

# VITAMIN C IN THE PROPHYLAXIS AND THERAPY OF INFECTIOUS DISEASES

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During the past century there has been a gradual decline in the incidence and case-mortality rates of most infectious diseases, as well as a marked shift in the age incidence. This trend is readily demonstrated by a brief survey of statistics.

**Tuberculosis.** At the beginning of the 19th century this disease caused one-fifth of all deaths in western Europe. In London the rate was even higher—30 per cent. In the large American cities the death rate at that time was about 400 per 100,000 of population. To illustrate the rate of decline in England the figures for the city of Ipswich in ten-year averages from 1840 to 1940 are as follows: 393, 340, 320, 305, 268, 217, 183, 151, 100 and 69, indicating an almost even decline throughout. These figures are closely paralleled for a corresponding period in Massachusetts, in which an evenly graded reduction in tuberculosis mortality from 444 to 36 occurred between 1859 and 1939. The change in age incidence has also been very marked. Fifty years ago the peak of incidence was in the third decade of life, with a rather high rate in infancy and childhood. Today the older age groups, 50 to 60 years, are mostly affected, and the early age groups are almost completely exempt.

**Pneumonia.** At the beginning of the present century this disease exceeded tuberculosis as a cause of death. In the past fifty years the mortality rates for this disease have also shown a steady decline from about 200 to 40 or less.

**Diphtheria.** Prior to the present century this disease was the major scourge of infancy and childhood. The mortality rates in the United States, for consecutive ten-year periods from 1900 to 1940, were as follows: 40, 21, 15, 5 and 1. For the city of Toronto, for ten-year periods from 1885 to 1945, the rates were as follows: 132, 66, 34, 19, 8 and 3. These figures show a steady reduction in mortality which began over 60 years ago. The age incidence has also advanced into older brackets.

A similar general decline in incidence and mortality rates for other infectious diseases, notably scarlet fever, whooping cough, measles, mumps, rheumatic fever and typhoid fever, has also been recorded.

The usual explanation offered for this changed trend in infectious diseases has been the forward march of medicine in prophylaxis and therapy; but, from a study of the literature, it is evident that these changes in incidence and mortality have been neither synchronous with nor proportionate to such measures. The decline in tuberculosis, for instance, began long before any special control measures, such as

mass x-ray and sanitarium treatment, were instituted, even long before the infectious nature of the disease was discovered. The decline in pneumonia also began long before the use of the antibiotic drugs. Likewise, the decline in diphtheria, whooping cough and typhoid fever began fully fifty years prior to the inception of artificial immunization and followed an almost even grade before and after the adoption of these control measures. In the case of scarlet fever, mumps, measles and rheumatic fever there has been no specific innovation in control measures, yet these also have followed the same general pattern in incidence decline. Furthermore, puerperal and infant mortality (under one year) has also shown a steady decline in keeping with that of the infectious diseases, thus obviously indicating the influence of some over-all unrecognized prophylactic factor.

Commenting on this orderly decline [Ross](#)<sup>1</sup> says: "While the control measures which have been applied have possibly accentuated the decline in young adult life... it seems reasonable to attribute the general decline to other factors more general in character and of which but little is really known." In support of this statement Ross compares the tuberculosis mortality of Mexico City with Ontario (Canada), showing that the decline in the former has been more rapid than in the latter in spite of the fact that in Mexico City there were no sanitariums, no diagnostic clinics and no antituberculosis movement. On this same subject [McKinnon](#)<sup>2</sup> says: "Quite obviously then, all the factors mentioned are not adequate in themselves to explain the recorded decline. Some other factor or factors must have been operating during this period and it is necessary to cast farther afield in search of them."

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### **THE AUTHOR'S HYPOTHESIS**

The most logical explanation for this uniformity in decline of infectious diseases, regardless of control measures, would seem to be that resistance to infection in general has been increased gradually throughout the past century, particularly in the younger age groups, and that the major factor in producing this result is most likely to have been some changed trend in nutrition. On this basis, artificial control measures which have mostly been applied within the last three decades would play a minor or supplemental role.

