Detection of residual prions from decontaminated medical and laboratory surfaces

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Iatrogenic & occupational prion transmission

Iatrogenic transmission

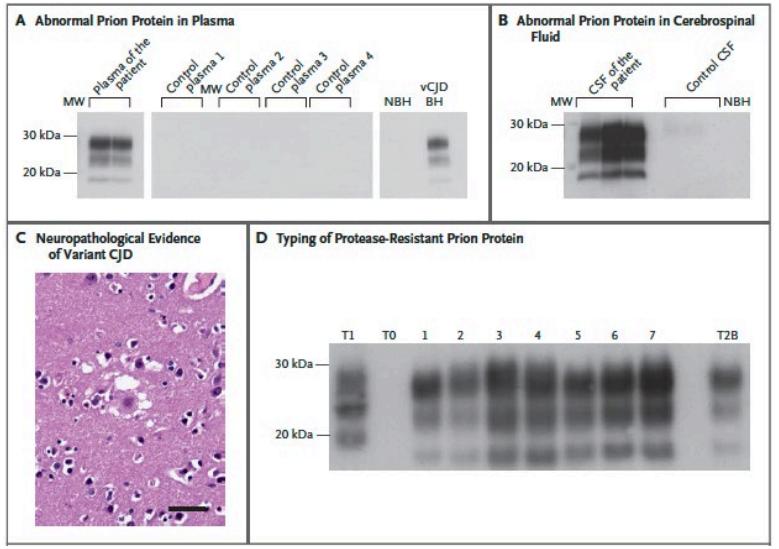
- Dura matter
- Human growth hormone
- Blood
- Surgical tools
- EEG electrodes

Occupational transmission

- Stainless steel forceps
- Puncture wound

The NEW ENGLAND JOURNAL of MEDICINE

Variant Creutzfeldt–Jakob Disease Diagnosed 7.5 Years after Occupational Exposure



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INFECTIOUS DISEASES

France halts prion research amid safety concerns

Iatrogenic & occupational prion transmission

Detection of surface bound prions

Method	Advantages	Disadvantages
Bioassay	Can detect wide variety of prions affecting multiple species with transgenic animals	Duration, cost
SSCA	Short duration	Limited strain recognition

- Prion contamination and decontamination of BH or stainless-steel wires assessed by either bioassay or Standard Scrapie Cell Assay (SSCA)
- Lack of amenability to surface surveillance.

Prion swabbing methodology

Contents lists available at ScienceDirect

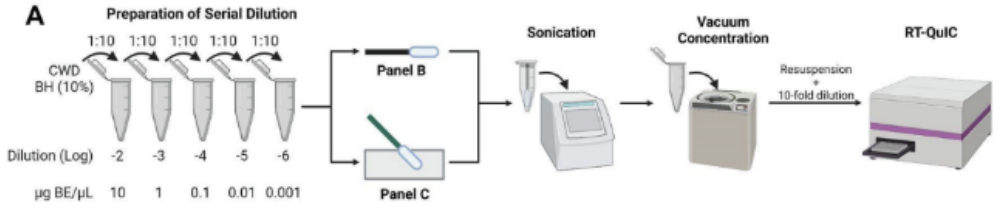
Environment International

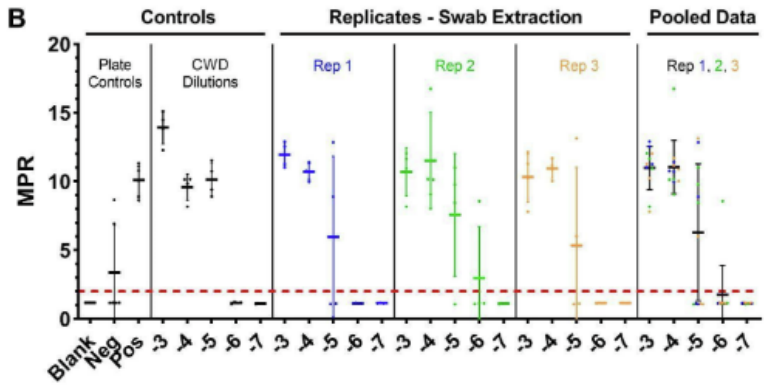
journal homepage: www.elsevier.com/locate/envint

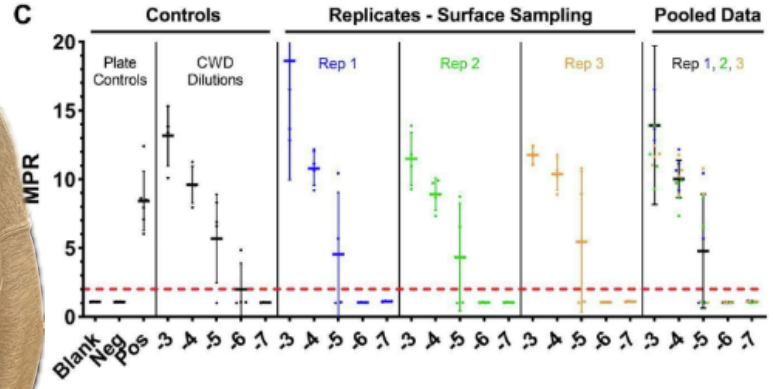
Full length article

Sensitive detection of chronic wasting disease prions recovered from environmentally relevant surfaces

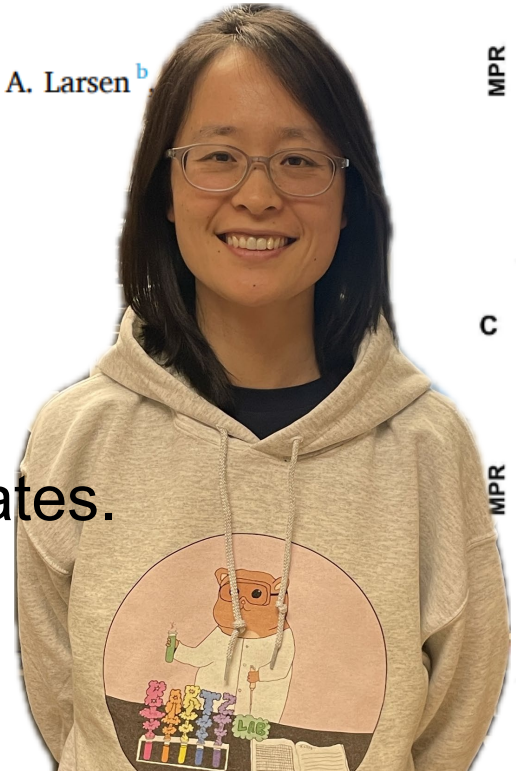
Qi Yuan [a], Gage Rowden [b], Tiffany M. Wolf [c], Marc D. Schwabenlander [b], Peter A. Larsen [b], Shannon L. Bartelt-Hunt [d], Jason C. Bartz [a,*]



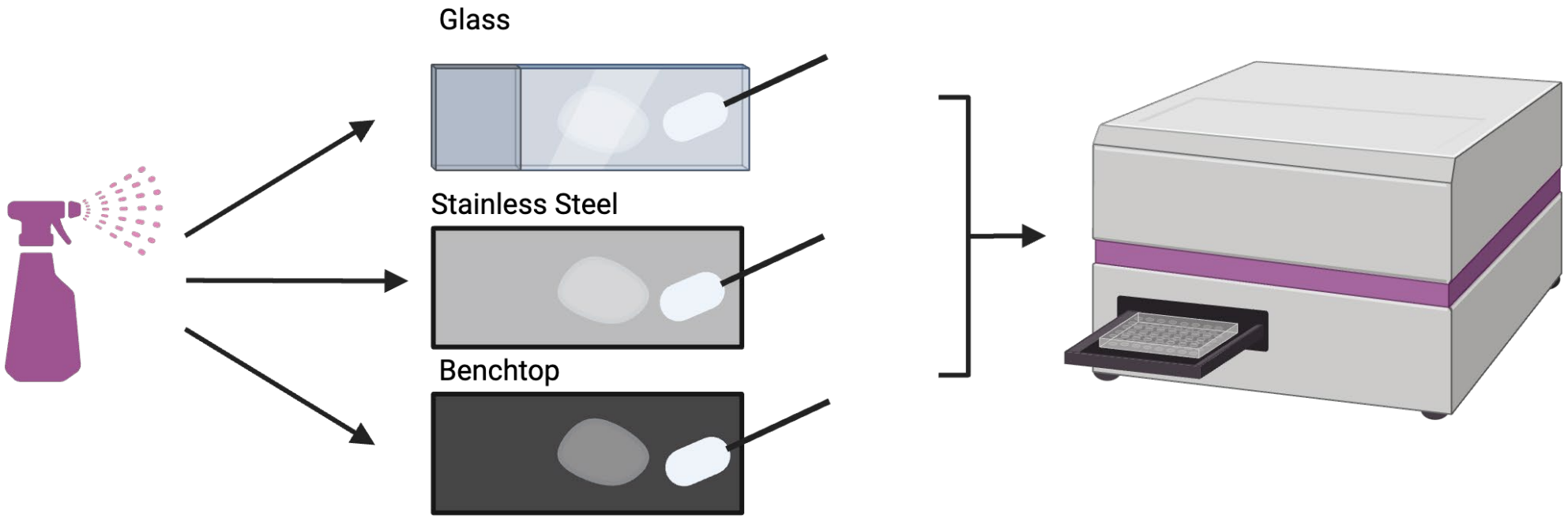




- Similar recovery for swab extracts obtained from CWD contaminated surfaces, contaminated swabs and CWD added directly to RT-QuIC plates.



