External Ventricular Device (EVD) Related Cerebral Spinal Fluid (CSF) Infection

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HDSC 824: Data Visualization and Acquisition

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Background

SDH = subdural hemorrhage

SAH = subarachnoid hemorrhage

ICH = intracerebral hemorrhage

AIS = acute ischemic stroke

IVH = intraventricular hemorrhage

CSF infections may occur following placement of an external ventricular device (EVD).

Patients may require an EVD for intracranial pressure (ICP) monitoring and/or management of acute hydrocephalus associated with SDH, SAH, IVH, ICH, or AIS.

An EVD is placed by the neurosurgeon using sterile technique. The placement of an EVD often occurs emergently, at the patient's bedside in the ICU and not in the operating room (OR).

In an academic medical center, like The University of Kansas Hospital, the EVD may be placed by a neurosurgery resident under the supervision of an attending neurosurgeon.

Literature Review

An online PubMed search was performed through Dykes Library.

Search strings used:

"EVD related CSF infection"

"external ventricular device and infection"

"external ventricular device and CSF infection"

"external ventricular device and cerebrospinal fluid infection"

I selected four peer-reviewed articles that were most relevant to this project.

Further research would warrant a comprehensive review of the literature.

Article highlights:

- Overall infection rate = 1.68% (Zakaria et al., 2021)
- Overall infection rate = 2.20% (Walek et al., 2022)
  - Non-antimicrobial-impregnated devices were predominantly used
  - EVD insertions were performed at the bedside or in the operating room
- Implementation of standard protocol for EVD placement leads to reduced infection rate (Zakaria et al., 2021; Walek et al., 2022)
- Overall infection rate = 3.60% (Huang et al., 2024
  - Infection rate reduced to 1.00% after the implementation of chlorhexidine gluconate bathing
  - SAH was strongly associated with non-infectious ventriculitis
  - Alcoholism and arteriovenous malformation significantly increased the risk of EVD infectionAr

DATA

This data is routinely analyzed by the Comprehensive Stroke Center administrative team at The University of Kansas Hospital for quality improvement purposes as required by The Joint Commission.

This data set was anonymized, including the use of anonymous dates to protect privacy but preserve relative timing.

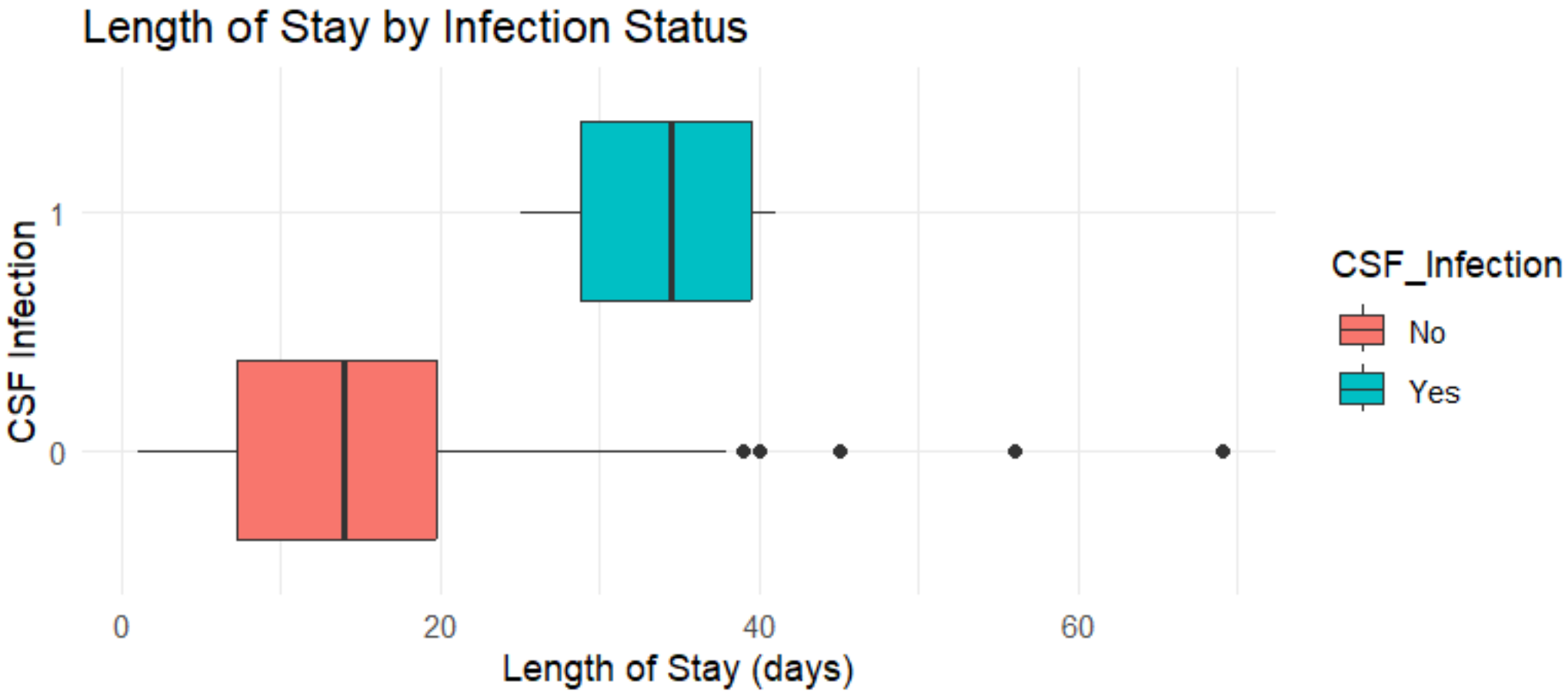
Variables collected:

