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QbD approach for optimization of Antimicrobial Polymeric Coating for Urinary Catheters

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This abstract explores the application of Quality by Design (QbD) principles in the development of antimicrobial polymeric coatings for urinary catheters. Our study aims to optimize the coating process by systematically identifying critical material attributes and process parameters to enhance the performance of the catheter. The coatings were developed using Chlorhexidine as a non-antibiotic antimicrobial active agent and chitosan polymer, with variations in chitosan concentration, pH, and temperature to achieve optimal results. Using QbD approach, we employed Box-Behnken design with 15 experimental runs, which facilitated systematic optimization of the coating process.

Subsequent Scanning Electron Microscopy (SEM) analysis was performed for studying morphological characteristics of the coated catheters. Furthermore, we investigated drug release profiles in simulated urinary media (pH 5.8), to study coatings efficacy in modelled life conditions. Our goal was to achieve a robust and reproducible coating process that ensures the sustained release of antimicrobial agents, preventing urinary tract infections. The innovative QbD-driven optimization strategy not only enhanced the antimicrobial efficiency of the catheter but also provides information about the factors influencing the coatings performance. Ultimately, our research contributes to the development of safer and more effective urinary catheters, addressing a critical aspect of healthcare- associated infections.