From increasing evidence of the anti-toxic and anti-infectious action of vitamin C, and from personal clinical experience in the prophylactic and therapeutic application of this vitamin, the author is firmly convinced that the major factor in bringing about this gradually changing picture in infectious-disease incidence has been the steady and phenomenal increase in the consumption of vitamin-C-rich fruits, notably citrus fruits and tomatoes, during the period in question. This hypothesis would not only account for the gradual decline in incidence, but would also explain the shift in age incidence of tuberculosis, diphtheria, poliomyelitis, etc., from the younger to the older age brackets, due to the fact that in the nursery the full benefit of this nutritional reform is obtained; whereas, during childhood and early youth perverse dietary habits are gradually acquired through lack of parental guidance and inadequacy of public-health education. The increased use of candy, carbonated beverages, tea, coffee, tobacco and alcohol tends gradually to displace

the more wholesome nutritional habits of early childhood, and malnutrition with increased susceptibility to disease is the price we pay for this diversion.

Chemically, vitamin C is known to be a potent reducing and oxidizing agent, its decolorizing action brings about the neutralization or destruction of bacterial and other organic toxins. It is also known to play an essential part in the oxidation-reduction system of the body and in the production of antibodies, thus favoring development of natural resistance to disease. During the recent world war it was found that German children, receiving a supplement of 50 mg. of vitamin C daily, were [less susceptible to infection than controls.](#)<sup>3</sup> More recently, [Nungster and Ames](#)<sup>4</sup> reported that vitamin C greatly increased the phagocytic action of white blood cells against infectious organisms.

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### CLINICAL OBSERVATIONS

It seems logical to assume that any agent which acts prophylactically should also have therapeutic value in infectious diseases, and vice versa. Accordingly, a brief summary of the clinical uses of vitamin C in this respect follows:

**Tuberculosis.** Many investigators have studied the effect of vitamin C in this disease because of its favorable influence on fibroblastic connective tissue, so essential to the healing of the exudative or ulcerative lesions. [Birkhang](#)<sup>5</sup> found that optimal vitamin-C level, induced by supplemental intake of ascorbic acid, produced an increase in body weight and reduction in tuberculous lesions in guinea pigs. Microscopic examination revealed less caseonecrotic lesions and more collagenous tissue in and around the tubercular centers than was observed in controls. [Albrecht](#)<sup>6</sup> found that daily subcutaneous injections of vitamin C in tubercular patients increased appetite, improved general health and blood picture, and frequently decreased the temperature. [Borsalino,](#)<sup>7</sup> reporting observations on 140 tubercular patients, found that vitamin-C therapy rapidly increased capillary resistance and stopped pulmonary hemorrhage, which reappeared when the treatment was discontinued.

Early in the history of this disease Richard Morton, in his classical work "Phthisiologia" (1689), stated that "scurvy is wont to occasion a consumption of the lungs."

**Pneumonia.** [Hochwald](#)<sup>8</sup> reports that vitamin C, 500 mg. every 90 minutes until the temperature drops to normal, exerts a curative effect in croupous pneumonia as shown by lessened prostration and dyspnea, early return to normal temperature, quicker disappearance of local findings and normalization of white-blood-cell picture. More recently, [Slotkin and Fletcher,](#)<sup>9</sup> reporting on the value of vitamin C in postoperative pneumonia, summarize their findings as follows: "Pulmonary complications in old debilitated patients requiring prostatic surgery is a common cause of death. The pulmonary lesions most noted were bronchopneumonia, lung abscess and purulent bronchitis. Most of these cases are so-called 'wet chests,' due to capillary secretions. Ascorbic acid, which increases the tonicity of these capillaries, has been of great value in alleviating these patients and in restoring

prompt pulmonary action by the disappearance of this infiltration.” (In this connection it should be noted that pneumonia is often the terminal cause of death in frank scurvy, and that the “rusty brown” sputum in pneumonia may in reality be a sign of the hemorrhagic status of the scorbutic background) . According to [Klenner, <sup>10</sup>](#) pneumonia never develops as a complication of measles when intensive vitamin-C therapy is employed, following which all symptoms usually disappear within 48 hours.