- Diagnosis (reason for EVD placement)
- Date of EVD placement
- EVD catheter brand
- EVD placement location (patient room vs. OR)
- Length of hospital stay, in days (calculated from admission & discharge dates)
- Length of EVD placement, in days (calculated from insertion & removal dates)
- Presence of CSF infection (Y/N) – defined as positive CSF culture or provider note(s) indicating presumed CSF infection related to EVD
- Patient death within 24 hours of EVD placement or removal (Y/N)
- Patient death within 72 hours of EVD placement or removal (Y/N)

Summary Statistics and Analysis

- n = 74
- CSF infection rate = 5.41% (4 infections)
- Mean EVD days by diagnosis:
  - AIS = 8
  - ICH = 6.69
  - ICH with IVH = 11
  - IVH = 6.25
  - SAH = 9.43
  - SDH = 3
- EVD placement location (# of infections):
  - OR = 8 cases (0 infections)
  - Bedside (in ICU) = 66 (4 infections)
- Summary – length of stay (in days):
  - Minimum = 1.00
  - 1st Quartile = 8.25
  - Median = 14.00
  - Mean = 16.89
  - 3rd Quartile = 22.00
  - Maximum = 69.00
- Mortality count:
  - Y (deceased) = 30
  - N (not deceased) = 44

Length of Stay by Infection Status



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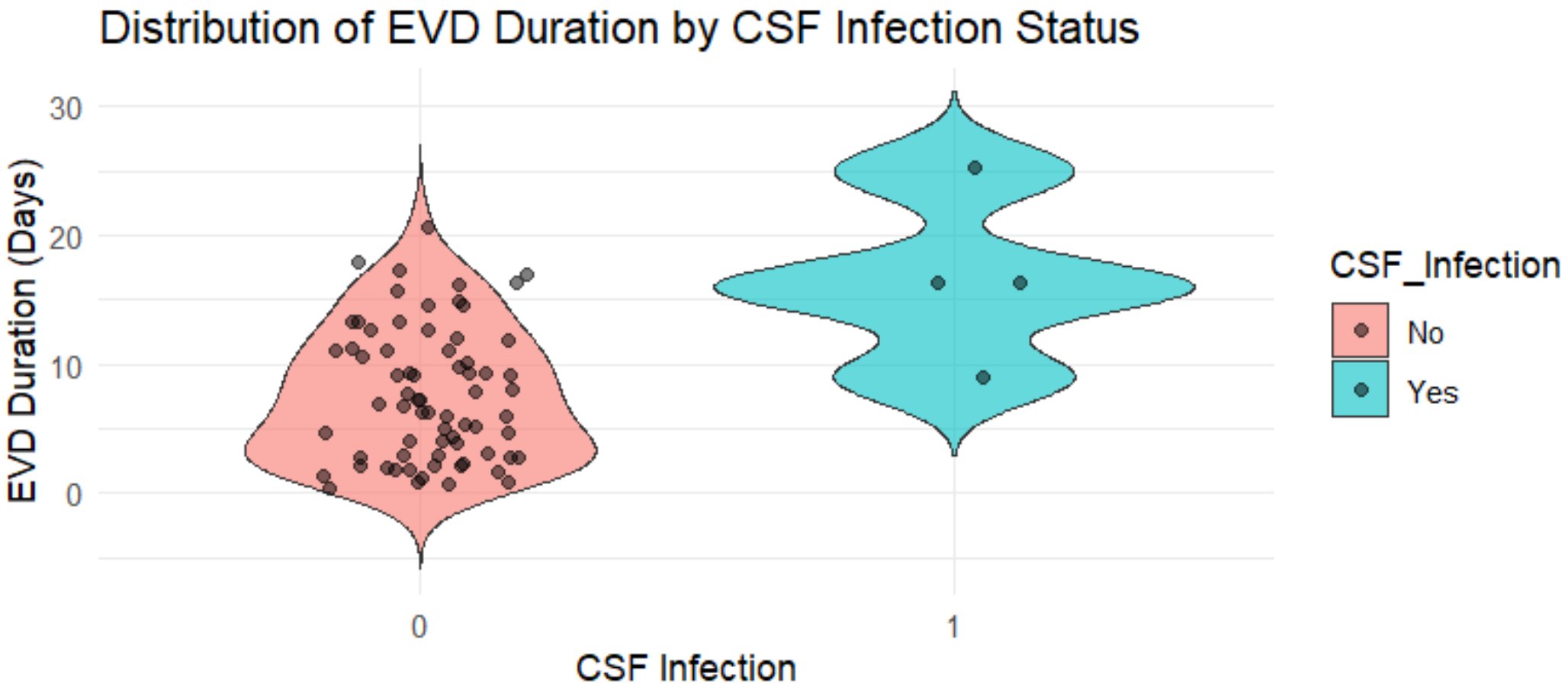
EVD Duration by Infection Status



