Efficacy of a novel catheter connector system with UV Sterilization module

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Introduction/Background

Problem: Catheter related bloodstream infections (CRBSIs) from IV catheters via intraluminal route are particularly difficult to prevent. CRBSIs lead to increased hospital costs and longer patient stays.

Needs: Reduce rate of CRBSIs, caused by recontamination of the lumen. Must continuously sterilize fluid flowing through catheter before it enters the bloodstream. Also must have minimal interference with existing hospital equipment

Mission Statement

Reduce the risk of IV catheter related bloodstream infections (CRBSIs).

Concept

Catheter Connector System Featuring Integrated UV-Sterilization Module. Fluid passes through the catheter into the connector system, which uses UV-C radiation to sterilize the fluid before entering the bloodstream, reducing the risk of catheter-related bloodstream infections (CRBSIs)

Core Features

- UV-C radiation sterilization
- Compact design
- Compatible with standard catheters

Specifications

- Dimensions and weight
- UV-C wavelength and power output
- Expected lifespan and recharge cycle
- Compliant with all standards and regulations

Technical Model Description	Model Equation
A flow model where Q represents flow rate, P represents pressure, r represents radius, and l is length, related to fluid dynamics in a catheter.	$Q = \frac{\pi \Delta P r^4}{8 \eta l}$
A population growth model where dN/dt is the rate of change in population N, r is the growth rate, K is the carrying capacity, and k is a decay rate.	$\frac{dN}{dt} = r \cdot N \cdot (1 - \frac{N}{K}) - k.N$
A power absorption model where P_{abs} represents absorbed power, I is intensity, and a is an absorption coefficient, related to UV sterilization.	$P_{abs} = I \cdot \sigma_a$
A model for dose D, where E is energy, t is time, I is intensity, and R represents reflectance or resistance, related to radiation exposure.	$D = E_t \cdot I_R$

Materials

Biocompatible plastics for the casing, UV-C LEDs.

Manufacturing Costs

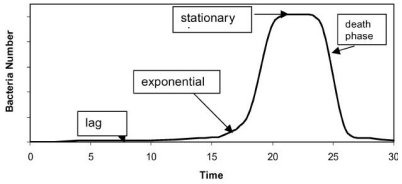
Estimation per unit production cost and scalability through injection molding and LED sourcing.

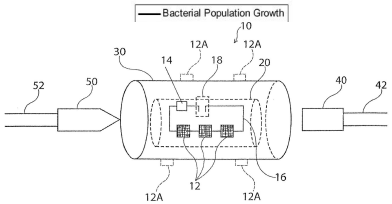
Customer Needs

- Limit hospital acquired infections
- Effective sterilization of fluid flowing into bloodstream via catheter lumen
- Easy to integrate into existing hospital workflows
- Limited UV radiation exposure
- Efficient sterilization procedures

Metrics

- User satisfactory rating
- Durability for multiple uses
- Power sufficiency for UV-C light emissions





Project Planning/Timeline

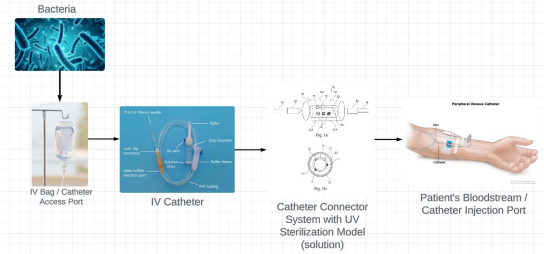
Research & Development
Design & Prototyping
Testing & Validation
Manufacturing Preparation
Regulatory Approval & Market Launch

Current Status

Entering design and prototyping phase

Future Steps

- Complete functional prototype and perform tests to assess efficacy of UV-C sterilization
- Clinical trials for safety and efficacy validation
- Regulatory submissions for FDA approval
- Planning for production scale-up



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