Artificial Intelligence in Health Care and Drug Discovery for Hepatitis.

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ABSTRACT:

Hepatitis is a viral disease which represents a major damage to public health and it globally leads to cause of death. Hepatitis is classified into five specific types – Hepatitis A virus, Hepatitis B virus, Hepatitis C virus, Hepatitis D virus, Hepatitis E virus. Each type has specific differences like transmission, risk, pathophysiology, complications, etc. In 2016, the WHO released its plan to eliminate viral hepatitis as a public health threat by the year 2030, along with a discussion of current gaps and prospects for both regional and global eradication of viral hepatitis. AI offers hope and promises to use improved diagnosis for treatment strategies. Advances in Artificial Intelligence have created new opportunities to improve the prevention detection, diagnosis, treatment and monitoring of hepatitis across different health care settings. AI techniques, including machine learning, deep learning and natural language processing can rapidly evaluate diverse sources of medical information such as electronic health records, biochemical investigation, radiological images, pathology findings and viral genomic data. These technologies assist in identifying infected individuals, assessing the extent of liver injury, predicting fibrosis progression, estimating the likelihood of treatment success and recognising patients who have increased risk of serious complications. Further most AI contributes to public health by improving hepatitis surveillance, enhancing large scale screening program, identifying vulnerable populations and supporting timely preventing interventions.

AI assisted Clinical Decision Support System (CDSS) is the technology where AI can scan patient reports (laboratory results, imaging and electronic health records) and provide diagnostic suggestions, treatment recommendations and preventive guidance. The recommendations are reviewed by health care professionals- they are not a replacement for a doctor’s judgement.

KEY WORDS:

Artificial Intelligence (AI), Hepatitis, Machine learning, Deep learning, Drug discovery, Clinical Decision Support System (CDSS), Disease Diagnosis, Medical Imaging, Electronic Health Records (EHR), Predictive analytics, Health care technology.

INTRODUCTION*:*

AI is advancing in hepatitis drug discovery by accelerating drug repurposing, predicting viral behaviour and optimizing molecule design. According to different algorithms of AI, AI is usually divided into traditional AI and deep learning used in the medical field. AI technology based on the data mining or radiology in determining the hepatitis and diagnosing benign and malignant liver masses. The clinical utility in routine practice of AI based on data mining predict the hepatitis A, B, C, or E divided into different stages of hepatitis B, predict the progression of hepatitis C in veterans and diagnose.

With the digitization of medical records, clinical trials, precision medicine, drug discovery and health policy will be able to benefit from data driven rest methods. Due to recent progress, there is a great interest in the application of artificial intelligence (AI) methods to improve various stages to drug discovery pipeline including de novo molecular design and pre-clinical and clinical development.

Hepatitis is a disease caused by viral infections, alcohol, drugs, autoimmune diseases or toxins effecting the liver resulting in inflammation, swelling and causes severe liver dysfunction. The cause might also be by communicable or non-infectious sources. Hepatitis can be differentiated based on epidemiology, structure, time of incubation, natural history, mode of transmission, diagnosis and prevention. It is categorised into five types based on the severity of the infection- Hepatitis A, Hepatitis B, Hepatitis C, Hepatitis D, Hepatitis E.