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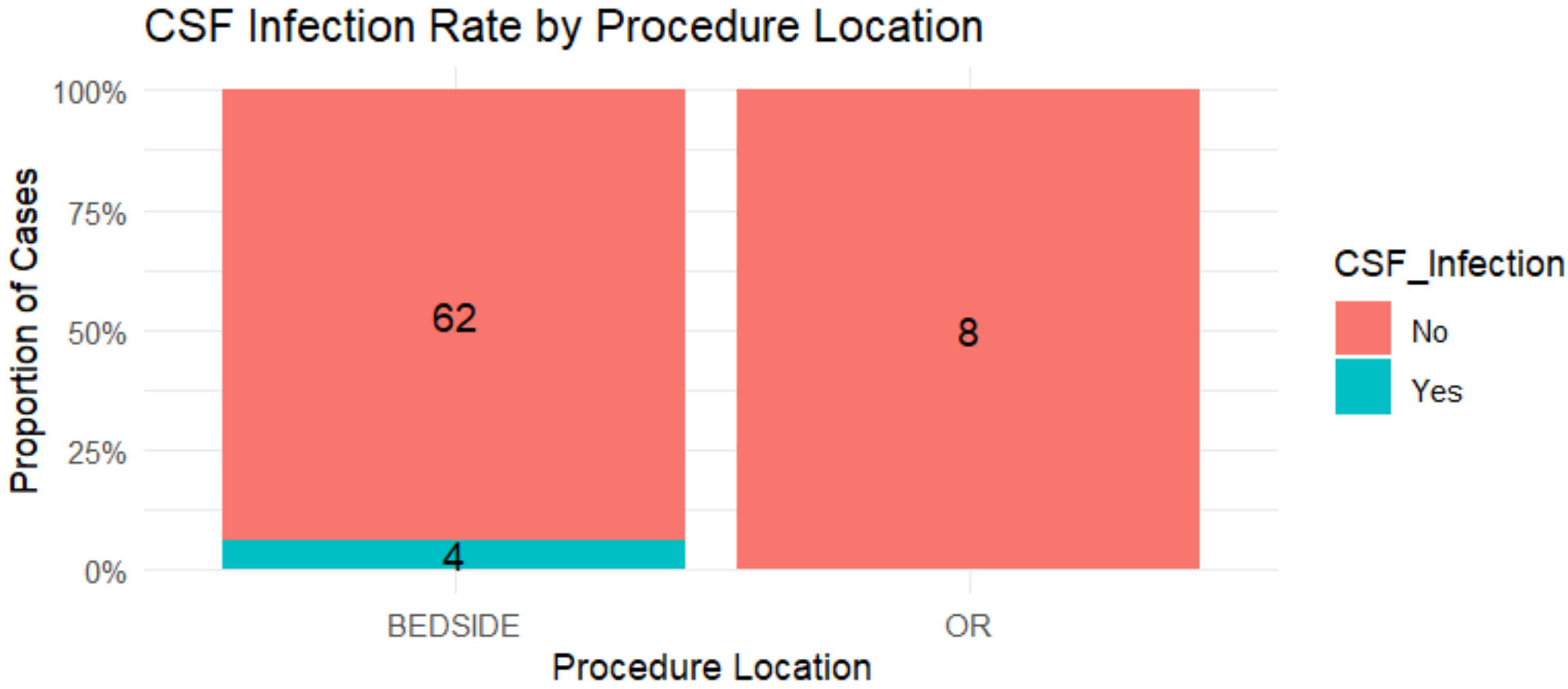
CSF Infection Rate by Procedure Location



