# A dry powder inhaler formulation provides excellent protection against pneumonia-causing bacteria

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Community-acquired pneumonia is a leading cause of morbidity and mortality worldwide. Credit: pojoslaw/iStock/Thinkstock

Despite advances in vaccination and antimicrobial therapy, community-acquired pneumonia remains a leading cause of morbidity and mortality, even in highly developed countries. Desmond Heng, Reginald Tan and co-workers at the A*STAR Institute of Chemical and Engineering Sciences have now developed a dry powder inhalation formulation to treat bacterial infections associated with this disease.

Community-acquired pneumonia, a type of lung inflammation contracted outside of a hospital or nursing-home setting, is most often caused by infections with bacteria, such as Klebsiella pneumoniae, Pseudomonas aeruginosa and Staphylococcus aureus. The condition affects people of all ages, but is particularly prevalent among infants, the elderly and patients with chronic obstructive pulmonary disease.

The formulation developed by the team contains two important ingredients: ciprofloxacin hydrochloride (CIP), an antibiotic commonly used to eliminate pathogenic bacteria, and beclomethasone dipropionate (BP), a corticosteroid commonly used to inhibit inflammatory responses.

The novelty of this formulation lies in the combination of the two drugs. Previous clinical trials have evaluated the efficacy, safety and tolerability of CIP on human patients. The inhalation of BP is known to be an effective treatment for patients with non-asthmatic chronic airflow obstruction. Yet no one had put these two together to check the feasibility of combining CIP and BP as an inhalable dry powder formulation for direct concomitant delivery to the lungs.

The researchers employed a state-of-the-art spray drier to prepare the CIP–BP dry powder and ensure uniformity, fineness and overall quality. They characterized the CIP–BP dry powder using field-emission scanning electron microscopy and showed that the majority of particles had a diameter of approximately 2.36 micrometers—small enough to be breathed in. X-ray diffraction analysis revealed only a single diffuse, broad peak, suggesting that the CIP–BP dry powder is highly amorphous.

"What's important is that the CIP–BP dry powder exhibits superior aerosol performance and excellent antimicrobial activities," explains Heng. "Our follow-up microbial assays show that a concentration as low as one microgram per milliliter is enough to inhibit three of the bacteria known to cause this type of pneumonia."

"We found that it is feasible to package the CIP–BP dry powder in an inhaler that can treat bacterial infections associated with community-acquired pneumonia," adds Heng.

Dry powder inhalers exhibit several advantages

over traditional drug delivery methods, including improved formulation stability, enhanced delivery efficiency, excellent portability and ease of use. The delivery of CIP and BP via dry powder inhalers may become a novel and useful strategy for treating patients with community-acquired pneumonia.

**More information:** Lee, S. H., Teo, J., Heng, D., Zhao, Y., Ng, W. K. et al. Steroid-decorated antibiotic microparticles for inhaled anti-infective therapy. *Journal of Pharmaceutical Sciences* 103, 1115–1125 (2014). dx.doi.org/10.1002/jps.23874

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