Project overview



Disinfectants:

- Water
- 70% Ethanol
- Undiluted bleach

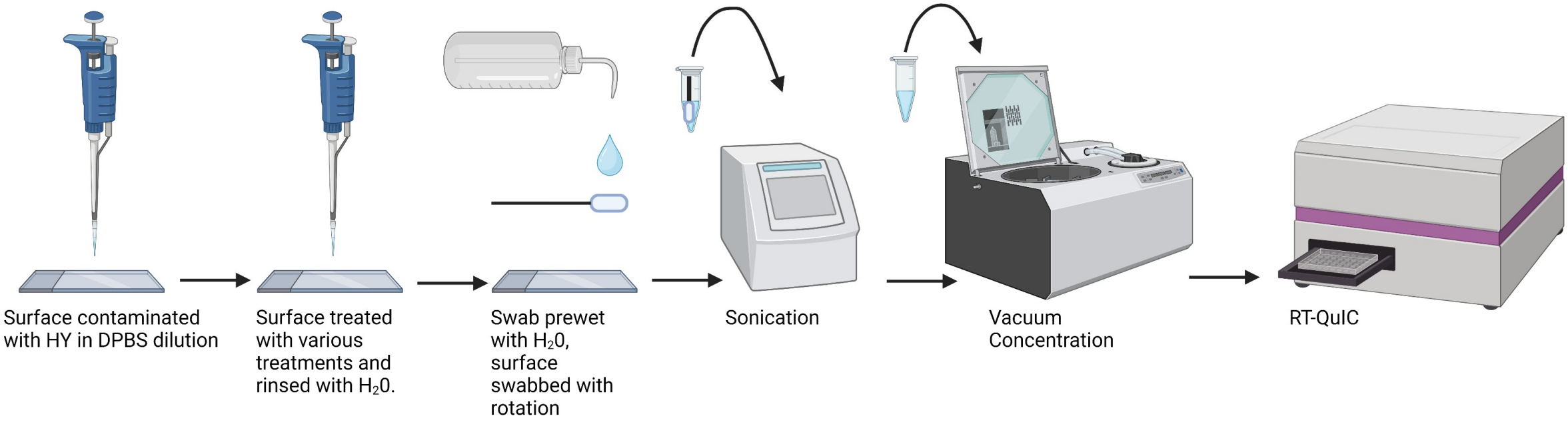
Surfaces:

- Glass
- Stainless steel
- Benchtop

Evaluation:

- Surface swabbing
- RT-QuIC
- Animal bioassay

Project overview
Methodology

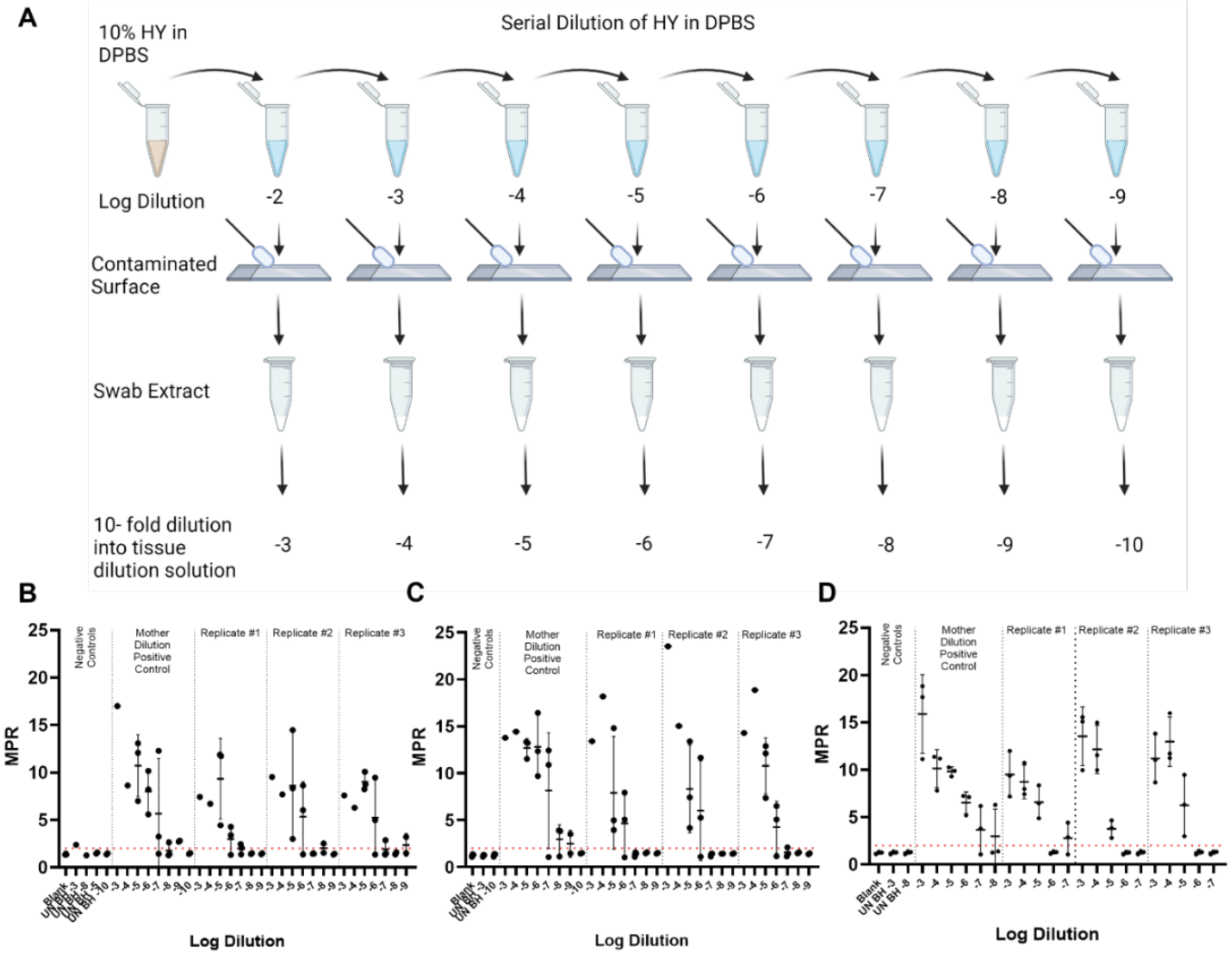


- Studies performed on HY TME
- Greater than three biological and 8 technical replicates
- RT-QuIC seeding titer (SD_{50}) was calculated by method of Reed and Muench

Effective swabbing recovery of prions applied to laboratory surfaces.

Sensitive detection of PrP^{Sc} from:

