposed to the sixteen hours' land and sea journey. Subsequently, during the phase of the build-up, returning Dakota aircraft were evacuating up to 800 casualties daily.

The break-through and pursuit resulted in the capture of airfields at Amiens and St. Omer and from these a flight of "Sparrow" aircraft ferried casualties back to the Bayeux group of hospitals.

During this phase, two important lessons were learnt:

(a) The necessity for providing suitable medical units (say a 200-bedded hospital or C.C.S.) in the vicinity of airfields where casualties are emplaned or deplaned. Such units should be capable of providing full pre-flight treatment and nursing.

(b) The advisability of having casualties readily available to take advantage of empty returning transport planes returning to base.

The capture of Brussels with its airfield greatly facilitated the air transport of casualties, and daily from 700 to 900 patients were flown direct to the United Kingdom.

Early in 1945 flying was repeatedly interrupted by bad weather; on one occasion for seven consecutive days. This demonstrates the vital necessity of having adequate land transport available for casualties at all times.

After the crossing of the Rhine the journey of a casualty down the 200 miles of L. of C., which took approximately ten hours by train, was completed by air in one hour and twenty minutes.

The subsequent seizure of airfields at Luneburg and Celle enabled the air transport to the Brussels group of hospitals of up to 900 patients daily. The provision of medical holding units of from 200 to 600 beds in the vicinity of airfields enabled full use to be made of empty returning transport aircraft.

During this campaign the Royal Air Force developed "Casualty Air Evacuation Squadrons," medical units capable of receiving, holding and emplaning patients from airfields.
SOUTH-EAST ASIA OPERATIONS, 1941–1945

Most theatres of war produced difficulties of movement (and transport of casualties), but none more so than in South-East Asia.

Assam and Burma, with their wide mountainous areas covered with jungle, with few roads and these liable to be washed away during the five months’ monsoon, presented grave problems to supply and casualty evacuation.

The Australian forces in New Guinea had dearly demonstrated the value of transporting casualties by aircraft over jungle-covered mountain ranges.

The Burma retreat of early 1942 and the first Wingate “Chindit” expedition in the spring of 1943 had shown the extreme limitations of both supply and casualty evacuation through the mountainous jungles with their few precarious paths and roads.

From early 1942 the Director of Medical Services with the British forces (Brigadier T. O. Thompson, now Lieut.-General Sir Treffry Thompson) seeing the difficulties in taking out the wounded and sick had persistently urged the provision of aircraft for transporting casualties. But the extreme lack of aircraft of all types, fighters, bombers and transport aircraft, prevented this.

With the formation in 1943 of South-East Asia Command under Lord Louis Mountbatten, amphibious assaults in South Burma were contemplated, but abandoned owing to the diversion of all L.S.I. and L.S.T. for use in Europe at the Anzio and other landings.

An alternative land offensive was planned in Northern and Central Burma with simultaneous advances along the Arakan coast.

The Arakan force included one West African Division which had no lines of communication, but was on complete air supply maintained by Troop
The Transport of Casualties by Air

Carrying Command under General Old of the U.S. Air Force. From October 1943 until June 1944 all wounded and sick from this Division were flown from Field Ambulance areas inside Brigade perimeters direct to West African General Hospitals; and the full advantages (and limitations) of air transport of casualties were demonstrated.

The successive Battles of Sinzweya (when the Japanese encircled the 7th Division for three weeks) and of Kohima and Imphal (when the Japanese attempted to invade Assam), showed that the organization of air supply and air evacuation of casualties was the only method by which Allied forces could advance through the jungles of Assam and Burma and defeat the Japanese forces.

The transport of wounded by air usually took place in two echelons. A forward echelon of light planes (chiefly American Piper Cubs or Ls.4 and 5) organized a shuttle service between forward strips in Divisional areas and advanced airfields in the vicinity of Corps Medical Centres.

Thence, "Dakota," plus a few "Commando," medium-sized aircraft flew casualties back to Base Hospital areas.

