

Urinalysis in Western culture: A brief history

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Today physicians use urine to diagnose selective conditions but from ancient times until the Victorian era, urine was used as the primary diagnostic tool. Laboratory medicine began with the analysis of human urine, which was called uroscopy and today is termed urinalysis. Uroscopy was the mirror of medicine for thousands of years. From a liquid window through which physicians felt they could view the body's inner workings. Numerous, somewhat accurate, physiologic theories arose from uroscopy. Then the importance of urinary diagnosis became exaggerated, and increasingly complex, until physicians required only the presence of urine, not patients, to diagnose disease. Uroscopy then escaped medical control, becoming first a home health aid and then a tool of uneducated practitioners. Thomas Brian led a medical rebellion against all uses of uroscopy and published the *Pisse Prophet*, a book that devastated uroscopy.

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Laboratory medicine began 6000 years ago with the analysis of human urine, which was called uroscopy until the 17th century and today is termed urinalysis. Today physicians use urine to diagnose selective conditions but from ancient times until the Victorian era, urine was used as the primary diagnostic tool. Physicians spoke of urine as a 'divine fluid', or a window to the body.¹ Babylonian and Egyptian physicians began the art of uroscopy. Uroscopy, from the word 'uroscopia,' means 'scientific examination of urine.' The word is derived from the Greek 'ouron' meaning 'urine' and 'skopeo,' meaning to 'behold, contemplate, examine, inspect'.

THE ANCIENT WORLD

Although Hippocrates is credited with being the original uroscopist, urine diagnosis is believed to pre-date Hippocrates.¹ In ancient times the symbol for urine was a pairing of water and phallus. Sumerian and Babylonian physicians of 4000 BC recorded their assessment of urine on clay tablets. Ancient Sumer, one of the earliest civilizations, recognized that urine characteristics were altered with different diseases.² Sanskrit medical works from 100 BC describe 20 different types of urine. Hindu cultures were aware that some people's urine tasted sweet, and that black ants were attracted to this sweet urine, a characteristic of the disease now known as diabetes mellitus. The word diabetes, which stems from the Greek word *siphon*, was coined by Areteus the Cappadocian in the second century. Areteus did not mention the sweetness of urine, but described the disease, poetically, as, 'A melting down of flesh and limbs into urine'.³

The predominant theory of disease causation, accepted into the 16th century, was that of the four humors: blood, phlegm, yellow bile, and black bile, each of which was thought to originate from a different region of the body. It was the physician's responsibility to keep the four humors in balance; disruption caused disease.

In the fourth century BC, Hippocrates (460–355 BC) hypothesized that urine was a filtrate of the humors, which came from the blood and was filtered through the kidneys, a fairly accurate description. In *Aphorisma*, Hippocrates describes bubbles that lay on the surface of fresh urine as an indication of long-term kidney disease. Bubbles on the surface of urine are in fact often owing to proteinuria and can, in fact, indicate kidney disease or urinary tract infection.⁴ In *Aphorisma* Hippocrates also associated urinary sediment with fever, and noted that sediment increased as the fever worsened. The observed sediment may well have been

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due to white blood cells and bacteria from a urinary tract infection. The presence of blood in the urine was attributed to kidney or bladder ulceration. Hematuria can indeed be due to ulceration, although we now know that it can also be caused by, among other conditions, urinary tract infection, glomerulonephritis, nephrolithiasis, cystolithiasis, cystic kidney disease, sickle cell anemia, bladder cancer, several other diseases, and even exercise.⁵ Not all ancient diagnoses and theories have borne the test of time. For example, the first century physician Rufus, of Ephesus, hypothesized that patients urinated blood owing to the widening of the channel therefore letting blood and other thick substances into the kidney.⁶

The doctrine of urine did not change until six centuries later, when Galen (AD 129–200) began his scientific findings in Rome. Galen refined Hippocrates' ideas, theorizing that urine represented, not a filtrate of the four humors and overall condition, but rather, a filtrate of the blood. Galen sought to make urine diagnosis more specific. He used the phrase, 'diarrhea of urine' to describe excessive urination, and noted that it was an atypical symptom. We now know that polyuria is a symptom of diabetes and other conditions. Galen thought that the liquid ingested equaled the urine expelled in a healthy person. Today, a decrease in urine output is known to be a symptom of dehydration or chronic renal failure.^{7–9}

THE MIDDLE AGES (AD 500–1500)

Uroscopy reached new levels of diagnostic dominance during the Middle Ages, when nearly every condition or disease was identified with different features of urine.¹⁰ Theophilus Protospatharius, a seventh century physician, wrote *De Urinis*. This manuscript from Byzantium, was the first publication exclusively on the subject of urine. The book described a range of colors of 'the urines' and their implications. *De Urinis* remained influential throughout the Middle Ages.¹¹ Isaac Judaeus (AD 855–955), a Hebrew physician, published manuscripts that clarified Protospatharius' writings. Urine became unrivalled as a diagnostic tool.

