severely impedes their ability to effectively clear the aerosol created and stored in a holding chamber such as that used by Exubera® (Nektar, San Carlos, CA).

Nebulizers, such as the jet nebulizers, produce a fine aerosol mist/droplets which carry the drug either as a suspension or dissolved in the aqueous medium. The jet nebulizers use compressed air to atomize the aqueous solution. The flow rate of the compressed air should be matched to the inhalation flow rate of the patient for optimum delivery of the drug. The patient can be administered the drug with repetitive non-forced inhalation over a prolonged period of time. The amount of drug delivered is influenced by a large number of factors such as viscosity, volume of drug fill, surface tension, inhalation flow, etc. The amount of drug delivered ranges from 3% to 6% for pediatric patients and 3% to 13% for adults. For pediatric delivery the nebulizers are normally coupled to a face mask. Since the nebulizer continues to produce the aerosol during the exhale cycle of the breath this leads to drug wastage, increased exposure of the drug to the patient's face and eyes and also to the care-giver. The disadvantages of nebulizers in general are their poor efficiency of delivery to the patient, a requirement for a compressor or compressed air and long delivery times, on the order of 5 to 15 minutes, etc.

Thus there is a need for a delivery mechanism for infants and young children, and also for respiratory compromised patients that overcomes the aforesaid and other disadvantages of the prior art, in a manner that delivers the drug efficiently, does not require inhalation co-ordination, operates under low inhalation volume, minimizes the exposure of the care giver to the drug, delivers the drug in a short time (preferably less than a minute), and is low cost and portable.

According to a first aspect, there is provided a device for delivering dry powder medication to infants and respiratory-compromised patients, ventilated patients or unconscious patients, comprising a housing defining an aerosol chamber into which an aerosolized medication may be introduced; an outlet for said chamber; a facemask connected to the outlet; a nebulizer including a vibratory element for aerosolizing said dry powder medication and introducing aerosolized medication into the chamber; a microprocessor and control for the vibratory element; a manual actuator for permitting a

patient, a user, or a caretaker to activate the vibratory element, wherein said manual activation of the vibratory element introduces a controlled amount of medication into the chamber independent of the infant's or respiratory-compromised, ventilated or unconscious patient's inhalation strength, rate and timing; a sensor for sensing an inhalation and/or exhalation cycle of the infant or patient; and a controller for controlling the vibratory element over two or more inhalation cycles.

According to a second aspect, there is provided a device for delivering dry powder medication to infants and respiratory-compromised patients, ventilated patients or unconscious patients, comprising a housing defining an aerosol chamber into which an aerosolized medication may be introduced; an outlet for said chamber; a nasal cannula connected to the outlet; a nebulizer including a vibratory element for aerosolizing said dry powder medication and introducing aerosolized medication into the chamber; a microprocessor and control for the vibratory element; a manual actuator for permitting a patient, a user, or a caretaker to activate the vibratory element, wherein said manual activation of the vibratory element introduces a controlled amount of medication into the chamber independent of the infant's or respiratory-compromised, ventilated or unconscious patient's inhalation strength, rate and timing; a sensor for sensing an inhalation and/or exhalation cycle of the infant or patient; and a controller for controlling the vibratory element over two or more inhalation cycles.

According to a third aspect, there is provided a device for delivering dry powder medication to infants and respiratory-compromised patients, ventilated patients or unconscious patients, comprising a housing defining an aerosol chamber into which an aerosolized medication may be introduced; an outlet for said chamber; a mouthpiece connected to the outlet; a nebulizer including a vibratory element for aerosolizing said dry powder medication and introducing aerosolized medication into the chamber; a microprocessor and control for the vibratory element; a manual actuator for permitting a patient, a user, or a caretaker to activate the vibratory element, wherein said manual activation of the vibratory element introduces a controlled amount of medication into the chamber independent of the infant's or respiratory-compromised, ventilated or

unconscious patient's inhalation strength, rate and timing; a sensor for sensing an inhalation and/or exhalation cycle of the infant or patient; and a controller for controlling the vibratory element over two or more inhalation cycles.

According to a fourth aspect, there is provided a propellant free device for delivering nebulized dry powder medication to an inhaled airstream of an infant and a respiratory-compromised patient, a ventilated patient or an unconscious patient, comprising a vibratory element for aerosolizing the dry powder medication and introducing the medication into the airstream, a facemask into which the airstream is introduced; a microprocessor and control for the vibratory element; a manual actuator for permitting a patient, user or a caretaker to activate the vibratory element, wherein said manual activation of the vibratory element introduces a controlled amount of medication into the airstream independent of the infant's or respiratory compromised, ventilated or unconscious patient's inhalation strength, rate and timing; a sensor for sensing an inhalation and/or exhalation cycle of the infant or patient; and a controller for controlling the vibratory element over two or more inhalation cycles.

The present invention provides a device, its use and method for aerosolized dosing of dry powder pharmaceutical preparations, which overcomes the aforesaid and other problems of the prior art, and provides a simple and relatively low cost device operative independently of a source of compressed carrier air. More particularly, in accordance with the present invention there is provided a device, its use and method for aerosolized dosing of dry powder pharmaceutical preparations, or pharmaceutical agents dissolved or suspended in a liquid medium comprising a pharmaceutical aerosolization