- Glass
- Stainless steel
- Laboratory benchtop



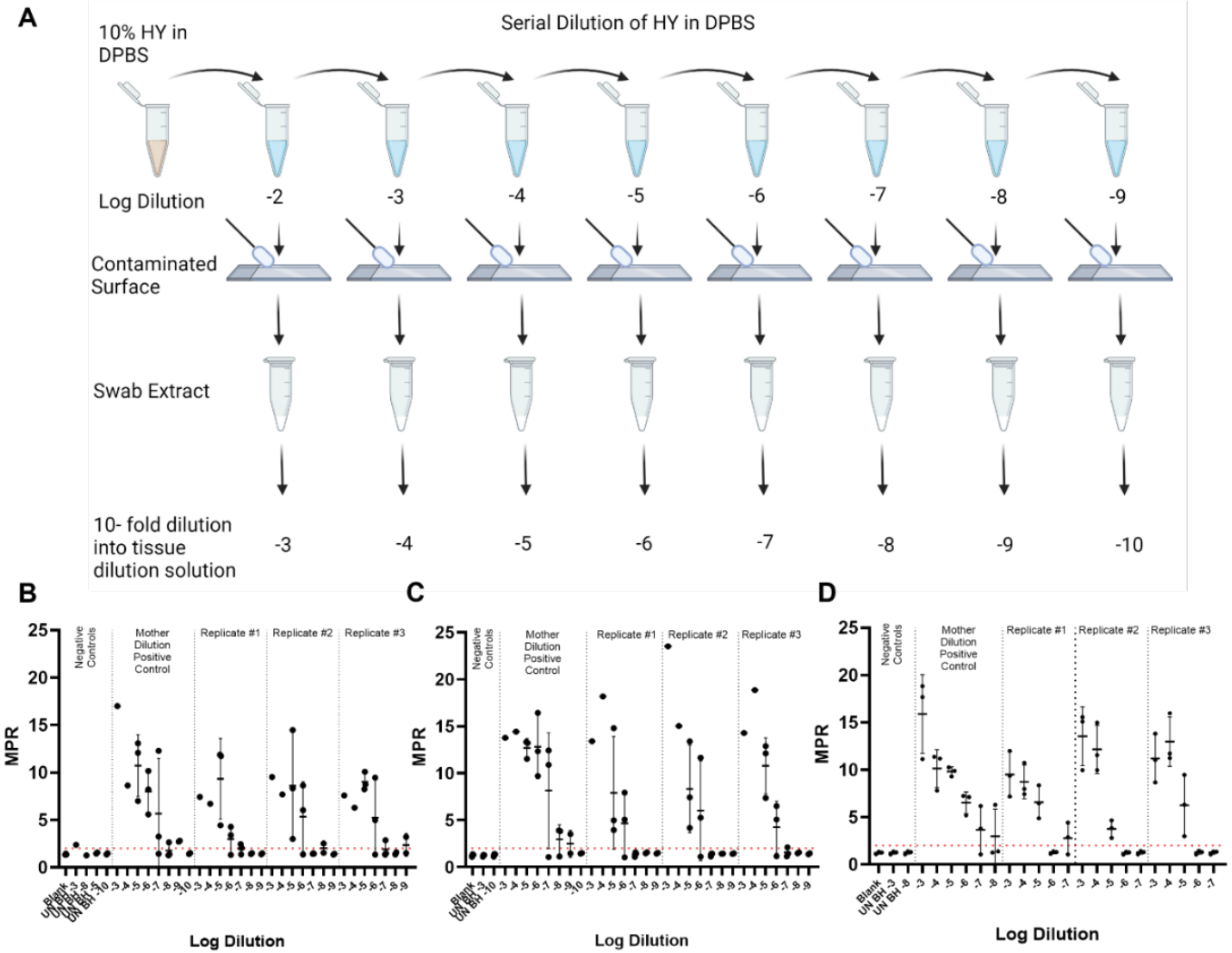
Simmons et al., mSphere, In Press

Effective swabbing recovery of prions applied to laboratory surfaces.

Sensitive detection of PrP^{Sc} from:

- Glass
- Stainless steel
- Laboratory benchtop

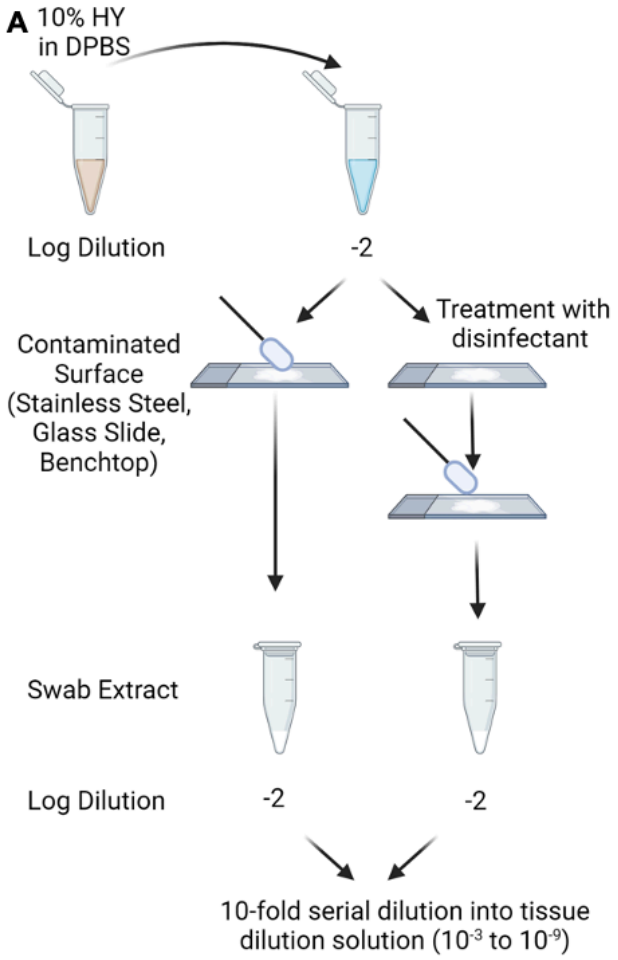
- Disinfection of surface
  - Water (negative control)
  - 70% EtOH
  - Bleach (positive control)

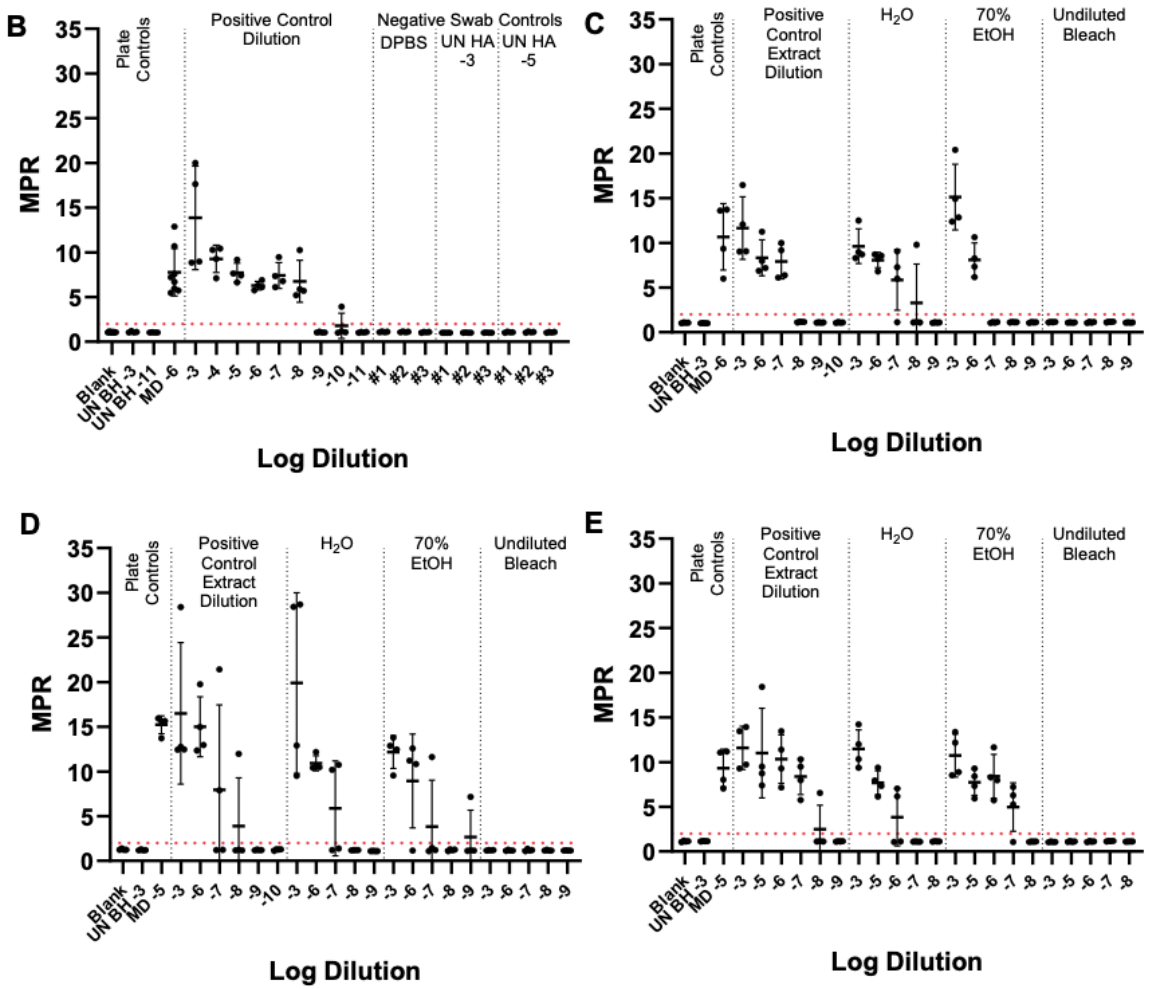


Simmons et al., mSphere, In Press

Bleach is an effective disinfectant laboratory surfaces, while 70% EtOH and H_2O are ineffective