Five hundred years after Galen, Protospatharius, who had the idea that adding heat to urine might present more insight, invented the first documented laboratory technique. Heat would precipitate proteins, causing proteinuria to manifest through cloudiness. Hundreds of years later, in the 16th century Paracelsus used vinegar to bring out cloudiness; acid, like heat, will precipitate or 'cook' proteins. A century later physician Fredrick Dekkers matched these laboratory findings to proteinuria,¹² which remains a useful diagnostic indicator today.

The technique of collecting urine was thought to be important for accurate interpretation. Ismail of Jurjani, an 11th century physician, recommended collecting the full amount over 24 hours in a large clean vessel and keeping it out of the sun or heat, which could alter color. The vessel was to be shaped in the form of a bladder, in the belief that a more accurate diagnosis would arise if the urine could

conform to the vessel in the same way that it conformed in the body. Ismail also recognized that food and aging altered urine, and required a good nights sleep and empty stomach before collection. He wrote about this in the most comprehensive instructional book on urine collection and examination. The teaching from Persia was dispersed throughout the world and was thought to reflect the best medical system for centuries.¹³

Gilles de Corbeil (1165–1213), royal physician to King Philippe-Auguste of France, built on Protospatharius' and Judaeus' writings. His teachings related 20 different types of urine to conditions of the body, he noted differences in sediment and color. De Corbeil also introduced the matula, also called a jorden, a glass vessel in which a physician viewed urine, assessing color, consistency, and clarity.¹⁴ Rounded at the bottom and shaped like a bladder, the matula was made of clear, thin glass, and was held up to the light for proper inspection.¹¹ It was to be held only in the right hand (Figure 1). De Corbeil believed that different parts of the vessel represented different areas of the body. The increasing complexity of uroscopy led to the creation of charts of all the urine categories. Originally these charts were only published in Latin, which allowed only the most educated to understand them (Figure 2). De Corbeil, who taught at the Medical School of Salerno, wrote a piece called, 'Poem on the Judgment of Urines,' in which he incorporated his ideas along with those of Protospatharius and Judaeus into a lyrical tune that made it easy for medical students to memorize. The poem remained popular for centuries. So did the matula, which become not only a tool, but as a badge of honor, a symbol that distinguished physicians in the same way that a white coat and stethoscope does today.²

During the 13th century, William of Saliceto, an Italian physician, noted and accurately described what would later be known as chronic nephritis.³ He stated, 'The signs of hardness in the kidneys are that the quantity of the urine is diminished, that there is heaviness of the kidneys, and of the spine with some pain: and the belly begins to swell up after a



Figure 1 | Physician holding matula into the light for inspection.



Figure 2 | A chart used to categorize urine.

time and dropsy is produced the second day.' In this case, the reduction of urine output together with other signs and symptoms, constituted an accurate diagnostic aid.

Urine diagnosis became increasingly popular. Patients and physicians thought it as a rational, painless way to distinguish and measure humoral imbalance. Urine offered a noninvasive method for evaluation.²

The potency of the matula as a symbol of medical powers also increased. In some European cities the matula would serve as a billboard.² Physicians would dress in long robes, and would make a ritual of holding the matula to the light and rotating it before confidently disclosing the patient's fate. This impressed the patient and instilled assurance in the physician's intelligence.¹⁵

Urine became the exclusive diagnostic tool, reigning superior to the pulse. Some physicians began to diagnose without ever seeing the patient. This lack of patient contact was controversial within the medical community (perhaps in the same way that physicians who prescribe over the Internet are castigated today). Some physicians, including Joannes Actuarius (1275–1328) from Constantinople, warned of the dangers of diagnosis based on urine alone. Actuarius, who became chief physician to the empire, wrote *On Urine*, a treatise so extensive that it was divided into seven books.