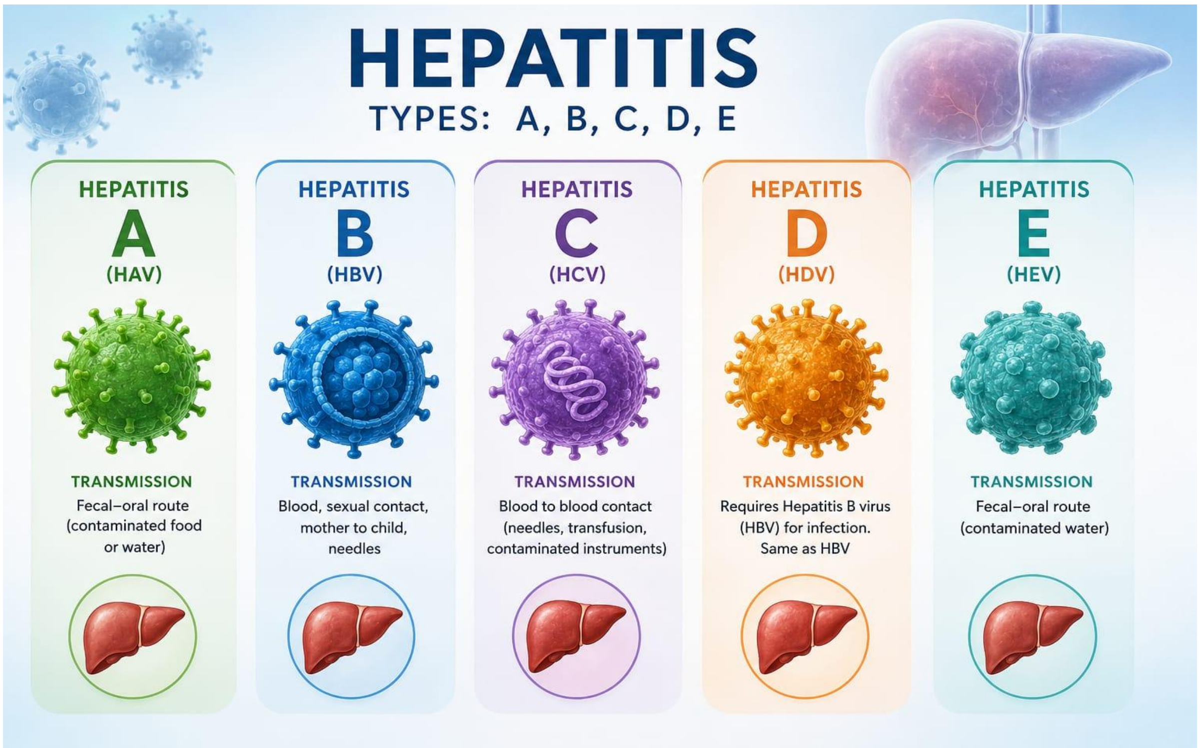

Figure 1: Types of Viral Hepatitis (A–E) and Their Major Routes of Transmission

HEPATITIS A (**HAV**):

It is an initial primary world-wide health concern which most particularly seen in Africa, Asia and Latin America because of unhygienic standards and sanitation. The HAV is responsible for estimation of above 1.3 million infections each year and up to 8,240 accounting 0.5% mortality. It is highly contagious and short term or acute liver infection. The most usually seen symptoms are abrupt nausea and vomiting, exhaustion, discomfort near liver, clay colour faeces, lack of appetite, low grade fever, joint pain, jaundice etc. It is majorly transmitted by contaminated food and drinks in which faecal matter carrying the virus. But it can also be transmitted from person to person.

HEPATITIS B (**HBV**):

Chronic hepatitis B is a substantial world-wide health hazard. Hepatitis B is a DNA virus infection of the liver caused by HBV. It spreads through blood, sexual contact and vertical transmission. Acute infection may cause jaundice, while chronic infection can lead to cirrhosis and Hepatocellular carcinoma. Diagnosis based on HBV DNA testing. First line treatment includes Tenofovir and Entecavir. Prevention is mainly by recombinant HBV vaccination and safe medical practices.

HEPATITIS C (**HCV**):

Hepatitis C virus (HCV) has been shown to be responsible for the 90 % of blood transfusion-related cases of Hepatitis as well as called Non -A, Non -B Hepatitis. It is the most common blood – borne infection. Some may develop to chronic or long lasting, which can also lead to cirrhosis and liver cancer. It is mainly caused by virus entering into blood and body fluids is in contact of transmission. The WHO aims to eliminate HCV as a public health threat by 2030 through improved diagnosis, treatment and prevention strategies. Preventive measures include safe infection control practices, blood screening and as there is currently no vaccine for Hepatitis C, avoiding exposure to infected blood.

HEPATITIS D (**HDV**):

Hepatitis D is a liver infection caused by the HDV which causes liver inflammation and damage, a defective RNA virus that requires Hepatitis B virus to replicate. This occurs only in individuals infected with HBV and can lead to severe liver damage, cirrhosis and liver cancer. The virus spreads through contact with infected blood and contaminated needles and unprotected sexual contact. Diagnosis is confirmed by detecting anti -HDV antibodies and HDV RNA. Treatment includes interferon – alpha, newer drugs like Tenofovir alafenamide. Hepatitis B vaccination is most effective to prevent Hepatitis D.

