Hand Hygiene Indicator

Emily Andrews, Allie Finney, Rachel Mosher, Susie Samreth
Client: Dr. Chris Crnich | Advisor: Bill Murphy
Department of Biomedical Engineering University of Wisconsin-Madison

Motivation

Every year, at least 80,000 deaths are caused by hospital-associated infections. These are communicable diseases contracted in the hospital and often transmitted to patients by their clinicians. Approximately a third of these infections could be prevented by the implementation of a hand hygiene program, but hand hygiene compliance is reported to be only 20-50%. Additionally, hand hygiene has transitioned from traditional soap-and-water hand washing to use of alcohol-based hand sanitizers, rendering existing hand hygiene teaching tools obsolete.

Problem Statement

In order to teach proper hand hygiene technique and ensure compliance, a quantitative measure of hand hygiene is necessary at common problem areas, including finger tips and between fingers.

The objectives of this project are to:

1.Identify a molecule with intrinsic fluorescence to act as a marker

2.Quantitatively measure marker fluorescence associated with improper hand hygiene.

Product Requirements

Fluorescent Marker must be:

- Safe for application to human skin, ideally FDA approved
- Distinct from intrinsic fluorescence of skin
- Compatible for use with alcohol-based hand sanitizer:
  - Attenuation with exposure to alcohol
  - Ability to mix in hand sanitizer

Marker Measurement must be:

- Portable for use in clinical environment
- Able to provide real-time, quantitative measurement on three-dimensional surface
- Consistent, standardized and focus on problem areas

Fluorescent Marker

Fluorescent Molecule

Visirub: diethylaminocoumarin

Application 1

•Fluorescent marker mixed with hand sanitizer

•After performing hand hygiene, marker fluoresces where hand sanitizer has been applied, indicating proper coverage

Application 2

•Fluorescent marker applied hands, unbeknownst to clinician

•After performing hand hygiene, marker fluorescence is attenuated where hand sanitizer has been applied

•For both applications, fluorescence can be quantified and correlated to hand hygiene proficiency

Marker Measurement

Spectrofluorometer

Ocean Optics Jaz

- Portable with internal microprocessor
- Optical fiber assembly for flexible measurement on three-dimensional surface
- Displays real time spectrographs and intensity values
- Customizable and adaptable to different fluorescent molecules

Hand Holder

- Allows standardization of testing method and reduces error
- Maintains hand position for uniform measurement of problem areas:
  - •Fingertips
  - •Thenar space
  - •Back of hand

Testing

Goals:

•Determine if fluorescence could be detected in cuvette using spectrofluorometry

•Identify molecule with greatest emission intensity in 300-600 nm range

•Measure attenuation over time due to addition of alcohol

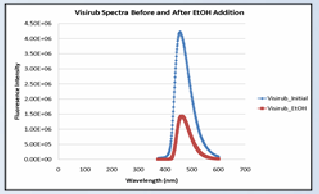
Discussion of Results:

•Visirub spectrograph displays significant fluorescence intensity attenuation

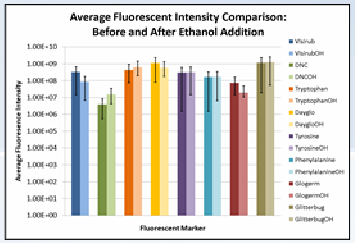
- 75% change in intensity

•Two-sample t-test (based on a 95% confidence interval) revealed that Visirub demonstrated the highest P-value

- P=4.54E-7



Marker	%Change in Intensity
Visirub	74.49%
D&C Red	52.75%
Tryptophan	45.72%
Tyrosine	3.75%
Phenylalanine	3.19%
DayGlo	47.58%
GloGerm	73.83%
Glitterbug	6.80%



Marker	P-Value
Visirub	4.55E-07
D&C Red	7.11E-03
Tryptophan	1.71E-01
DayGlo	1.44E-02
Tyrosine	1.20E-01
Phenylalanine	9.46E-02
GloGerm	6.49E-03
Glitterbug	1.60E-02

Future Work

- Determine appropriate parameters and purchase Jaz spectrofluorometer
- Conduct testing using Jaz spectrofluorometer on problem areas
- Optimize fluorescent molecule concentration and coverage for accurate detection and coverage
- Modify hand holder to achieve uniform measurement
- Determine standards for hand hygiene

Thanks to Kevin Eliceiri for his continuous support and guidance.