More sophisticated than previous scholars, Actuarius sought to explain metabolism by examining all waste, predominantly urine. He categorized urine into different kinds, diagnostic values, abnormalities, disease, and prognosis. Actuarius believed in physiology based on four humors, but modified the theory by classifying the body into four types of digestion, based on temperature. The four fundamental temperatures were sanguine, choleric, phlegmatic, and

melancholic. Urine stemmed from the third digestion. Yellow urine was considered healthy, darker urine was due to an increase in waste, and light urine was due to some type of bodily weakness.¹⁶ Actuarius also concentrated on urine's sediment, hypothesizing that the body's elements separated based on their densities. Fire and air, being light, rose to the top whereas the heavier elements earth and water would sink to the bottom. Therefore, a physician could detect imbalance area of the body by the abnormal region of the matula. Bubbles on the surface could represent a disparity in the head, whereas heavy sediment sinking to the bottom would indicate a lower extremity ailment.¹⁴ Actuarius altered the shape of his matula in an effort to refine diagnostic precision.

THE RENAISSANCE (1450–1600)

During the renaissance, uroscopy entered the household through the best selling book *Fasiculus Medicinae*, published in 1491 by Johannes de Ketham from Germany. De Ketham explained current theories and included a self-diagnostic color wheel, with which individuals could self-diagnose their condition.¹⁷ This book became exceedingly popular. Some authors have compared it to the *Merck Manual* (which is sold in consumer bookstores and arguably used more by consumers than physicians). During this era, physicians began to adopt aggressive therapies, treating many ailments with bloodletting and purging. Some patients turned away from doctors, relying instead on this home diagnostic tool. Two similar books in the 16th century self-diagnostic books became frequently used in place of medical treatments.¹⁷

Hippocrates believed that no harm should be done to the patient, used gentle therapies, and approached medicine with a holistic attitude. By the 15th century urinary diagnosis had transformed the patient–doctor dynamic. The author Voswinckel describes the situation, 'The belief in progress and the overestimation of instrument and experiment led to a deep change in both the understanding of disease and the relationship between doctor and patient.'¹⁷

An increasing number of physicians were diagnosing from urine alone; examination of the patient was seen as unimportant. Thomas Linacre, the founder of the College of Physician in London, was opposed to the primacy of urine diagnosis, and mockingly commented that if patients brought in a shoe instead of their urine, either specimen would have an equal chance of an accurate diagnosis.² Translations of scientific and medical manuscripts, previously available only in Latin made uroscopy accessible to more people. As texts circulated outside the circle of the university educated, laymen began to take on the roles of healers. The amateurs were called 'leches'; the term was used to describe any medicinal practitioners who were not physicians.

There were clear educational, social, professional, and economic distinctions between physicians and leches. Physicians held at least a bachelor degree in medicine, although most possessed a doctorate of medicine. Leches, on the other hand, had no formal training. Leches concentrated on practice and patient interaction. Physicians concerned

themselves with the philosophy of disease. Leches did not have the prestige or wealth of physicians, but they did not lack for customers. Some patients preferred the practical experience of a leche to the lofty knowledge of a physician. In general, however, it was the underprivileged population that saw leches most often. Leches diagnosed based only on the color of urine. Patients would seek to trick the leche by combining their urine with animals or with other people's urine in order to garner a desirable diagnosis (perhaps in the same way that a modern patient undergoing drug testing may submit a friend's urine for analysis). An oft-repeated story in the literature is that of a woman who combined her urine with cow urine, in hopes of avoiding a pregnancy diagnosis. Unfortunately, the leche announced that both she and her cow were pregnant.¹⁸ By the 17th century, the uses of uroscopy had spiraled far beyond the edge of reason. Physicians and leches started telling fortunes and predicting the future with urine, a practice known as 'uromancy'. Witch hunters mixed urine with nails to distinguish witches from non-witches. The abuses of urine finally caused a backlash. Activist and author Thomas Brian led a medical rebellion against all uses of uroscopy over the centuries. In 1637, Brian published the *Pisse Prophet*, a book that devastated uroscopy. Physicians seen with a matula became objects of ridicule. Those who used urine diagnoses were called pisse prophets, pissemongers, water-caters, pisse-procrastinators, and urinarians.¹⁹

CONCLUSION

Uroscopy was the mirror of medicine for thousands of years. From a liquid window through which physicians felt they could view the body's inner workings, urine led to the beginnings of laboratory medicine. As the role of physicians became elevated, the importance of urinary diagnosis became exaggerated, and increasingly complex, until physicians required only the presence of urine, not patients, to diagnose disease. Uroscopy then escaped medical control, becoming first a home health aid and then a tool of uneducated practitioners. Perhaps this exploitation led to the renuncia-

tion of uroscopy by the medical profession and in the end, uroscopy became a source of ridicule.

Today, uroscopy is no longer practiced, but urine analysis remains an effective diagnostic tool, with a long and colorful history.

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