- Disinfection of surface
  - Water (negative control)
    - No effect
  - 70% EtOH
    - No effect
  - Bleach
    - Complete elimination of RT-QuIC seeding activity





Simmons et al., mSphere, In Press

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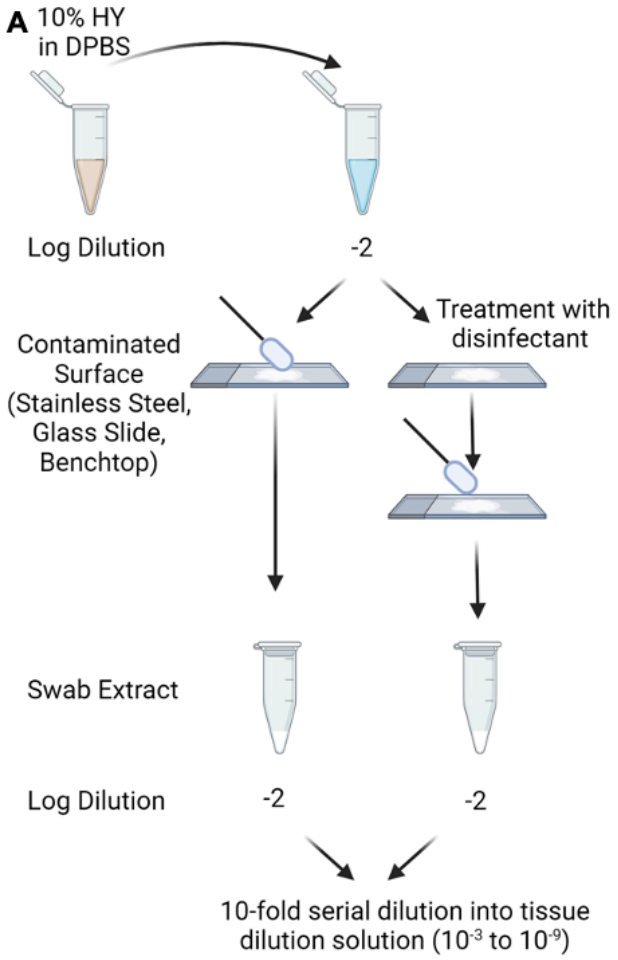
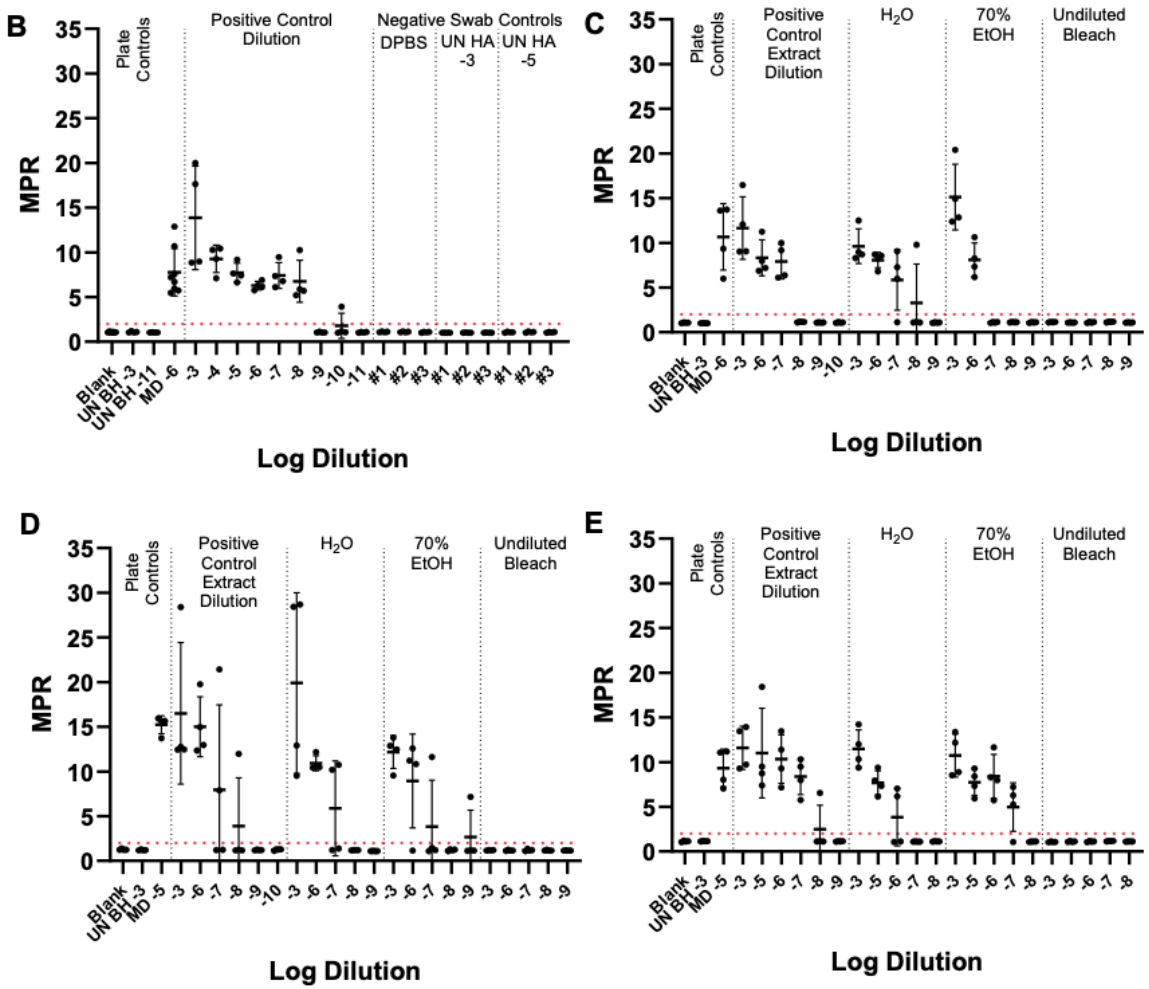
- Disinfection of surface
  - Water (negative control)
    - No effect
  - 70% EtOH
    - No effect
  - Bleach
    - Complete elimination of RT-QuIC seeding activity
    - What if bleach is just inhibiting the RT-QuIC reaction?





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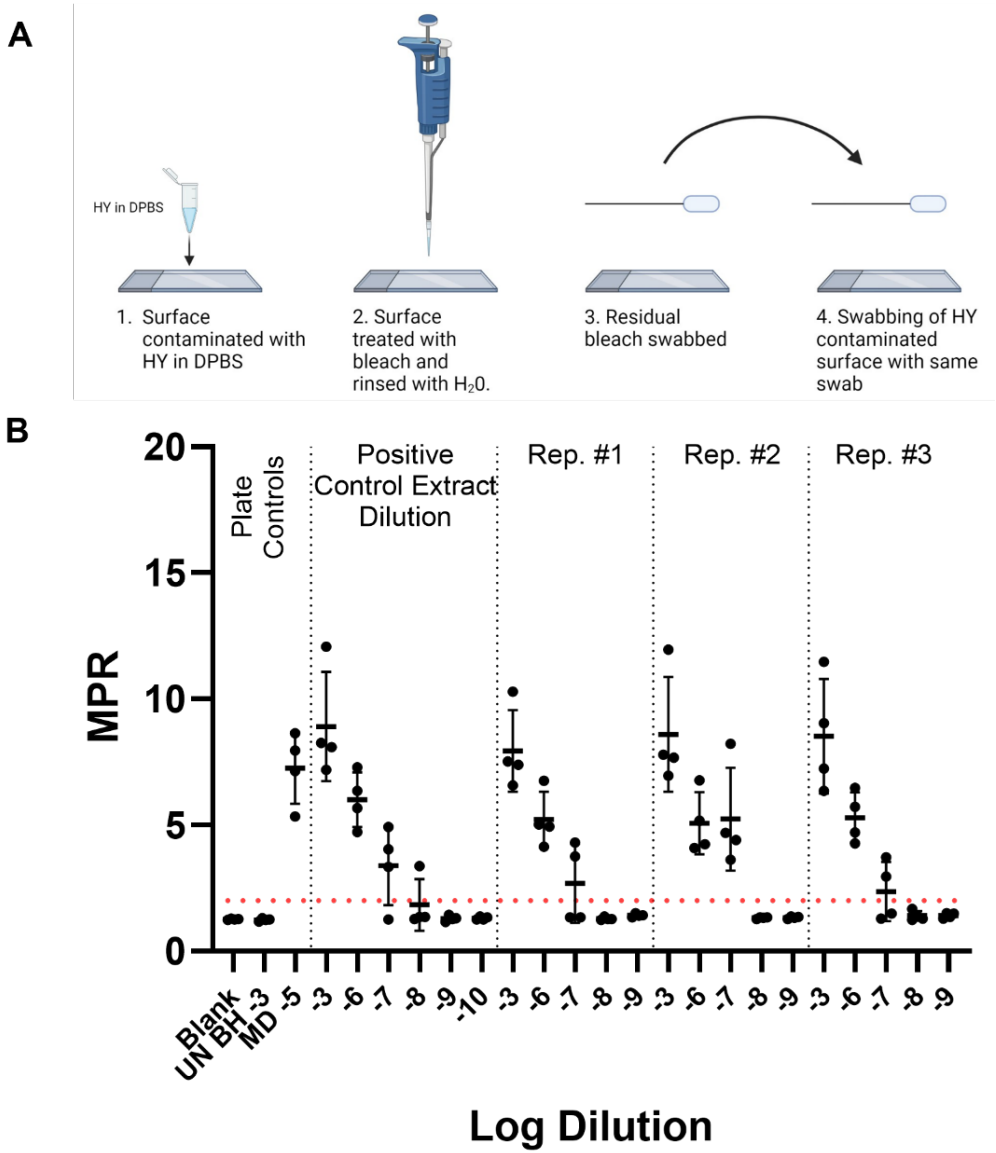
Residual bleach does not interfere with RT-QuIC detection of surface recovered prions.