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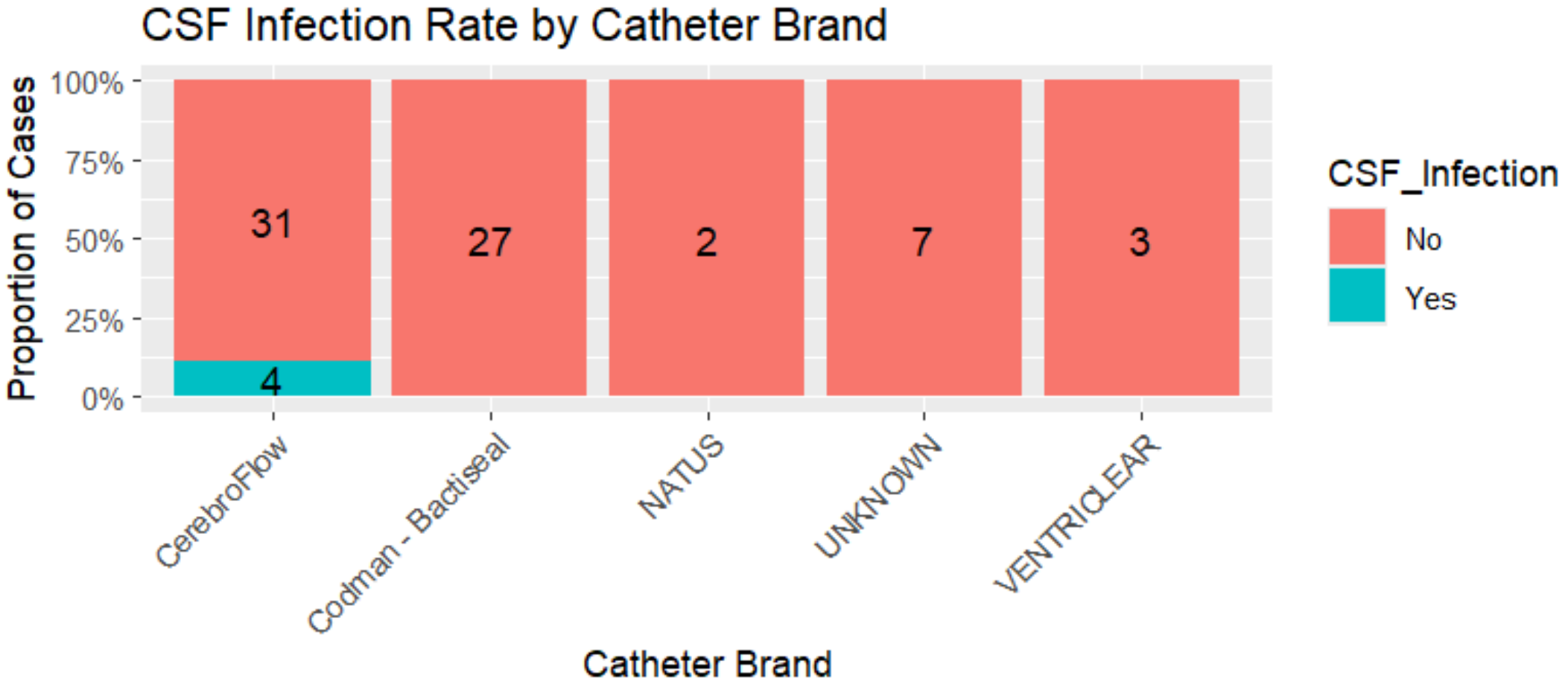
CSF Infection Rate by EVD Catheter Brand