HEPATITIS E (HEV):

It is an acute liver disease caused by HEV, which is mainly transmitted through contaminated water and poor sanitation. Most infections are self -limiting and recover without specific treatment, but pregnant women and individuals have high risk of severe disease. Treatment is mainly supportive and ribavirin may be used in selected chronic cases and prevention includes safe drinking water, sanitation, proper hygiene and vaccination where available.

AI ON HEPATITIS:

AI is an existing new discipline which promote, stimulate or expand human intelligence and integrates theory, language, research and development. AI may improve the knowledge with specialized machine learning. Based on different algorithms of AI, AI is usually divided into two Traditional Machine Learning and Deep Learning in the medical field.

Compared with traditional machine learning, deep learning automatically learns features from images without requiring manual feature extraction, whereas traditional machine learning requires manual feature extraction. With the digitalization of medical records, clinical trials, precision medicine, drug discovery and health policy will be able to benefit from data driven methods. Due to recent progress, there is a great interest in the application of AI methods to improve various stages to drug discovery pipeline, including de novo molecular design, pre-clinical and clinical development. Artificial Intelligence is mainly applied in Hepatitis A to improve early detection and outbreak monitoring.AI systems evaluate clinical symptoms, liver function test results, environmental conditions, sanitation status and population to identify areas that may experience an outbreak. These predictions help public health officials implement preventive measures, such as vaccination campaigns and sanitation improvements, before the infection spreads widely. Since Hepatitis A usually resolves without specific anti-viral treatment, AI is used for disease surveillance and patient risk assessment rather than treatment selection.

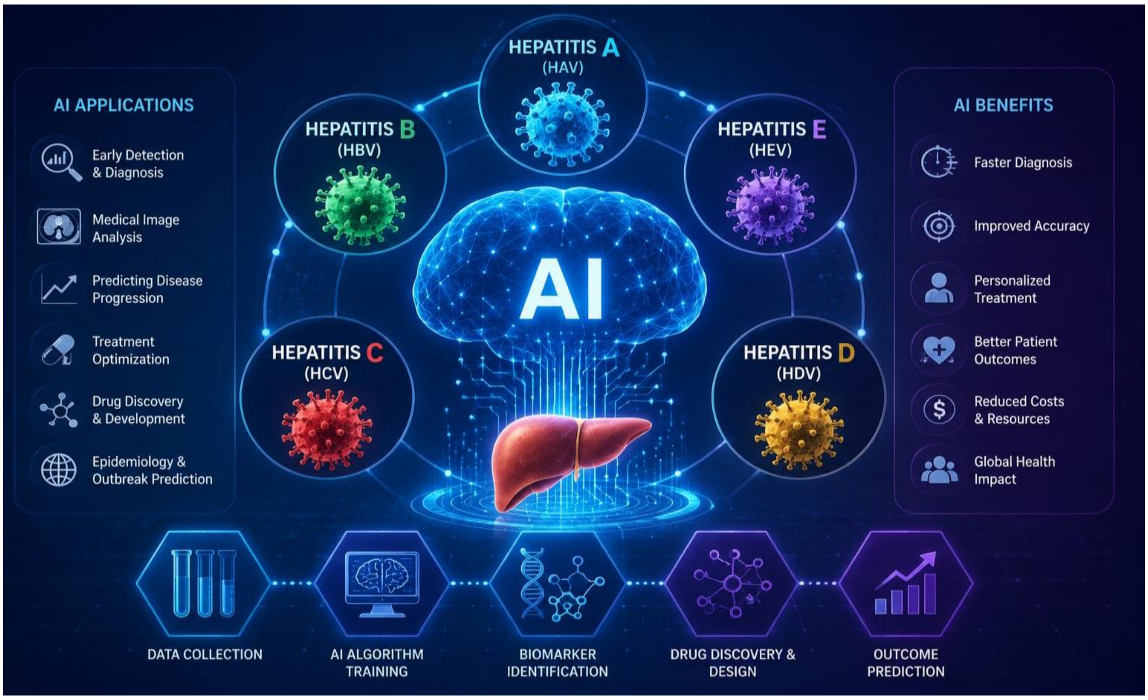

Figure 2: Applications of Artificial Intelligence in Viral Hepatitis Diagnosis, Prognosis, Treatment, and Drug Discovery

