to create "magic bullets" on which drugs were loaded and would kill all pathogens after only a particular treatment [48].

In the late 1970s, targeted drug delivery by using nanoparticles was still exploring and facing lots of limitation of the nonbiodegradability of the polymers which are used for their synthesis such as polyacrylamide [52] or polymethylmethacrylate [49]. Hence, at that time, the applications of nanoparticles in medicine for systemic therapeutic treatment for humans remained an unapproachable dream. Robert A Freitas gave the term "Nanomedicine" and has established it with the publication of a book and since then it has been used in the technical literature [12].

3. TYPES OF NANOPARTICLES USED FOR THERAPEUTIC TREATMENT

Nanoparticles are used for drug delivery systems are submicronsized particles size ranges from 3 to 200 nm or devices that are designed by using various materials including lipids (liposomes), polymers (polymeric nanoparticles, micelles, or dendrimers), and even organometallic substances. Nanoparticles-based drugs used for targeted delivery reduces the toxicity and side effects to improve the therapeutic index of the targeted drug. The nanodrugs are beneficial because they have similar size as biomolecules such as receptors, antibodies, and nucleic acids [53]. The approach of targeted drug delivery by nanosizing of drugs has numerous advantages as reported by McNeil [54] which has shown in Fig. 2.

3.1. Metal and Metal Oxide Nanoparticles

Metal nanoparticles have a wide application not only in the medical field for drug delivery but also in electronics, optics, fluorescent materials, biosensors, and catalysts. Metal nanoparticles are used alone or as a carrier with drugs and bioactive herbal extracts and represented as a promising candidate in drug delivery applications because of their size, biocompatibility, targeted, and controlled drug release [55,56]. The nanoparticles which are commonly used for therapy are magnetic nanoparticles (iron oxide), gold and silver nanoparticles, nanoshells, and nanocages have been continuously used and modified to enable their use as a diagnostic and therapeutic agent.

Iron oxide (FeO) is an inorganic compound and occurs naturally as the mineral magnetite which is superparamagnetic in nature. Superparamagnetic iron oxide nanoparticles (SPION) are using for several biomedical applications because of their ultrafine size and magnetic properties. The medical application of SPIONs such as to enhance resolution contrast agents for magnetic resolution imaging (MRI), as a drug carrier and imaging, gene therapy, stem cell tracking, molecular/cellular tracking, magnetic separation technologies (e.g., rapid DNA sequencing) hyperthermia for cancer treatment, early detection of inflammatory, cancer, diabetes, and atherosclerosis [57–66]. Polyethyleneimine (PEI)-modified magnetic nanoparticles (GPEI) are used as a potential carrier targeted delivery of vascular drug/gene to brain tumors [67]. According to the studies by Alexiou et al., complete tumor reduction in tumor-bearing rabbits have been observed by using magnetic

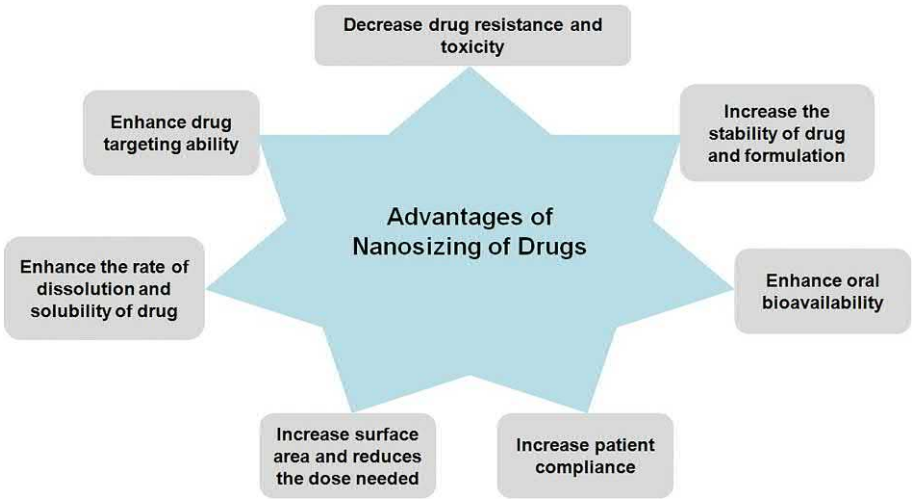

FIG. 2 Diagrammatic representations of advantages of nanosizing of drug.