**Diphtheria.** In the early history of this disease, when it was known as malignant angina or gangrenous sore throat, many observers reported the frequent concurrence of “gangrenous gingivitis.” Many physicians at that time regarded this complication as evidence of a scorbutic background. Boerhaave, a Dutch physician of international repute in the 18th century, held strongly to this viewpoint. The frequent concurrence of epistaxis and the profuse bleeding from the denuded fauces upon removal of the false membrane, so characteristic of diphtheria, are very suggestive of the hemorrhagic status of scurvy. Certainly, at that time scurvy was very prevalent in central and northern Europe, where the supply of fresh fruits was much less than in countries bordering upon the Mediterranean. The basic concurrence of this condition may have determined the very high case-fatality rate in diphtheria (80 per cent) at that time.

Recently, [Klenner <sup>10</sup>](#) reports the successful treatment of diphtheria by intensive vitamin-C parenterally, 1,000 to 2,000 mg. every two to four hours. He says that the cure by this therapy is effected in half the time required to remove the membrane and get negative smears by antitoxin. The membrane is removed by lysis when vitamin C is used in this way, rather than by sloughing as with antitoxin, and with the further advantage of freedom from serum reaction. The spectacular results reported by Klenner in parenteral vitamin-C therapy are perhaps attained by reason of the fact that a much higher tissue level of the vitamin is possible by this method than by oral intake.

**Rheumatic Fever.** [Abasy, Hill and Harris <sup>11</sup>](#) found a striking difference in excretion of vitamin C in 107 active rheumatic fever cases compared with controls. They conclude that large amounts of this vitamin are indicated both prophylactically and therapeutically. [Glazebrook and Thompson <sup>12</sup>](#) studied the effects of hemolytic streptococcus infection in potentially scorbutic and control groups in 1,500 youths in a naval training school. Of these, 355 were given liberal daily supplements of ascorbic acid, the remainder being used as controls. There developed 16 cases of rheumatic fever and 17 cases of pneumonia among the controls, and no case of either disease among the youths who received the extra vitamin C. [Rinehart <sup>13</sup>](#) tried out the effect of combined vitamin C and P in rheumatic fever and found that all cases showed a slowing of the sedimentation rate which was paralleled by marked clinical improvement.

**Whooping Cough.** [Otani <sup>14</sup>](#) found that the intravenous use of vitamin C in 81 cases had a definite antagonistic action on the toxin of the Bordet-Gengou bacillus. [Ormerod et al., <sup>15</sup>](#) reporting on 29 cases treated by oral vitamin C, 500 mg. the first day and 200 mg. daily thereafter, noted a marked decrease in the intensity, number and duration of the characteristic symptoms.

***Puerperal and Infant Mortality.*** It is the author's belief that the gradually increased use of citrus fruits and tomato juice in the maternal (prenatal) and infant diet during the past half century has been the major factor in reducing death rates in these classes. The increased intake of vitamin C would, for the physiological reasons previously stated, tend to minimize the danger of puerperal infection, decrease the incidence and severity of pre- and post-partum hemorrhage, and, by increasing the tensile strength of connective tissues, [prevent striae gravidarum and laceration of the birth canal](#) <sup>16</sup>, thus further lessening the danger of infection. In the infant this dietary revolution would tend to reduce the incidence of neonatal pneumonia, diarrhea and enteritis, and other infectious diseases of early infancy.