In Hepatitis B, AI has become an important tool for diagnosis, disease monitoring and treatment planning. Machine learning algorithms examine laboratory findings, viral load, liver enzyme levels and medical imaging to detect liver injury and estimate the severity of Fibrosis or Cirrhosis. AI can also identify individuals who have a higher chance of developing Hepatocellular Carcinoma (HCC). By analysing specific data, AI assist clinicians in predicting the effectiveness of anti-viral medications, including Tenofovir, allowing treatment to be tailored to each patient. Furthermore, AI supports drug discovery by identifying promising anti-viral compounds and acceleration of new therapies. AI plays a valuable role in the management of Hepatitis C by supporting accurate diagnosis and individualized treatment. It analyses laboratory reports, viral load measurements and liver imaging to detect infection and evaluate liver damage. Deep learning techniques can recognize different stages of fibrosis and cirrhosis from medical images with high accuracy. AI also estimates the livelihood that a patient will respond successfully to direct acting anti-viral (DAA)therapy, helping clinicians choose the most suitable treatment strategy. In addition, AI speeds up the search for new antiviral drugs by identifying potential drug candidates and predicting their biological activity.

For Hepatitis D, AI is mainly used to identify HBV-HDV coinfection and evaluate the severity of liver disease. By processing laboratory results, imaging findings and clinical information, AI models can estimate disease progression and the risk of liver related complications. AI also supports treatment monitoring and contributes to research by helping scientists discover new anti-viral targets and evaluate potential therapeutic agents. In hepatitis E, AI is applied in disease surveillance and outbreak forecasting. Machine learning models assess environmental and epidemiological information, including rain fall, water quality, sanitation and population density, to estimate the probability of future out breaks. AI also assist healthcare professionals in diagnosing infection using laboratory findings and identifying patients who are more likely to develop severe disease particularly pregnant women. Ongoing research is exploring the use of AI to support vaccine development and identifying new treatment options.

AI for Scanning Hepatitis Patient Reports to support Diagnosis, Treatment and Prevention:

Artificial Intelligence is playing an increasingly important role in the management of hepatitis by analysing patient reports and assisting health care professionals in clinical decision making. AI systems can rapidly examine laboratory reports, liver function test, hepatitis serology, viral load results, complete blood count, Fibro Scan findings, ultra sound, CT or MRI images, liver biopsy reports and electronic health records. By combining information from these sources AI identifies disease related patterns and provides a detailed evaluation of the patient's liver condition. For diagnosis, AI compares the patient's clinical data with information learned from large medical databases. This enables the system to recognise different types of viral hepatitis, estimate the severity of liver damage and detect complications such as fibrosis, cirrhosis, or hepatocellular carcinoma. Early identification of these abnormalities helps physicians make faster and more accurate diagnostic decisions.

