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HISTORICAL ARTICLE

A Tribute to Toilet Paper

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In modern use, toilet paper would seem to play an important role as a barrier to the transmission of enteric infection by the fecal-manual-oral route. A historical review reveals a dearth of information on this topic. The remarkable compliance with the hygienic practice of toilet paper use is in contrast to the more limited compliance with hand-washing policies touted universally as a sound infection-control measure.

The value of modern sewage systems, waste disposal, water purification, and personal hygienic practices is well known in the prevention of infectious diseases. Antibiotics and vaccines are lauded as miracles of modern medicine. Skilled epidemiologic studies, case-reporting systems, computerized data handling, and sophisticated biostatistical methods have played significant roles in providing us with a reasonably safe environment. But what about toilet paper? What impact has this highly standardized, readily available, cleansing, absorbable, and disposable tissue paper had in serving as a barrier to fecal contamination and preventing infectious diseases that are transmitted by the fecal-oral route? In the centuries before toilet paper, plagues of dysentery, typhoid, and cholera scourged the world. The unsanitary conditions evoked by armies and wars clearly revealed some of the influences responsible for contagious diseases. For example, in about 480 B.C., Xerxes' Persian army of 800,000 was reduced by half by dysentery. One can easily appreciate the ease of fecal-oral transmission under these adverse circumstances. Disposal of voided excreta and residual fecal contamination of the external body surfaces, clothing, bedding, and the like posed serious hazards to the troops. During the American Civil War (before toilet paper), the incidence of typhoid fever reached 80 cases/1,000 soldiers per year. In the Spanish-American War (also before toilet paper), this rate more than doubled [1].

The report of the Surgeon General of the Army in 1905 emphasized the importance of the infant science of hygiene and noted that "the issue of toilet paper is now authorized where posts have sewer connections" [2, 3]. During World War I the incidence of typhoid fever was ~3 cases/1,000 soldiers per year; in World War II it was <0.1/1,000; and in the Korean War it was even lower. What role did toilet paper have in the control of this and other diseases? Clearly, no one knows or will ever know.

Toilet paper provides a physical barrier between fecal excretion and the hand. At least a few grams of residual stool are removed from the anal and perianal areas following defecation. Otherwise, this excretion would remain on the skin and clothing. A major portion of the normal feces is made up of bacteria. Other microbes may include viruses, fungi, and protozoa. At least 60 different species of bacteria have been isolated from the feces of humans, probably representing only a fraction of the true flora. The nonsporulating anaerobes of the *Bacteroides* species are usually present at a concentration of 10^7–10^{12} organisms/g of wet feces. Enterobacteria usually number 10^6–10^{10} organisms/g. *Proteus* species, spore-bearing anaerobes, pseudomonads, lactobacilli, and enterococci vary in presence and amounts, with concentrations ranging up to 10^8 organisms/g [4].

Little is known about the nonbacterial microbial flora of the normal stool. While the vast majority of these enteric organisms are avirulent in the normal host, carrier states with organisms such as *Salmonella* and *Shigella* species are not uncommon. Seemingly, removal of residual feces from dispersal sites around the anus would serve to reduce the trans-

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mission of contagious diseases, although this theory has never been proven or disproven.

An extensive search of all available indices to the world medical literature and the literature of the paper industry, along with inquiries to the major manufacturers of toilet paper, failed to reveal a single study on the effect of toilet paper in the control of infectious diseases. In fact, only four publications dealing with toilet paper have appeared in the medical literature—three of these in the form of letters to the editor [5–8].

In 1983, Rhoda S. Brody of Bayside, New York, pointed out in her letter to the editor of the *Journal of the American Medical Association* that scented toilet paper causes vaginal irritation and pleaded for further research by the medical profession [5]. Earlier, Keith, Reich, and Bush [6] had pointed out in their letter to the same journal that they had observed severe pruritus in the perianal and perineal areas from the use of perfumed toilet paper. Taylor's letter published in the *British Medical Journal* comments, in a casual manner, on the transition from the use of hard to soft toilet paper in England and Wales and the temporal relation with the decline in notifications of dysentery [7]. The single scientific publication with reference to toilet paper by Gilbaugh and Fuchs [8] describes an in vitro study in which toilet seats and strips of toilet paper were inoculated with *Neisseria gonorrhoeae* and then cultured at intervals to determine survival time. The gonococcus remained culturable from toilet paper for as long as 3 hours. Thus, the whole of the medical literature on the topic of toilet paper provides no insight whatever into the significance of this item with regard to the control of infectious disease.