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### **(The Author's Experience)**

In the author's private practice during the past ten years, over 5,000 tests for vitamin-C status have been made, employing the dichlorophenol-indophenol color test on the urine. In many cases of deficiency, where the dietary intake indicates a subnormal in-take of vitamin C over a lengthy period, the correlated clinical history shows repeated occurrence of infectious processes, such as tonsillitis, pharyngitis, otitis, bronchitis, mastoiditis, cystitis, pyelonephritis, phlebitis, appendicitis, cellulitis, cholecystitis, pneumonia, etc. During this period the author has made intensive application of vitamin-C therapy, orally and parenterally, in many such infectious diseases, including even septicemia and tuberculosis, with results in every case even more rapid and favorable than could be expected from the use of the modern antibiotics, and with the added advantage of complete exemption from toxic or allergic reactions. To illustrate:

(1) An active case of **tuberculosis** was treated by the author as follows: 1,000 mg. of vitamin C intravenously, daily or every other day for three weeks, combined with 500 mg. orally in addition to copious intake of citrus juices. From the start the temperature was reduced and maintained at normal. The cough and expectoration have completely ceased, and a gain in weight of nearly ten pounds has been recorded.

(2) A case of **chronic pelvic infection**, with frequent acute exacerbations for the past six years following a spontaneous abortion, was given 1,000 mg. of vitamin C intravenously, twice daily, for 2½ days (5 injections only). The W. B. C. count at the beginning of treatment was 19,200. A second count made on the third day showed a reduction to 6,700. The patient was then placed on an oral maintenance dose of 500 mg. daily in addition to a liberal intake of citrus juices. This patient has now been symptom-free for nearly a year.

(3) A case of acute **septicemia** developed in an aged woman following an infected wound of the hand. When first seen there were marked swelling and redness of the hand and forearm and the temperature was 103 °F., plus. 1,000 mg. of vitamin C was given hypodermically and 1,500 mg. orally, plus copious intake of orange juice. On the following day the inflammatory swelling and temperature were reduced to normal and the patient made a rapid recovery.

(4) Several cases of **scarlet fever** were given vitamin-C therapy, intravenously and

orally, 2,000 mg. daily. In each case the fever dropped to normal in a few hours and the patients were symptom-free within three or four days.

The author's experience leads to the conclusion that the principle of trying to eradicate disease by concentrating our attack against the associated microorganisms by means of toxic antibiotics is fundamentally unsound. If we wish to eliminate a desert or swamp we do not proceed to cut down the sage brush and cactus of the former or the lush characteristic verdure of the latter. Instead, we change the condition of the soil. By irrigation we make the desert blossom like a rose, and by drainage we change the flora of the swamp.

The late [Dr. Alexis Carrel](#)<sup>17</sup> has said: "Microbes and viruses are to be found everywhere, in the air, in the water, in our food... Nevertheless, in many people they remain inoffensive... This is natural immunity... But natural immunity does not exclusively derive from our ancestral constitution. It may come also from the mode of life and alimentation... Some diets increase the susceptibility of mice to experimental typhoid fever. The frequency of pneumonia may also be modified by food. The mice belonging to one of the strains kept at the Rockefeller Institute died of pneumonia in the proportion of 52 per cent while subjected to the standard diet. Several groups of these animals were given different diets. The mortality from pneumonia fell to 32 per cent, 14 per cent and even to zero, according to the food. We should ascertain whether natural resistance to infections could be conferred on man by definite conditions of life. Injections of specific vaccine or serum for each disease, repeated medical examinations of the whole population, construction of gigantic hospitals, are expensive and not very effective means of preventing diseases and of developing a nation's health. Good health should be natural."

A great English physician, Dr. Leonard Williams, has said: "The discovery of the vitamins has entirely altered our conception of the causes and origins of disease. Until lately disease was regarded as a sin of commission by some unseen and subtle agency. The vitamins are teaching us to regard it, in some degree at any rate, as a sin of omission on the part of civilized or hypercivilized man. By our habit of riveting our attention on microbes and their toxins we have sadly neglected the side of the question which concerns itself with our own bodily defenses."