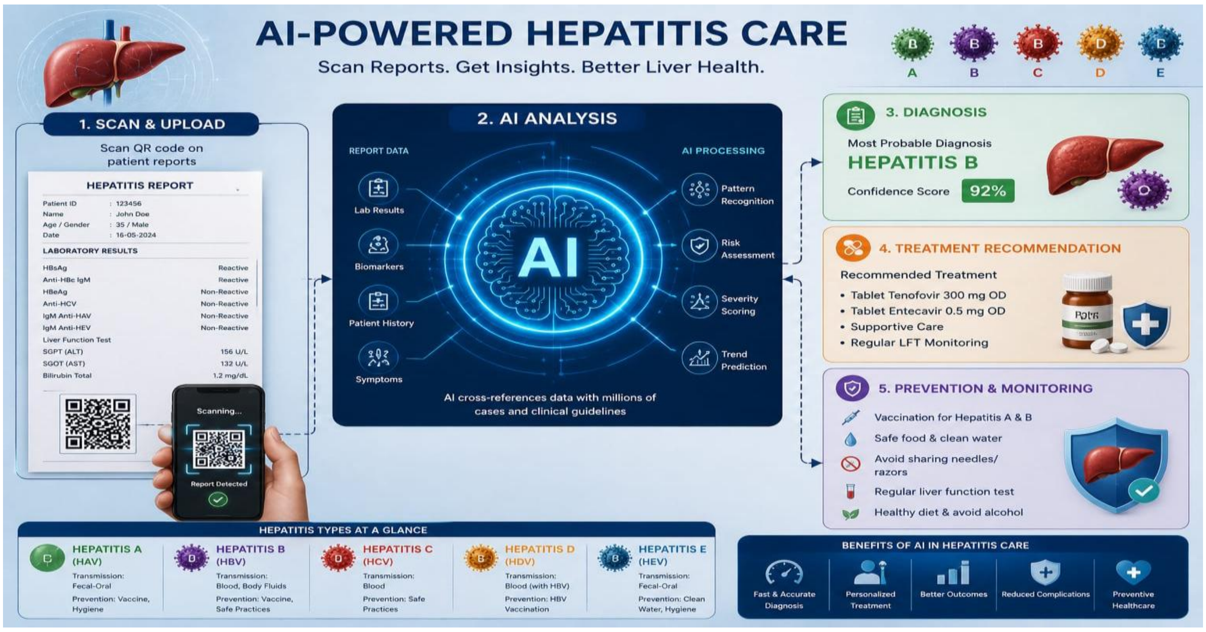

Figure 3: AI-Powered Workflow for Hepatitis Patient Data Analysis, Diagnosis, Treatment Support, and Prevention

AI also provides supportive treatment planning by analysing disease stage, viral load, laboratory findings and the patient's medical history. Based on these data, AI can predict the likely response to antiviral therapy and assist clinicians in selecting the most appropriate treatment approach for each patient. During follow-up, the system continuously reviews new laboratory reports and imaging results to monitor treatment response, identify disease progression and detect possible adverse drug reactions or complications. Although AI provides valuable recommendations, the final treatment decision is always made by healthcare professionals. In addition to diagnosis and treatment, AI contributes to hepatitis prevention.it can identify individuals who are at high risk of infection or disease progression, recommend early screening, support vaccination programmes and monitor public health data to detect disease trends. These applications enable earlier intervention and improve disease control within the community.

Overall, AI serves as a powerful clinical decision-support tool by analysing hepatitis patient reports, improving diagnostic accuracy, assisting in personalised treatment planning and strengthening preventive healthcare strategies. Its integration into clinical practice has the potential to improve patient outcomes while supporting physicians in delivering timely and effective medical care.

AI-BASED ANALYSIS OF QR CODE LINKED MEDICAL REPORTS FOR HEPATITIS DIAGNOSIS, TREATMENT, PREVENTION.

Artificial intelligence (AI) is transforming healthcare by enabling faster, more accurate and data-driven clinical decision -making. When in integrated with electronic health records (HER) and QR code technology, AI allows healthcare professionals to access and analyse patient information efficiently. In many hospitals and diagnostic laboratories, QR codes are printed on laboratory reports or discharge summaries. These QR codes do not diagnose directly, instead they provide secure access to a patient's digital medical records. After scanning the QR code using an authorized application, AI algorithms can retrieve laboratory finding, imaging reports, previous treatment records, medication history and demographic information for comprehensive clinical analysis.

RETRIEVEL AND ANALYSIS OF PATIENT CLINICAL DATA:

Once the patient's data are retrieved, AI processes multiple clinical parameters simultaneously. It can evaluate liver function tests, including alanine aminotransferase (GGT).AI also interprets hepatitis serological markers such as HBsAg, anti-HBc, anti-HDV, anti-HAV I and anti-HEV antibodies. Viral nucleic acid test results, including HBV DNA and HCV RNA levels, are also incorporated into the analysis. By combining these laboratory findings with patient history, AI provides a more complete clinical assessment than evaluating each test individually.

MACHINE LEARNING FOR HEPATITIS CLASSIFICATION:

Machine learning models are trained using thousands of clinical records from hepatitis patients. These algorithms recognize complex relationships among laboratory values, imaging findings, and patient characteristics that may not be immediately apparent to clinicians. Based on these learned patterns, AI estimates the likelihood of hepatitis infection and helps distinguish between hepatitis A, B, C, D and E. The technology can also identify whether the infection is acute or chronic and estimate the degree of liver inflammation and damage.

For hepatitis B and hepatitis C, AI assists in determining disease activity by analysing viral load, liver enzyme levels, fibrosis scores, and imaging results. Predictive models estimate the risk of disease progression, allowing clinicians to identify patients who may develop liver fibrosis, cirrhosis, portal hypertension, or hepatocellular carcinoma. Early identification of high-risk patients allows timely intervention and improves long term clinical outcomes.

AI ASSISTED MEDICAL IMAGING ANALYSIS:

AI also supports interpretation of medical imaging. Deep learning algorithms analyse liver ultra sound, computed tomography (CT), magnetic resonance imaging (MRI) and transient elastography (fibro-scan) images to detect fibrosis, cirrhosis, fatty liver disease and liver tumours. Automated image analysis reduces observer variability and improves consistency in identifying abnormal findings. AI generated imaging reports can assist radiologist by highlighting suspicious areas that require detailed clinical evaluation.