The reduction in pain, discomfort, time and loss of life can be appreciated by comparing the plight of a casualty in 1942 whose journey from the front in Arakan to a Base Hospital involved up to sixteen changes of transport lasting up to seven days. In 1944 and 1945 the same journey by air involved only three changes and took up to three hours.

The subsequent advances in the autumn of 1944 and the spring of 1945 in Northern and Central Burma coupled with the series of amphibious assault landings on the Arakan coast led to unprecedented development of air-supply and air-evacuation of casualties.

During the Burma campaign the gross total weight of supplies and equipment (including medical) flown by air was over 1,180,000 tons. The approximate total number of casualties evacuated by air during this period was 180,000.

It is impossible to pay sufficiently high tribute to the pilots and air-crews of the Royal Air Force and United States Air Force who flew repeated sorties over the vast areas of jungle, often through a nightmare of cloud-bank in hilly and mountainous country searching for improvised air-strips, the latter liable to be swept away by monsoon torrents.

Pilots flying light aircraft in the forward echelons would make six to eight sorties each day, sometimes under direct Japanese mortar and small-arms fire.

In Burma by 1945 the technique of air transport of casualties had successfully emerged from the most gruelling and exacting operational tests.

Limitations of Air-Transport of Casualties

Apart from clinical contra-indications (such as patients suffering from severe haemorrhage, shock, or myocardial ischemia), the principal factors which may limit the transport of casualties by air include:
(a) Availability of suitable aircraft and crews.
Now that it has been agreed that the Army will operate light aircraft in the very forward areas for casualty evacuation; i.e. in advance of the forward terminals of the R.A.F. services (usually between A.D.S. and C.C.S.), the supply of light aircraft and helicopter sorties may be easier. The Commander of the Army Formation concerned will be responsible for allotting adequate sorties for transporting casualties.

The provision of adequate medium and heavy aircraft sorties by the Royal Air Force will always be difficult owing to prior claims of fighter, bomber and other operational requirements.

(b) Availability of suitable air-strips and airfields.
Under satisfactory weather conditions, forward formation medical units can easily improvise air-strips for use by helicopters or light aircraft.

Airfields suitable for use by medium and heavy aircraft demand skilled engineering effort and must conform to the Royal Air Force lay-out for the particular theatre of operations. Hence to ensure the optimum use of empty returning aircraft, Corps, L. of C., and Base Medical Units may have to be sited within easy reach of such R.A.F. airfields. Such sites may not always be the ideal location for a hospital, but on balance will be the most efficient.¹

(c) Air superiority.
Pending international recognition of the protection of ambulance aircraft under the Geneva Convention, an essential pre-requisite of systematic flying of casualties will be the attainment of air parity or air superiority; transport aircraft, being relatively slow, and unarmed, are vulnerable to enemy attack.

(d) Weather.
In spite of radar aids to navigation, bad weather may seriously restrict the flying of casualties. Fog, mist, low cloud-base, monsoon-rains, or snow, may all interfere with flying.

This emphasizes the necessity of maintaining at all times a dual organization capable of transporting casualties by either land or air. The latter means should always be regarded as a bonus.

(e) Intercommunication.
To prevent patients making unnecessary journeys to the air-strip, or alternatively aircraft being grounded for longer than is necessary owing to delay in arrival of patients for emplaning, efficient means of intercommunication between medical units and the C.A.E.S. or other emplaning unit are essential; also ground-to-air radio-telephony, between the airfield and transport aircraft. Poor intercommunication may cause serious delay to the speed of evacuation of urgent cases.

¹ On the Burma front it was found that, owing to the uncertainties of the weather with flooding or damage to landing grounds, it was necessary to have two sets of Advance-base, or Base hospitals for reception of casualties and radio and telephonic communication to ensure prior information of arrival.—Ed.
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Clinical Features Limiting Air-Transport of Casualties

Nearly all patients fit to be transported by surface vehicles can safely travel by air, but the latter may be associated with decrease in air temperatures, oxygen lack (hypoxia), lowered atmospheric pressure causing decompression, and finally the effects of gravity, including severe "bumping" such as when flying through rapidly rising streams of air. Clinical experience and physiological conditions which include reduction in either the vital capacity, or the total amount, of circulating haemoglobin (the two conditions may co-exist) requires special consideration and treatment before emplaning, as well as during the flight (e.g. transfusions and oxygen).