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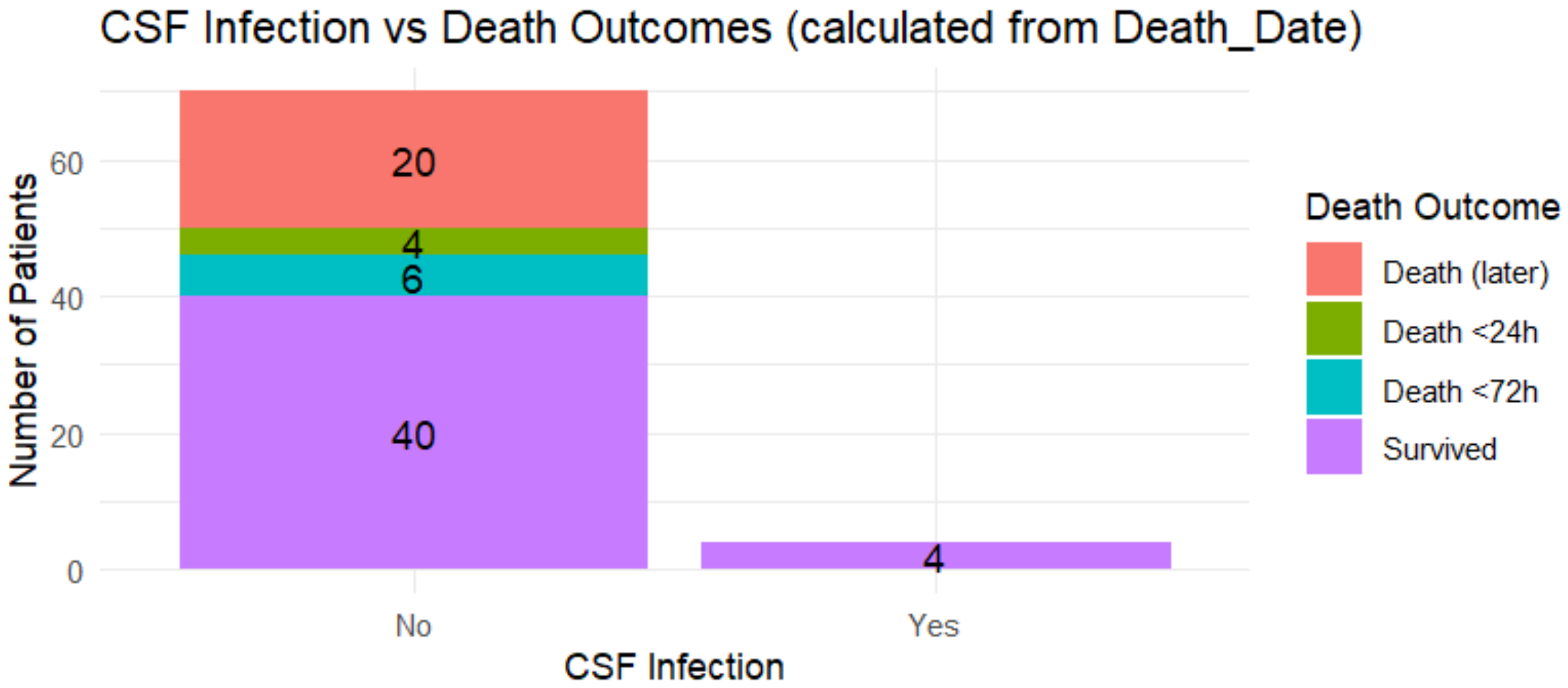
CSF Infection vs. Mortality