- Swabbing of bleached surfaces
  - We did not observe a change in the sensitivity of detection of prions from the surface.
  - We conclude that the elimination of RT-QuIC seeding activity is from inactivation of prion, not from bleach inhibition of RT-QuIC.



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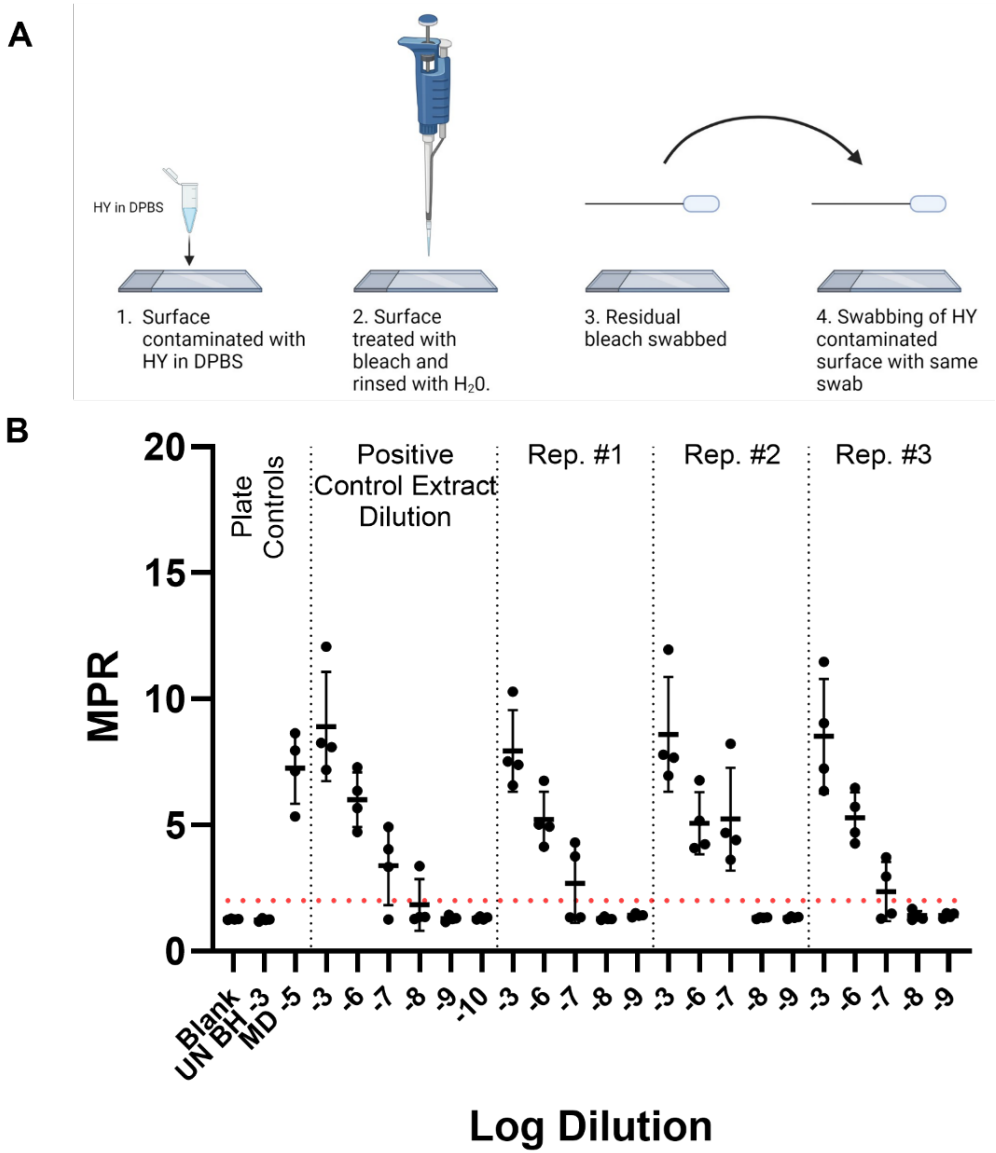
- What if prions are still on the surface that swabbing is not recovering?



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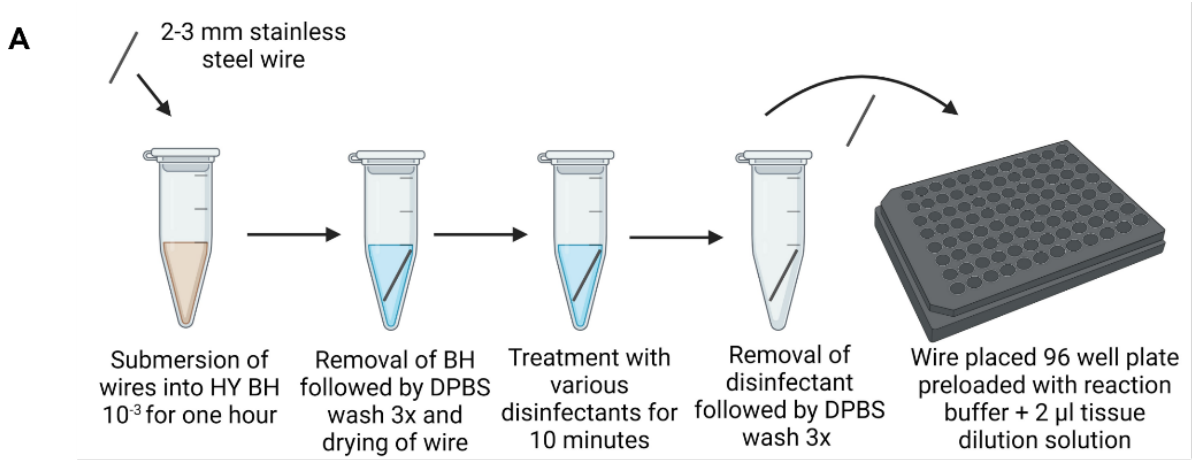
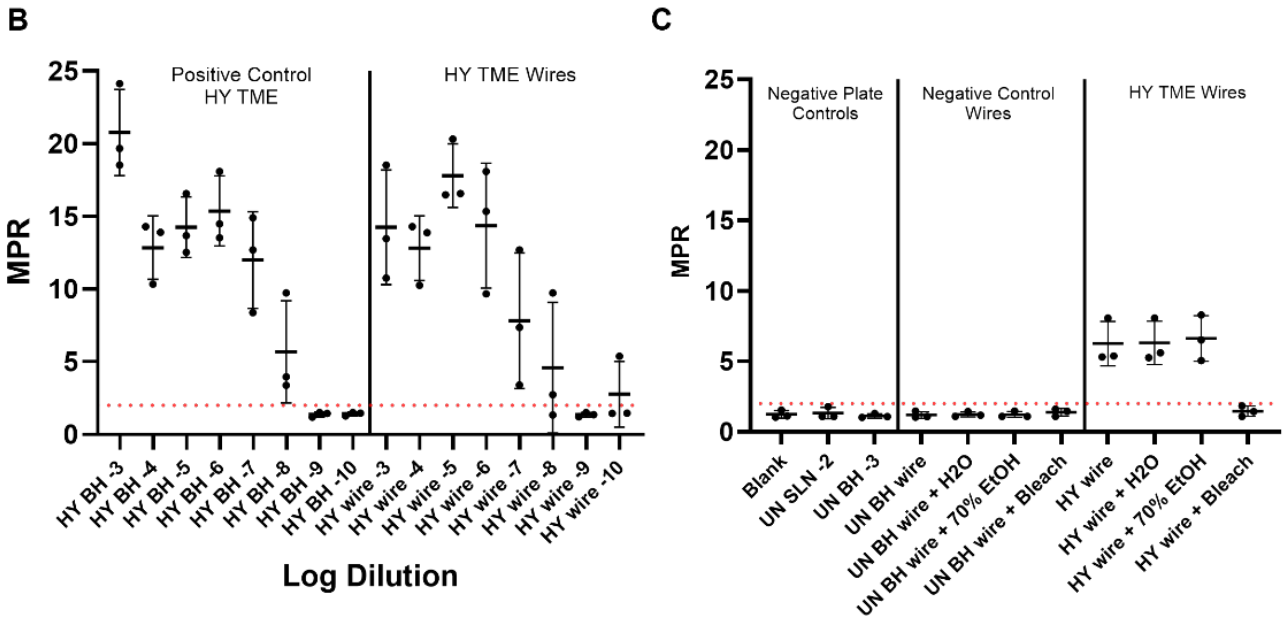
Direct surface measurement of prion seeding activity mirrors the results of surface recovered prions