The effects of decompression at high altitudes may lead to alterations in intrathoracic and intra-abdominal tensions. Gunshot wounds or trauma of either of these cavities may be aggravated by such decompression.

On the other hand, operational experience has shown that certain types of war wounds such as perforating wounds of the eye should be given high priority of transport by air.

Lesions recommended for priority air transport.

1. Perforating wounds of the globe of the eye.
2. Maxillofacial wounds.
3. Burns (especially of the hands or face); these patients will require preliminary treatment for shock.
4. Wounds of limbs and joints, which have received efficient immobilization.
5. Cranial wounds.
6. Severe flesh wounds.
7. Pelvic and spinal injuries.

Lesions which require special consideration and treatment before emplanement.

1. Haemorrhage, and shock, or any other cause of reduction in oxygen-carrying haemoglobin which may be intensified by hypoxia (anaemia, myocardial ischaemia).
2. Thoracic or abdominal wounds, or gastro-intestinal lesions, which may be worsened by effects of decompression.
3. Respiratory lesions involving reduction in the vital capacity, such as pneumothorax.
4. Maxillofacial injuries.
5. Infectious diseases, such as smallpox.
6. Mental diseases (non-quiescent suicidal or homicidal patients).

Before being transported to airfields for evacuation, the selected patients should receive the appropriate medical or surgical treatment to prepare them for flight. Full clinical data including such treatment should be entered on the documents accompanying such patients.
THE POSSIBLE CONVEYANCE OF DISEASE BY AIRCRAFT

Apart from the transport of human individuals either incubating, or carrying infectious or communicable diseases, mosquitoes (or other insects) which transmit diseases such as yellow fever, call for preventive spraying of aircraft.

THE AIRCRAFT

The different types of (land-based) aircraft used for transporting casualties are divided into three echelons, based on the following considerations.

(a) **Light aircraft, or Helicopters.**

These are capable of transporting 1 to 4 patients per sortie, a distance of up to 100 miles, at a speed of about 87 knots. Landing strip requirements are up to 700 feet open space on grass, hard sand, or on a road.

Types at present available include the American L-5, and the British Auster-Avis; also the Bristol 171, and Hover Fly II helicopters.

Light aircraft, or helicopters, are intended for use between advanced air-strips within Divisional areas (say at A.D.S. level), and the vicinity of the Corps Medical Centres. They will be operated entirely by the Army with Army Officers as pilots.

(b) **Medium-range aircraft.**

These are capable of transporting from 4 to 24 patients a distance of up to 900 miles, at a speed of about 150 knots. Take-off and landing runs require pavement, matting, good grass, or hard sand of up to 830 yards.

Types at present available include the “Valetta,” “Dakota” and “Anson.”

These aircraft are operated and piloted by the Royal Air Force.

(c) **Long-range, multi-engined aircraft.**

These can carry a total of up to 32 lying, plus 28 sitting patients per sortie, a distance of up to 1,880 miles, at a speed of 180 knots. Take-off and landing runs should be pavement of at least 1,450 yards length. The present British type of such aircraft is the “Hastings.” They are operated and piloted by the Royal Air Force.

OPERATIONAL CONTROL OF AIR-TRANSPORT OF CASUALTIES

(a) In Divisional areas, the transport of casualties between advanced air-strips (near an advanced dressing station) and advanced air-transport air-strips (located in Corps areas) may be effected either by helicopter or light aircraft. Each day Divisional headquarters notify Corps H.Q. their requirements for helicopter or light aircraft sorties. Corps H.Q. decide the relative urgency of requests from different Divisions, and allot sorties accordingly.

Helicopters and light aircraft flying forward to advanced air-strips should always carry stretchers and blankets to replace those used in evacuating casualties.
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To avoid delay in emplanement of patients it is essential that telephonic or other rapid means of communication should be established between the advanced dressing station and the advanced air-strip.