CLINICAL ASSISTED SUPPORT SYSTEM:

Another important application is clinical decision support system. AI integrates laboratory results, patient age, medical history and current treatment guidelines to assist physicians in selecting appropriate diagnostic investigations and therapeutic strategies. Decision–support systems recommend additional laboratory tests, suggest referral to hepatology specialists, or identify patients requiring urgent intervention. These recommendations enhance clinical efficiency while allowing physicians to make the final medical decision.

AI contributes significantly to individualized treatment planning. Patient-specific factors such as viral genotype, disease severity, kidney function, liver function, previous antiviral therapy and coexisting diseases and analysed together. Using Predictive models, AI estimates the probability to treatment success and helps clinicians select the most appropriate antiviral load reduction, enabling early identification of treatment failure, drug resistance, or adverse drug reactions.

Continuous monitoring is another major advantage of AI based healthcare systems. Every new laboratory report uploaded through the hospital information system becomes available automated analysis. AI compares current finding with previous reports to identify subtle changes that may indicate disease progression or recovery. If liver enzymes suddenly increases or viral load rises unexpectedly, automated alerts can notify healthcare providers, allowing prompt clinical evaluation before severe complications develop.

AI IN HEPATITIS PREVENTION AND RISK IDENTIFICATION:

AI also improves preventive healthcare by identifying individuals at increased risk of viral hepatitis. Predictive logarithms evaluate demographic factors, lifestyle behaviours, travel history, occupational exposure, previous blood transfusion, injection drug use and family history to estimate the likelihood of infection. Individuals identified as high-risk can be recommended for hepatitis screening, vaccination, or preventive counselling. Early screening reduces delayed diagnosis and limits disease transmission within the community.

Medication adherence is another area where AI contributes significantly. Digital health platforms linked to QR code-based patient records can automatically remind patients to take antivirals medications. Patients should attend follow-up appointments, undergo recommended laboratory investigations and receive appropriate vaccinations as recommended. AI can monitor treatment compliance and notify healthcare providers if patients repeatedly miss appointments or discontinue medication. Improved adherence increases treatment effectiveness and decreases the risk of disease progression.

Population-level healthcare also benefits from AI. By analysing anonymized healthcare databases, AI identifies geographical regions with increased hepatitis prevalence, detects changes in disease trends, predicts future health care demands and supports public health planning. Health authorities can use these analyses to organise health vaccination campaigns, allocate medical resources efficiently and strengthen surveillance programs during out breaks.

BENEFITS OF QR CODE LINKED AI HEALTHCARE SYSTEM:

The integration of QR code technology further enhances healthcare efficiently. Instead of carrying multiple paper reports, patients can provide healthcare professionals with immediate access to their digital records through a single QR code. This reduces paper work, minimizes transcription errors, shortens waiting time and improves communication between laboratories, hospitals and physicians. AI rapidly processes the retrieved information and presents clinically meaningful summaries, allowing faster medical decision making.

CHALLENGES AND LIMITATIONS:

Despite these advantages, several limitations remain. AI systems depend on accurate, complete, and standardized clinical data. Missing laboratory values, incorrect patient information, or poor-quality imaging can reduce the accuracy of AI predictions. Protecting patient privacy and maintaining cyber security are also essential because digital medical records contain sensitive personal information. Healthcare organisation must implement secure encryption, authentication systems and regulatory safe guards before widespread clinical adoption.

Another challenge is algorithm bias. AI models trained using limited or non-diverse patient populations may perform less accurately in different ethnic groups or healthcare settings. Therefore, AI systems should undergo continuous validation using diverse clinical datasets before implementation. Transparency in AI decision-making is equally important so that clinicians understand the basis of AI recommendations.

FUTURE PERSPECTIVES:

Figure 4: AI-Assisted Analysis of QR Code-Linked Medical Reports for Hepatitis Diagnosis, Treatment Support, and Prevention

Although AI significantly improves diagnostic accuracy, treatment planning, disease monitoring and preventive care, it should not replace clinical expertise. Physicians remain responsible for interpreting AI-generated recommendations in the context of each patient's medical condition. Human judgement, clinical examination and patient preference continue to play essential roles in healthcare decision-making.

