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History of diabetes screening: from tasting urine to continuous glucose monitoring

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Abstract: Diabetes is a chronic disease caused by inadequate production of insulin by the pancreas or ineffective use of produced insulin by the body. In 2024, there were 589 million people have diabetes in the world, and 107 million people in the SEA Region; by 2050, this will rise to 185 million. In Nepal, 7.7% adults were found to have diabetes. There is a sharp increase in diabetic adults. The ancient Egyptian Ebers Papyrus, a medical text, mentions a condition similar to diabetes around 1550 BC. This described the condition as "Too great emptying of the urine". After that, around 600 BC-500BC (i.e., 5th /6th Century), an Ancient Indian physician noticed a similar condition and called as "Madhumeha". 10th-11th century, Avicenna, a Persian physician, described diabetes in "The Canon of Medicine" as abnormal appetite, decline in sexual function, sweet urine, and diabetic gangrene. 'Dextrometer' was developed for monitoring blood glucose at home. The haemoglobin A1C (HbA1c) was developed in the late 1960s and It was first used for monitoring glycaemic control in the 1970s and is now a standard tool for both diagnosing diabetes and monitoring long-term control. (CGM) The system was developed in the late 1990s and early 2000s.

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Introduction

Non-communicable diseases (NCDs) are the primary causes of disability and death. The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2021 estimated that NCDs already account for more than half of the global burden of disease. NCDs are also the leading causes of disease burden in China, and this burden is increasing due to the aging population and changes in lifestyles(1). Diabetes is a chronic disease caused by inadequate production of insulin by the pancreas or ineffective use of produced insulin by the body. Diabetes causes blindness, kidney failure, heart attacks, stroke and lower limb amputation. In 2021, diabetes and kidney disease due to diabetes caused over 2 million deaths. In addition, around 11% of cardiovascular deaths were caused by high blood glucose(2).

Diabetes is a vast and growing clinical and public health issue. The International Diabetes Federation (IDF) estimated that in 2024, there were 589 million people with diabetes in the world, and 107 million people in the SEA Region; by 2050, this is expected to rise to 185 million. In Nepal, 7.7% (1,259,100) out of 19,117,900 adults were found to have diabetes (3). By 2015, the number of diabetic adults was 415 million, and by 2024 reached 589 million, and by the end of 2040, it will reach 642 million diabetic adults (3& 3.1). The data indicated that there is a sharp increase in diabetic adults.

Diabetes includes 3 groups of diseases: type 1 diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes. Type I diabetes is diagnosed after hyperglycemia symptoms like polyuria, polydipsia, weight loss, and lethargy. Screening for type II diabetes can be done by fasting blood sugar, hemoglobin (A1C), glucose tolerance testing, and random blood sugar(4).

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Methodology: A Review of secondary data from different journals and articles related to the topic was conducted.

History of diabetes screening

The ancient Egyptian Ebers Papyrus, a medical text, mentions a condition similar to diabetes around 1550 BC. This described the condition as "Too great emptying of the urine". After that, around 600 BC-500BC (i.e., 5th /6th Century), an Ancient Indian physician noticed a similar condition and called as "Madhumeha" or "Honey urine" as it attracted ants(5). The term "Diabetes" was coined by the ancient Greek Physician Apollonius of Memphis around 250 BC. It was derived from the Greek word 'Diabainein', meaning 'to pass through'. described the condition as 'excessive and continuous flow of urine'. It was best described by Aretaeus of Cappadocia in 2nd century as 'melting down of the flesh and limbs into urine'. Similarly, during the 10th-11th century, Avicenna, a Persian physician, described diabetes in "The Canon of Medicine" as abnormal appetite, decline in sexual function, sweet urine, and diabetic gangrene(5).

During the 17th century, Thomas Willis added the word 'Mellitus' (meaning 'honey' in Latin) to the word 'Diabetes'. He tasted the urine of patients to confirm its sweetness. Similarly, during the 18th century, Mathew Dobson confirmed the presence of excess sugar in the blood and urine of the patient. Understanding and concept of Diabetes shifted from a kidney problem to a systemic disease(5).

Screening for diabetes keeps developing towards every century. In the mid-19th century, chemical tests using copper reagents were developed to detect glucose in urine. From the 20th Century, modern ways for screening diabetes were developed. Screening of diabetes through Urine Test Strips (named as 'dip and read') was developed in the 1950s. In 1965, the first blood glucose test strip (named 'Dextrostix') was developed. A drop of blood was placed on the strip and a colour change determined the blood glucose. Initially, that was used in a doctor's

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office(6). Similarly, in the 1970s, Anton Hubert Clemens invented the first blood glucose meter, which was able to read the change in colour of the Dextrostix strip and provide a result in numeric form. These were large, expensive and used in a clinical setting. In the 1980s, 'Dextrometer' was developed for monitoring blood glucose at home(4).

The haemoglobin A1C (HbA1c) was developed in the late 1960s. The A1C test measures the average blood glucose level over the previous two to three months by looking at the percentage of haemoglobin in red blood cells that is coated with glucose. It was first used for monitoring glycaemic control in the 1970s and is now a standard tool for both diagnosing diabetes and monitoring long-term control(6). The Continuous Glucose Monitoring (CGM) system was developed in the late 1990s and early 2000s. The first CGM allowed healthcare providers to download a patient's glucose data. Later versions like the 'Medtronic Guardian' and 'Dexcom G-series' provided real-time glucose readings to the patient. These devices, which use a small sensor inserted under the skin, have transformed diabetes management by providing a continuous picture of glucose levels and alerting users to dangerously high or low readings(4).

Conclusion

Diabetes is a chronic disease caused by inadequate production of insulin by the pancreas or ineffective use of produced insulin by the body. Diabetes includes 3 groups of diseases: type 1 diabetes mellitus, type 2 diabetes mellitus, and gestational diabetes. Type I diabetes is diagnosed after hyperglycemia symptoms like polyuria, polydipsia, weight loss, and lethargy. Screening for type II diabetes can be done by fasting blood sugar, hemoglobin (A1C), glucose tolerance testing, and random blood sugar. This study shows how our understanding and diagnosis of diabetes have evolved dramatically over thousands of years. It began with ancient civilizations observing symptoms like excessive urination and sweet-tasting urine. Over time, the condition shifted from being seen as a kidney problem to a systemic disease involving blood sugar. The development of diagnostic methods progressed from simply tasting urine to chemical tests, and

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eventually to modern, sophisticated tools like continuous glucose monitors and the HbA1c test, which have modernized the ability to both diagnose and manage the condition.

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