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Drug-Delivery Systems in eMedicine and mHealth

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16.1 Introduction

In recent years, a more significant number of people are suffering from severe life-threatening health conditions and chronic diseases worldwide, including cardiovascular diseases (hypertension, heart attack, and stroke), cancer, diabetes, melancholia, malignant lymphoma, and septicemia [1]. Some experts in the field of medical and biological sciences

have a view that the primary key to controlling or even eliminating such high-risk disorders is by performing early detection and treatment of such diseases [2–3]. The administering of drugs plays a role in the treatment regimens of most of these diseases.

Currently, conventional ways of delivering drugs (i.e., oral tablets or injections) are used in treating most medical illnesses [4]. However, this method has several key disadvantages [5]:

- Some drugs are not completely absorbed from the gastrointestinal tract due to solubility issues or significant first-pass hepatic metabolism that may occur after the administration of the drug.
- The instability of drugs occurs in the gastrointestinal system (GITS).
- The efficacious concentrations of drug products in the targeted areas require systemic concentrations that can lead to toxicity or unwanted side effects.
- In order to achieve effective drug treatment, sustained and controlled manner of drug release must be maintained for periods longer than 24 h.
- Some drugs may lose their potency within a short period of time, which could lead to ineffective results.

Thus, we may conclude that these conventional methods are not effective in controlling levels of drug-delivery treatment [6–7].

Given these weaknesses, and the general dearth of progress in treatment efficacy for severe diseases, there is a growing need to develop a new approach to delivering drugs in a more targeted manner to desired tissue areas [8]. Drug-delivery methods are important because the efficacy of the drug is significantly affected by the choice of methods for delivering the drug into a human body [9]. Furthermore, a drug may not produce beneficial results and may have unwanted side effects when the wrong concentration of the drug (either lower or higher than the maximum allowable concentration) is given to a patient [9].

A drug-delivery system (DDS) refers to a group of recent technological developments in drug delivery that aim to offset the weaknesses of conventional drug-delivery methods. The key desirable feature of a DDS is the capability to control the release of the drugs at specific areas inside the body and/or at particular periods of time [10], so that patients have their physiological or pathological requirements fulfilled better than before [7,11–12].

This feature forms the basis of DDS's advantages, such as the potential for decreasing frequency of drug dosage and improving the patient compliance of medication [13], maintaining drug concentration within the therapeutic interval by reducing in vivo drug concentration fluctuation [14], and reducing some of the unwanted side effects [15–17] by locally delivering the drugs exactly at the targeted areas (either at the disease sites or in the affected cells) [18–19], as well as enhancing the bioavailability of drug products by reducing or delaying premature degradation of a drug and intensifying the uptake of a drug [19]. Drug-delivery systems has become one of the most prominent research subjects in the fields of medicine and healthcare. Twenty-five years ago, in 1990, the Food and Drug Administration (FDA) approved the first liposomal DDS amphotericin B [20]. Since then more than 10 DDSs have been commercially released for different treatments ranging from cancer to muscular degeneration (as shown in Table 16.1) [20].

The use of DDSs appears to be a valuable method in improving the efficacy of drugs by relieving pain in patients suffering from prolonged critical illnesses [19]. Their availabilities have even influenced the economics of drug development [19]. Taking a step forward to transform existing drugs into controlled release formulations may lead to the enhancement