While a dearth of information exists in the medical literature, some general historical data permit a sketch of toilet paper usage. The Chinese were probably the first to use this product. In a French book published in 1718, Eusebius Renaudot's *Anciennes Relations des Indes et de la Chine de Deux Voyageurs Mohametans*, mention is made of Arabs who, while traveling in China in the ninth century, found such paper [9]. In 1747 Lord Chesterfield wrote in *Letters to His Son*: "I knew a gentleman who was so good a manager of his time that he would not even lose that small portion of it which the call of nature obliged him to pass in the necessary-house; but gradually went through all the Latin poets in those moments. He bought, for example, a common edition of Horace, of which he tore off gradually a couple of pages, carried them with him to that necessary place, read them first and then sent them down as a sacrifice to Cloacina; thus was so much time fairly gained; and I recommend you to follow his example. It is better than only doing what you cannot help doing at those moments and it will make any book which you shall read in that manner, very present to your mind" [10]. The more customary source at this time was either squares of paper in a wooden or porcelain container or papers hung from a nail in the wall.

In Victorian times toilet paper was never referred to in specific terms. Since women often curled their hair by rolling it on folded pieces of paper, the housewife would often ask the storekeeper for "curl papers" and both clearly understood the transaction. Also, in the 1800s, toilet paper was sold as "wrapping paper" and used in bathrooms. By the middle of the century, some product popularity was evident. For example, Madam's Double Utility Fan was a fan-shaped box of 150 sheets of tissue. Customers often ordered toilet tissue by whispering to the druggist, who might reach for it under the counter [11].

The first paper product specifically manufactured as toilet paper was Gayetty's Medicated Paper in 1857. It was advertised as "unbleached pearl-colored pure manila hemp paper, a perfectly pure article for the toilet and the prevention of piles" [11]. A package of 500 sheets sold for 50 cents. Every sheet was watermarked with Gayetty's name.

In 1871 a United States patent for toilet paper in roll form was issued to Seth Wheeler [12], and in 1879 the Scott Paper Company was founded by E. Irwin Scott and his brother, Clarence. A year later the British Perforated Paper Company came into existence [10]. The use of toilet paper did not progress rapidly. To a limited extent the Sears, Roebuck catalogue served the purpose during these early years. However, by 1900 with the increased use of indoor plumbing, toilet paper was in general use, and by 1919 it had become an important commodity in the paper market [12]. The early toilet paper in rolls used in the United States was essentially the same type of paper as that used for newspaper production [10]. A creped paper produced in 1907 was the first advance toward the modern soft tissues.

The earliest census records—in 1879—showed that 4,063 tons of tissue paper were produced. Toilet tissue production was first recorded separately in 1919

and reported to be 79,940 tons. By 1925 production had increased to 108,847 tons, and by 1949 it had increased to 486,348 tons [13].

About the time the United States entered World War II, the government ordered a large supply of toilet paper for the army and navy, with a request for speedy delivery. Consequently, civilian stores exhausted their supplies before stocks could be replenished. Hoarding of toilet paper became commonplace. There were numerous instances in which grocers sold full cases (100 rolls) to single customers [12]. During World War II a serious disruption of toilet paper production occurred because the War Manpower Commission failed to declare toilet paper "essential." However, toilet paper was indeed an essential part of the equipment of armed services personnel. A letter written on 22 September 1942 by a member of the field service of the American Ambulance Corps attached to the British Army indicates the magnitude of the problem: "I have been sick again—this time with a combination of sandfly fever and dysentery. It was awful! The fever makes you terrifically tired and hot, and every bone, particularly the back, aches like hell. That combined with the necessity of trotting off to a latrine over one-quarter mile away at fifteen and thirty minute intervals, made life miserable for about three days. Decent toilet paper isn't available at any price." This same letter went on to mention that pocket packs of toilet paper were found in supplies captured from the Germans. The paper was of very coarse quality and not packaged in moisture-proof containers as were the American packets. The carrying of pocket packs of toilet paper by all armies reflects the importance of the item in the field [13].

In one of his articles from North Africa, the famous reporter Ernie Pyle states, "You become eminently practical in war time. A chaplain who recently went through the pockets of 10 Americans killed in battle said the dominant thing he found was toilet paper. Careless soldiers who were caught without such preparedness have to waste 20-franc notes" [13].