- Wire RT-QuIC
  - We found a similar sensitivity of detection of prions on wires vs. prions added to RT-QuIC.
- Treatment of wires with water, 70% EtOH and bleach has similar results to swabbing studies.
  - We conclude that the swabbing result are predictive of what remains on the surface.





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- Treatment of wires with water, 70% EtOH and bleach has similar results to swabbing studies.
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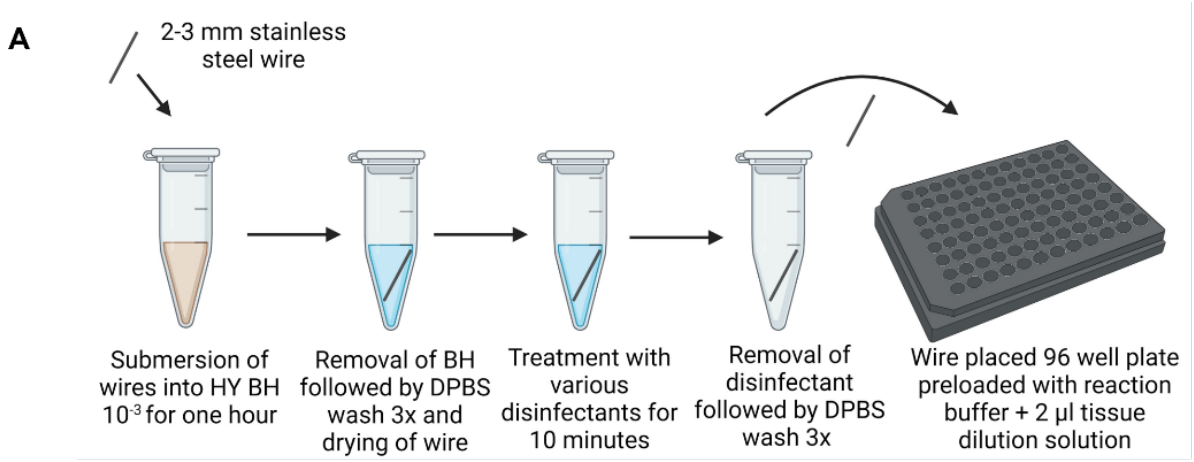
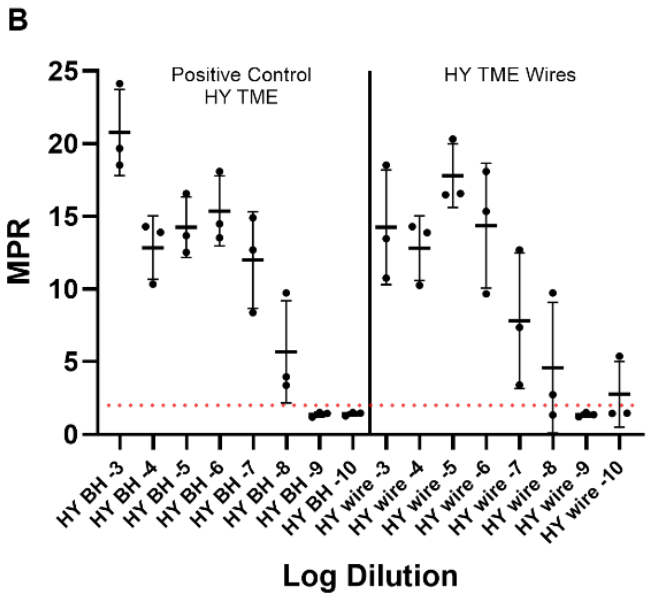
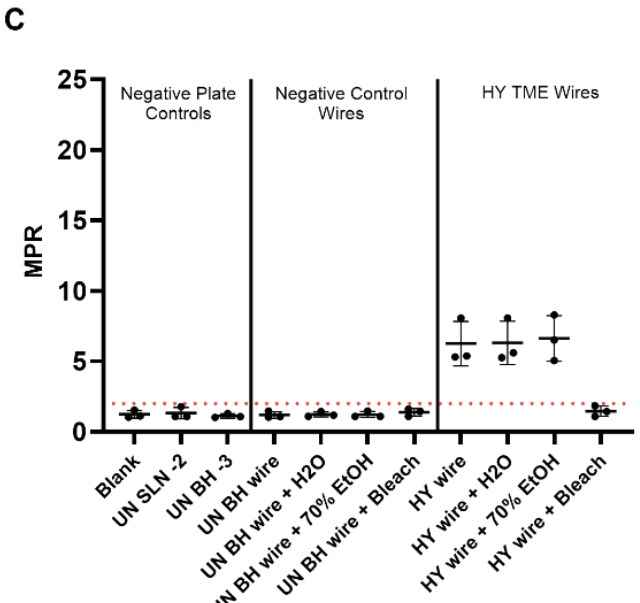
- Is RT-QuIC seeding activity predictive of infectivity?







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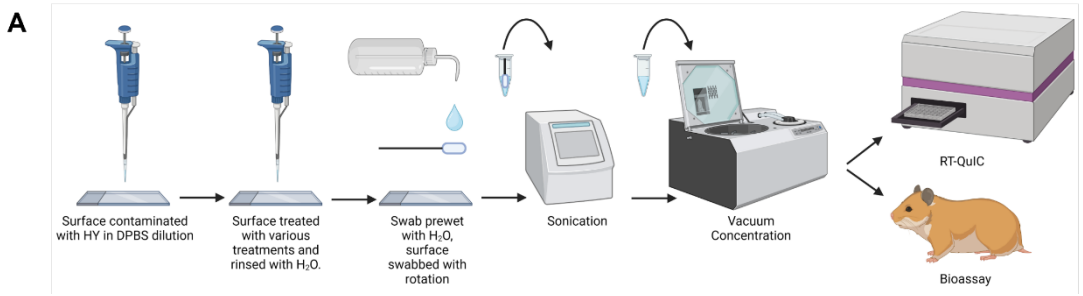
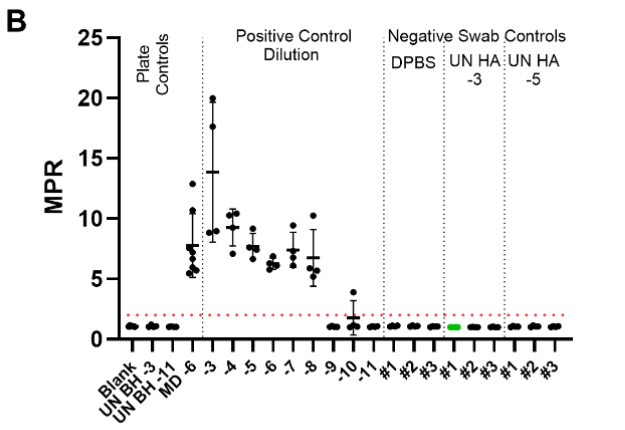
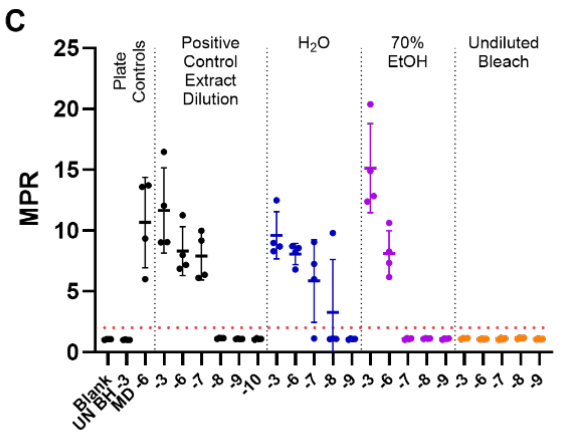
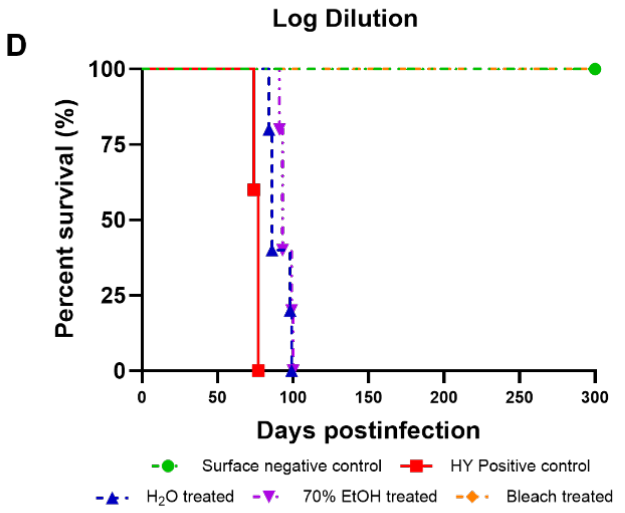
RT-QuIC and animal bioassay of swab extracts produced similar results