Charcot has said: "Disease is from of old and nothing about it has changed. It is we who change as we learn to recognize what was formerly imperceptible."

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## SUMMARY

Statistical data are presented to show the marked decline in incidence and case-fatality of many infectious diseases within the past century. The uniformity of this decline suggests the operation of some major overall factor improving natural resistance, compared with which our artificial control measures have played a minor or supplemental role. The existence of such a factor has been recognized by epidemiologists, but not yet identified.

The author advances the hypothesis that some major change in the trend of nutrition offers the most likely explanation, and singles out the greatly increased

consumption of citrus and other fruits rich in vitamin C as the possible unidentified factor.

The physiological action of vitamin C is discussed in relation to its anti-infection role, and clinical evidence is cited from the literature relative to the prophylactic and therapeutic use of this vitamin in infectious diseases, in addition to the author's personal experience in this respect.

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## REFERENCES

1. Ross, Mary A.: Tuberculosis Mortality in Ontario. *Canad. Pub. Health J.*, 25: 73, 1934.
  2. McKinnon, N. E.: Mortality Reductions in Ontario, 1900-1942. *Canad. Pub. Health J.*, 36: 423, 1945.
  3. Summary of Certain Public Health Measures Adopted in Germany During the Present War. *Bull. War Med.*, 2: 5, 1941.
  4. Nungster and Ames: Report to American Society of Bacteriologists, 1947 Convention.
  5. Birkhang, K. E.: Tuberculosis in Animals Treated with Ascorbic Acid. *J.A.M.A.*, 112: 2376, 1939.
  6. Albrecht, E.: Vitamin C als Adjuvans in der Therapie der Lungentuberkulose. *Med. Klin.*, 34: 972, 1938.
  7. Borsalino, G.: La Fragile Caillare Nella Tuberculose Polmonare a le sue Modificazione par Azione Della Vitamin C. *Gior. di clin. med.*, 18: 273, 1937.
  8. Hochwald, A.: Beobachtungen uber Askorbinsäure-wirkung bei der Krupposen Pneumonie. *Wien. Arch. f. Inn. Med.*, 29: 353, 1936.
  9. Slotkin, G. A. and Fletcher, R. S.: Ascorbic Acid in Pulmonary Complications Following Surgery. A Preliminary Report. *J. Urol.*, 52; Nov. 6, 1944.
  10. Klenner, Fred R.: The Treatment of Poliomyelitis and Other Virus Diseases with Vitamin C. *South. Med. & Surg.*, Vol. III, No. 7, July 1949.
  11. Abasy, M. A.; Hill, N. J. and Harris, L. J.: Vitamin C and Juvenile Rheumatism. *Lancet*, 2: 1413, 1936.
  12. Glazebrook, A. J. and Thompson, S.: The Administration of Vitamin C in a Large Institution and Its Effect on General Health and Resistance to Infection. *J. Hyg.*, 42: 1, 1942.
  13. Rinehart, J. F.: The Treatment of Rheumatic Fever with Crude Hesperidin (Vitamin C and P). Paper Read Before California Heart Assoc., Los Angeles, May 6, 1944.
  14. Otani, T.: Vitamin-C Therapy of Whooping Cough. *Klin. Wchnschr.*, 15: 1884, 1936.
  15. Ormerod, M. J. and Unkauf, B. M.: Ascorbic Acid Treatment of Whooping Cough. *Canad. M. A. J.*, 37: 134, 1937.
  16. McCormick, W. J.: The Striae of Pregnancy. A New Etiological Concept. *M. Rec.*, Aug. 1948.
  17. Carrel, Alexis: *Man the Unknown*. p. 207, 1935.
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*[Note: In the interest of clarity at least one heading in (parentheses) was added, and the enumerated case histories have been broken into numbered list format. Some font manipulation was added to draw the eye. - AscorbateWeb ed.]*

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