What has accounted for the remarkable use of and demand for an item that has never undergone the mildest scientific scrutiny as a product of hygienic efficacy? There is no substantial evidence to prove that the use of toilet paper has or has not had any impact on the prevention of infection. No promotional campaigns have come from the Surgeon General, the Centers for Disease Control, the National Institutes of Health, the World Health Organization, or any of the prestigious medical societies. In fact, over the century, efforts have been made to avoid mention of this product. Its very name was whispered in the 19th century, and until 1975 the American Broadcasting Company required that the term "bathroom tissue" be used [11]. Now the words "toilet paper" can be spoken freely, but advertisements speak only of its softness or whiteness. We have not found a single advertisement that promotes the product for the purpose for which it was developed. Despite these handicaps, toilet paper abounds (table 1). What American does not have access to it? It is found in homes, offices, hospitals, churches, gas stations, factories, roadside parks, trains, buses, airplanes, ships, submarines, and outer-space transports. American paper companies produce over 7 billion rolls of toilet paper (31.8 rolls per person) annually; consumers spend 2 billion dollars to purchase these rolls [11]. A threat to this supply causes panic. Several years ago, Congressman Harold Frochlich from Wisconsin mentioned an impending shortage of toilet paper. This warning was repeated by Johnny Carson on the *Tonight Show*, and the following day supermarkets were depleted of toilet paper stocks.

Table 1. Toilet paper sales in the United States.

Year	Sales (in millions of dollars)
1971	503
1972	517
1973	553
1974	650
1975	780
1976	1,140
1977	1,269
1978	1,377
1979	1,519
1980	1,610
1981	1,771

What would be the consequences of the removal of toilet paper from the United States? One can appreciate the aesthetic problems as well as the likelihood of increased transmission of enteric pathogens from person to person due to contamination of hands from residual fecal materials on skin and clothing. While proper hand washing after toilet use would control the problem, this might not be easily accomplished universally. Hospital infection-control officers can testify that even physicians and nurses sometimes fail to comply strictly with hand-washing policies. It seems reasonable to assume that compli-

Table 2. "Flushability" of paper products.

Paper	No. of sheets* that flushed (flushability factor, %)		
	Current best-selling bowl (wash-down type)	Usual best-selling bowl (reverse-trap type)	Best-quality bowl (siphon-jet type)
Kraft wrapping	2 (5.08)	8 (7.92)	8 (4.18)
Catalogue, plain	8 (13.55)	17 (16.83)	53 (27.74)
Catalogue, roto	5 (10.16)	17 (16.83)	35 (18.32)
Telephone directory	8 (13.55)	17 (16.83)	53 (27.74)
Newspaper	8 (13.55)	23 (22.77)	23 (12.04)
"Umpire" tissue†	59 (100.00)	101 (100.00)	191 (100.00)

NOTE. Data for this table are taken from [13].

* Number of 4½-inch by 5-inch sheets that flushed.

† Umpire Tissue was a standard grade of toilet paper selected for the test by the National Bureau of Standards. For compilation of the results of the test, the flushability factor for Umpire Tissue was set at 100% and the flushability factor for the substitutes was computed in relation to this value.

ance with toilet paper usage in this country must approximate 100%, but compliance with hand-washing practices falls short of this figure even in the best of hospitals.

We must also consider an additional consequence of the complete removal of toilet paper—one that would be quite real and perhaps of greater impact on the spread of infection than failure to use the tissue for the purpose for which it was intended. The plumbing systems in the United States are highly developed and standardized. Few of us live without plumbing and indoor toilet facilities. It can be predicted clearly that the nation's plumbing systems would be rendered nonfunctional in a relatively short period if toilet paper were not available [13]. This prediction is based on a study in 1942 under careful test conditions of the "flushability" of the most likely substitutes for toilet paper. The tests were conducted in the laboratories of the Universal Sanitary Manufacturing Company in Camden, New Jersey. It is apparent from table 2 that some of the paper substitutes analyzed were ≤27.7% as flushable as the "Umpire" toilet tissue which was used by the National Bureau of Standards as representative of the average toilet paper's flushing characteristics. It is also evident from table 2 that the "current best-selling" bowl would flush no more than eight sheets from newspapers, catalogues, or telephone directories without clogging, indicating that these substitutes are only one-eighth (13.6%) as disposable as toilet tissue. Realistically, the average bowl would be able to flush fewer than eight sheets of newspaper because it is unlikely that a newspaper page would be torn into the small sheets (4½ inches by 5 inches) used in this study [13].

What "tribute" should we pay to toilet paper? Despite the lack of evidence for the role of toilet paper in the prevention of diseases, our general knowledge of microbial diseases leads us to expect that the use of toilet paper has served a preventive function. Another important aspect of the use of toilet paper might have a major impact on modern infection-control practices and would warrant tribute. If the motivation for the remarkable compliance that has evolved in the use of toilet paper as a hygienic practice could be understood and applied to other practices (such as hand washing), the life of the hospital infection-control officer would be improved.

Finally, in a philosophical vein, Somerset Maugham reminds us in his *Summing Up* of every person's humility. He wishes that His Lordship at the Old Bailey had, beside his bunch of flowers, *a packet of toilet paper* which would remind him that he was a man like any other [14].

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