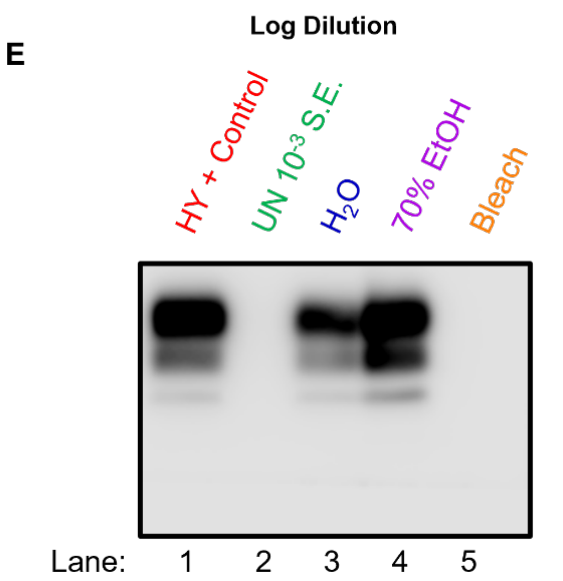


- Animal bioassay and RT-QuIC analysis of the same samples
  - Animal bioassay and RT-QuIC results matched.









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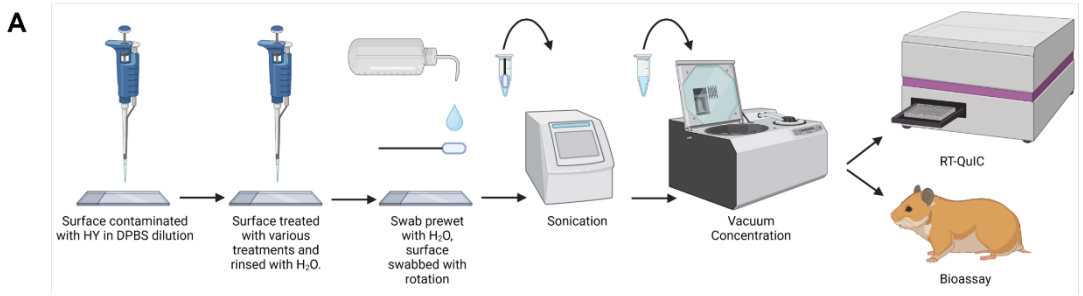
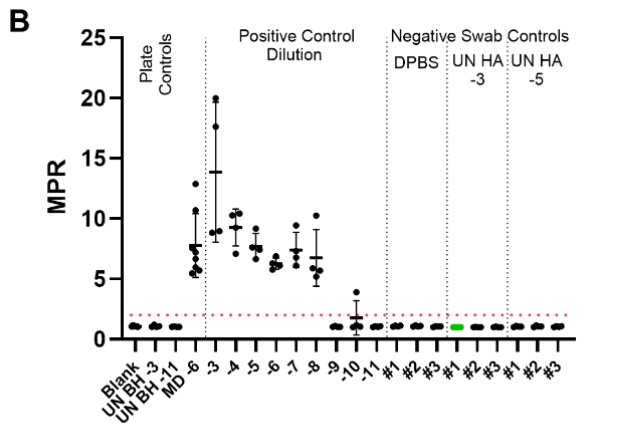
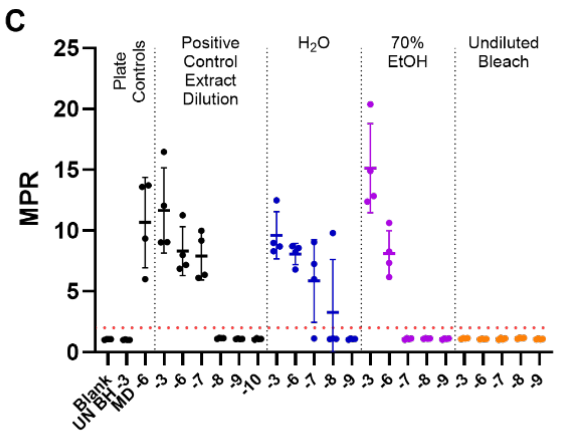
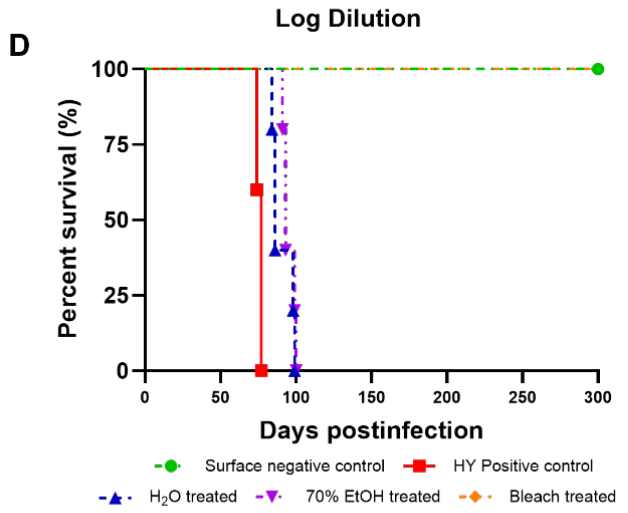
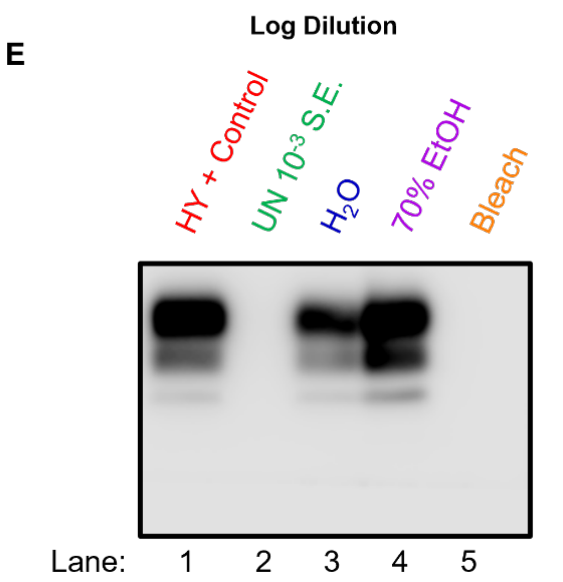


- Animal bioassay and RT-QuIC analysis of the same samples
  - Animal bioassay and RT-QuIC results matched.
- What effect does dust have on the RT-QuIC assay?