(b) Between advanced air-transport airfields and main (or base) transport airfields, the provision and control of aircraft sorties is a Royal Air Force responsibility and is best effected by the Army authorities notifying the R.A.F. daily the estimated number of patients requiring transport by air from Corps medical centres (located near advanced air-transport air-strips), to General Hospitals within easy reach of main or Base Hospitals.

The retention and care of casualties at these airfields, and the emplaning, care during flight, and deplaning, is performed by R.A.F. Casualty Air Evacuation Squadrons. These C.A.E.S. have an establishment of approximately 327 personnel of all ranks, including medical and nursing officers, nursing orderlies, clerks, cooks and other administrative personnel.

The squadron is divisible into three flights, Headquarters, “A” and “B,” and each squadron can receive and emplane or deplane up to 500 casualties per day, and can retain and accommodate up to 100 patients at any time.

The Headquarters flight is usually located at main transport airfield in the theatre of operations; “A” and “B” flights are located on advanced air-transport air-strips.

If required, two light sections can be detached from each of “A” and “B” flights and be flown forward to work on forward air-strips.

DOCUMENTATION

All casualties transported by air should be accompanied by the same medical documents as on land. These include the Field Medical Card A.F.W. 3118, Sulphonamide or Anti-biotic labels, and also A.F.W. 3083 (Casualty Evacuation Label).

Any treatment given at a C.A.E.S. or during flight should be noted on the relevant documents.

If kit or other effects accompany patients, the appropriate labels should be affixed. (A.F.W. 3300 for Officers and A.F.W. 3042 for Other Ranks.)

PROTECTION OF AMBULANCE AIRCRAFT UNDER THE GENEVA CONVENTION

International agreement has not yet been reached concerning the protection of ambulance aircraft under the Geneva Convention.

Helicopters and light aircraft operating in forward areas cannot reasonably expect such protection, as the pilots during flight inevitably observe enemy concentrations and dispositions.

But for medium and long-range aircraft used exclusively for transporting casualties and for flying over routes (notified to the enemy), say from Corps
Medical Centres to Base Hospital areas, protection under the Red Cross might reasonably be claimed.

Such aircraft would require appropriate markings.

DEVELOPMENTS IN AIR-TRANSPORT OF CASUALTIES SINCE 1945

The experience gained by the Allies between 1939 and 1945, when over 500,000 were transported by air, have been the subject of critical reflection and planning for future policy.

At the International Military Medical Congress held at Mexico in October 1949, the British Delegation headed by the Director-General of the Army Medical Services (Lieut.-General Sir Neil Cantlie) reviewed such past experiences and made constructive suggestions for future planning.

Technical developments of jet-propulsion, refuelling whilst in flight, as well as new designs of aircraft such as the De Havilland “Comet” and the Bristol “Brabazon” enlarge the scope of possible air-transport of casualties.

At the present time the Royal Air Force is continuing to transport limited numbers of patients by helicopter and light aircraft in Malaya and Korea; and by medium and long-range aircraft from overseas theatres to the United Kingdom.

The United States Air Force has evolved a scheme by which hospital ships have been eliminated and all casualties from Europe, Alaska, the Caribbean and Far Eastern theatres are flown direct to hospitals in the U.S.A. Within the United States the M.A.T.S. (Military Air Transport Service) provides a
The Transport of Casualties by Air

twice-weekly service by which patients can be flown to any Service hospital from Boston to San Francisco.

The Allied experiences from 1939 to 1945, as well as during the Berlin airlift, and the operations in Malaya and Korea have shown that the use of Air Forces solely for offensive fighting, bombing and tactical support, is not sufficient.

The Burma campaign (in which an average transport aircraft replaced at least six lorries) showed that as soon as air superiority is gained a large number of aircraft can be used for logistical purposes, giving the ground forces greater flexibility, reducing the lines of communication commitments and enabling them to outmaneuver their opponents.

The Medical Services must be prepared, at short notice, to make the fullest use of aircraft returning to base after delivering supplies. Transport aircraft must be capable of being loaded with standard service type stretchers.

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The Transport of Casualties by Air

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