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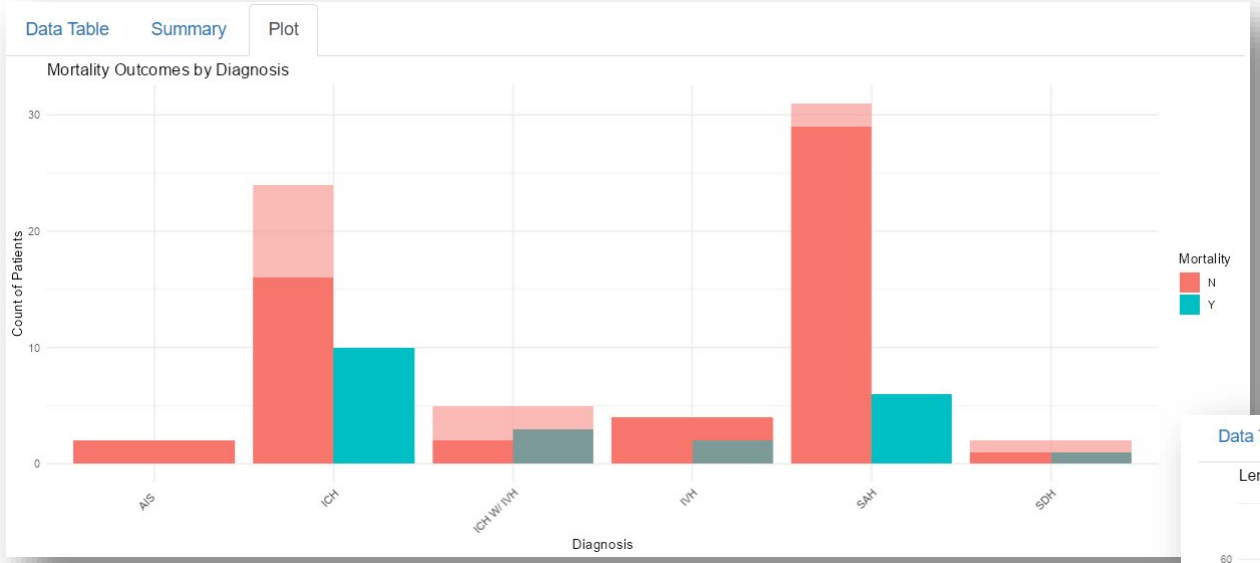
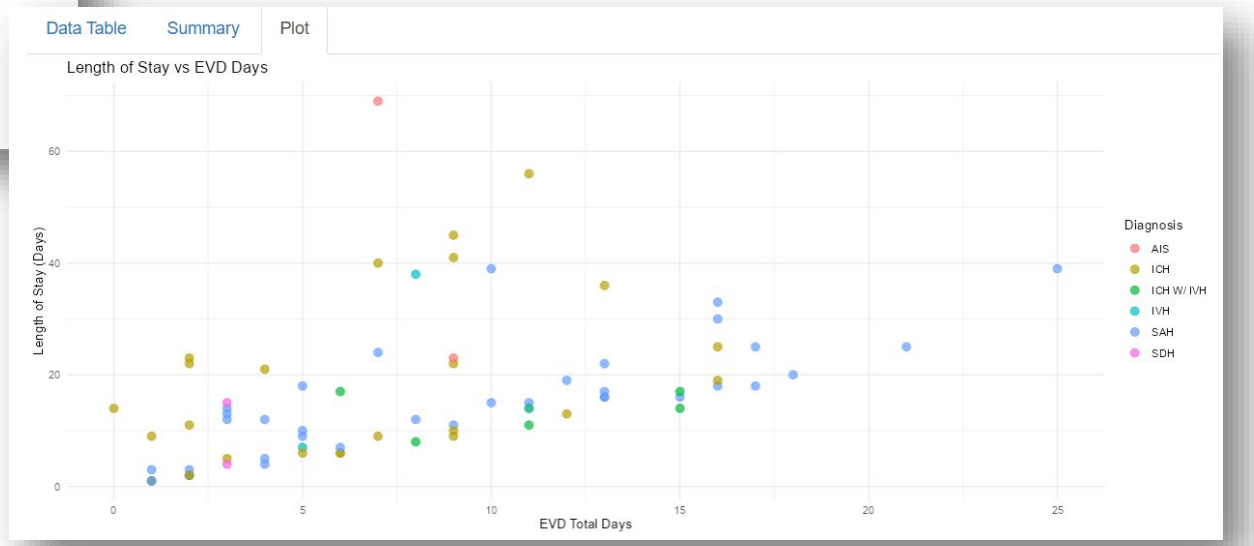
SHINY APP AND GITHUB



https://github.com/

"mlhoughton/CSF_Infection_Surveillance"



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CONCLUSIONS

FACTOR	VARIABLE TYPE	FINDING
Length of stay by infection status	Discrete	Mean length of stay (in days) was higher for patients with CSF infection.
EVD duration by infection status	Discrete	EVD duration (in days) was highest for 1 patient with a CSF infection, otherwise no visual difference is observed.
CSF infection by procedure location	Categorical	All 4 CSF infections occurred in patients whose EVD was placed at the bedside.
CSF infection rate by EVD catheter brand	Categorical	All 4 CSF infections occurred with the CebroFlow EVD catheter.
CSF infection vs. mortality	Categorical	CSF infection did not result in death in the 4 patients with infection.

References

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