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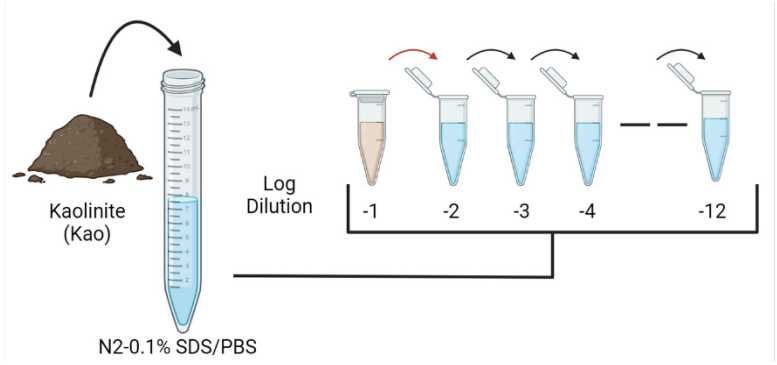
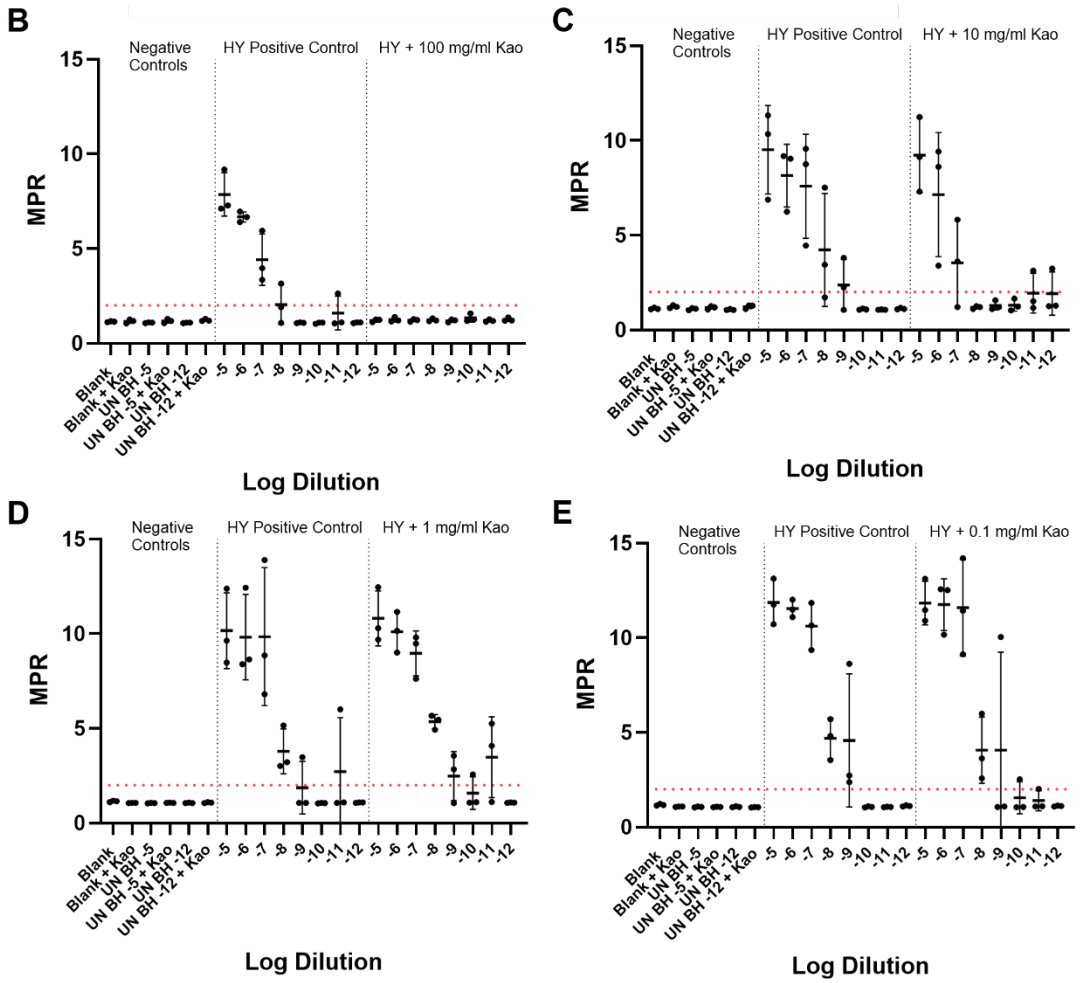
Impact of soil on RT-QuIC detection is dependent on soil concentration



- Added soil to RT-QuIC
  - Kaolinite
  - Montmorillonite
  - Hectorite
- Identified concentrations that inhibited RT-QuIC reactions.



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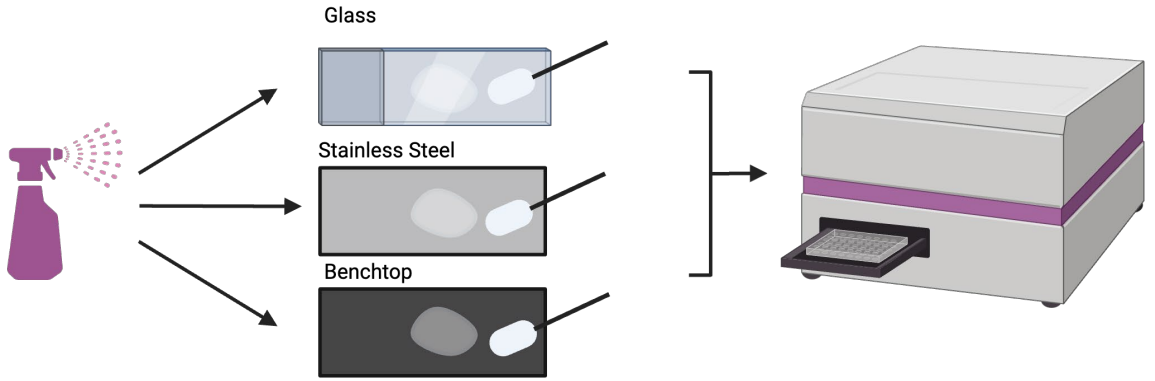
Project outcomes

- Sensitive detection of prions from laboratory and clinical surfaces
- Prion inactivation status of surfaces can be determined from surface swabbing
- RT-QuIC seeding activity corresponds with prion infectivity
- Environmental contaminants can interfere with prion detection.



PLOS PATHOGENS

Sensitive detection of pathological seeds of α-synuclein, tau and prion protein on solid surfaces

Christina D. Orrú[1☯*], Bradley R. Groveman[1☯], Andrew G. Hughson[1☯], Tomás Barrio[2], Kachi Isiofia[1¤a], Brent Race[1], Natalia C. Ferreira[1¤b], Pierluigi Gambetti[3], David A. Schneider[4], Kentaro Masujin[5], Kohtaro Miyazawa[5], Bernardino Ghetti[6], Gianluigi Zanusso[7], Byron Caughey[1*]

Project outcomes / Future directions

- Training
- Master's student who has transitioned to a Ph.D. program
- Investigate the mechanisms of prion interactions with surfaces and the requirements for establishing infection of prions bound to surfaces

Sara M. Simmons

CJD FOUNDATION

CREUTZFELDT-JAKOB DISEASE FOUNDATION, INC.

Supporting Families Affected by Prion Disease

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Vivianne Payne
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Sara Simmons
Benjamin Steadman
Sarah Stein
Taylor York
Qi Yuan
Johsette Witt

The CJD Foundation Grant

Contributed by: The Families of the CJD Foundation
Funds donated by supporters of the CJD Foundation have been applied to research grants awarded since 2009.

The Tom Stivison Memorial Research Grant

Contributed by: Sandra (Cookie) Stivison
Established in 2015.

The Strides for CJD Research Grant

Contributed by: The Families of the CJD Foundation
Funds raised by the annual Strides for CJD run/walk have been applied to research grants awarded since 2016.

The Peggy J. Black Memorial Grant

Contributed by: Jim Black and Family
Established in 2022.

The Rudy Wolter Memorial Grant

Contributed by: Jan Wolter, Family, and Friends
Established in 2023.

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Supporting Families Affected by Prion Disease

MINNESOTA CENTER FOR PRION RESEARCH AND OUTREACH
UNIVERSITY OF MINNESOTA
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CIDRAP

North American interdisciplinary chronic wasting disease research consortium
- United States Department of Agriculture NC1209 -

NIH National Institutes of Health

PRC
prion research center

NEBRASKA GAME PARKS

DEPARTMENT OF NATURAL RESOURCES DNR MICHIGAN

Project overview

Horizontal Dilutions Summary: Log SD_{50}/g of brain homogenate (Reed and Muench)										
	Biological Replicate #1			Biological Replicate #2			Biological Replicate #3			
Treatment:	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Rep. 1	Rep. 2	Rep. 3	Avg ± Std Dev
Swab Extract -2 (No treatment)	10.2	10.7	11.33	11.87	11.03	11.2	10.20	11.03	10.2	10.86±0.55
Swab Extract -2 (H20)	10.2	10.37	10.37	10.02	10.53	9.2	10.2	9.47	8.70	9.90±0.59
Swab Extract -2 (70 % Ethanol)	9.7	10.03	10.03	10.2	10.7	10.19	8.93	9.33	9.2	9.81±0.53
Swab Extract -2 (Undiluted Bleach)	MPR <2	MPR <2	MPR <2	MPR <2	MPR <2	MPR <2	MPR <2	MPR <2	MPR <2	MPR <2
Swab Extract -2 (Bleach Control)	11.37	10.93	10.37	10.2	10.53	10.53	10.03	11.7	10.33	10.67±0.53