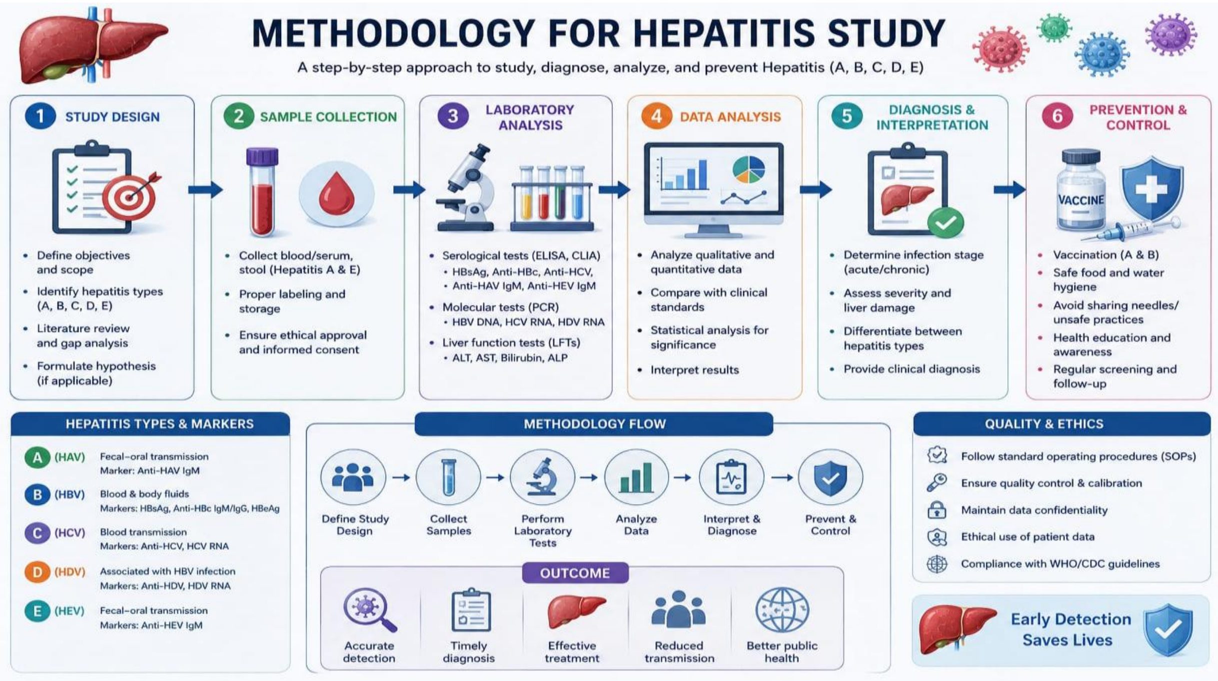

Figure 5: Methodological Workflow for Hepatitis Research: Study Design, Sample Collection, Laboratory Analysis, Data Interpretation, Diagnosis, and Prevention

Future developments are expected to combine Artificial Intelligence with wearable devices, remote patient monitoring systems, cloud computing, telemedicine platforms and genomic medicine. These integrated technologies may allow continuous monitoring of hepatitis patients, earlier identification of disease progression, personalized treatment recommendations and improved long-term patient outcomes. As digital healthcare continues to evolve, AI-assisted analysis of QR code-linked medical records is likely to become an important component of precision medicine for viral hepatitis.

CONCLUSION:

AI is becoming an important support in the prevention, diagnosis, treatment and drug discovery in viral hepatitis. By combining machine learning, deep learning, medical imaging, laboratory investigations, electronic health records, QR code-linked patient data, AI can improve diagnostic accuracy, assist in personalised treatment planning, monitor disease progression and support public surveillance. AI also accelerates the identification of potential drug candidates, reducing the time and cost involved in developing new therapies.

Although AI offers significant advantages, it's effectiveness depends on the availability of high-quality clinical data, secure data management and careful validation of AI models across diverse patient populations. AI should be viewed as a clinical decision support system rather than a replacement for a healthcare professionals, as expert medical judgement remains essential for patient care.

With continued advances in digital health technologies, AI has the potential to transform hepatitis management through earlier detection, precision medicine, improved treatment outcomes and more efficient healthcare delivery. Future research should focus on developing reliable, transparent, ethically responsible AI systems that can be integrated into routine clinical practice to support global efforts towards the elimination of viral hepatitis.

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