PULSE EXPERIENTIAL TEAM ASSIGNMENT

Team #: 40

1. Title of your PULSE experiential assignment.
Provide a creative and informative title.

Fatal Protein Misfolding: A Story of Prions and Creutzfeldt-Jakobs Disease

2. Please summarize your PULSE experiential assignment (max 300 words).
Provide a non-technical (lay) summary of your PULSE assignment. Prompts to think about: What is the topic? What is the format? Why did you choose this topic and format? The summary for lay audience is a brief and accessible summary of the assignment that is used to explain complex ideas, technical writing and scientific terms to people who do not have prior knowledge of the subject (e.g., high school science level). This summary should include the importance, impact, and content of your assignment to a broader audience.
[Team 23 is an example of an informative lay summary.]

Our assignment explores Creutzfeldt-Jakob disease (CJD), a rare and fatal neurodegenerative disorder caused by misfolded prion proteins that trigger abnormal folding of normal brain proteins. This process leads to rapid brain tissue damage with a characteristic sponge-like appearance. The pathogenesis of CJD involves prion propagation, where misfolded proteins act as templates, spreading damage through the brain. Both genetic mutations (PRNP gene) and environmental factors, such as exposure to contaminated tissue, can contribute to disease onset.

CJD occurs in several forms, including sporadic, genetic (familial), variant (linked to bovine spongiform encephalopathy), and iatrogenic (medical transmission). Symptoms progress quickly and may include memory loss, confusion, visual disturbances, poor coordination, and involuntary movements, usually advancing to severe neurological decline.

Diagnosis typically relies on MRI imaging, cerebrospinal fluid (CSF) biomarkers, and electroencephalography (EEG), with definitive confirmation sometimes requiring brain tissue biopsy analysis. Prognosis is poor, as CJD is incurable and progresses rapidly, often leading to death within a year of symptom onset.

Treatment is supportive, focusing on symptom management and patient comfort. Preventive measures emphasize strict medical protocols to avoid transmission. Our infographic aims to present the complex biology of CJD in a clear, engaging format—highlighting its causes, mechanisms, symptoms, and impact—while raising awareness of this rare but devastating disease.

3. Provide up to 6 keywords relevant to your PULSE experiential assignment.
3-6 keywords are ideal.

1. Neurodegenerative

2. Neurotoxicity
3. Prion
4. Protein misfolding
5. Dementia
6. PRNP gene mutation

4. Identify the course topic with which your PULSE assignment most aligns.
Refer to the various topics outlined under 'Course content and Schedule' in the syllabus (e.g. Inflammation).

Infectious Diseases, Diseases of the Central Nervous System

5. What are the learning outcomes?
There should be a minimum of 2 learning outcomes for your assignments. For further information on learning outcomes, the Centre for Teaching and Learning offers information: https://teaching.uwo.ca/curriculum/coursedesign/learning-outcomes.html

By the end of this infographic, readers should be able to...

Explain the pathogenesis of Creutzfeldt-Jakob Disease (CJD), including how misfolded prion proteins propagate and cause neuronal damage.

Analyze the risk factors and transmission routes associated with CJD, including genetic, medical, and environmental factors.

Understand the reasoning behind different diagnostic methods and recognize characteristic MRI findings of CJD.

Understand why the prognosis of CJD patients is poor and how symptoms are managed.

6. Why did the team select the chosen topic and the medium? How will the topic and medium of choice help learners?

The team selected Creutzfeldt-Jakob disease (CJD) as the topic because it is an interesting and unique disease that is a major example of prion disease in humans. CJD highlights how abnormal protein folding can lead to severe neurodegradation, with serious late stage symptoms such as dementia. The team selected an infographic as the medium as it allowed the team to include visual elements to help highlight key ideas and improve clarity of complex concepts. The infographic will help learners understand the complexity of CJD by exploring different aspects of the disease, including its etiology, risk factors, pathogenesis, diagnosis, complications, prognosis, treatment and methods of transmission. The topic also helps learners understand how abnormal protein folding leads to severe neurodegeneration. The infographic format supports learning by presenting information in a clear and visually organized way. Those who are visual learners may find that the visual elements alongside the text make difficult concepts easier to understand.

7. Did the team use an artificial intelligence (AI) technology tool? If so, which AI technology tool(s) did the team use? What other technology tools did the team use? Is the technology tool novel? Is the team using this technology tool in a novel fashion? If the team did not use technology tool, why did the team decide against using the technology tool(s)?

Please include details (e.g., for what purpose was the tool used for? Why was the tool the best tool to use for your assignment? Are there alternative tools that were considered?)

The team did not use any artificial intelligence tools. This is because the team agreed that artificial intelligence tools can be difficult to fact-check should they provide false information and false sources. The team believed it would be easier to do our own research to gather information and have valid information and real sources.

The team utilized Canva, an online graphic design tool, to create the infographic. Canva allows users to structure information in a clear and visually engaging format. Canva is not considered novel as it is commonly used for creating presentations and infographics. The team did not use Canva in a novel fashion. The team utilized Canva's standard features to organize and present information. Canva was the best tool for our assignment as it is free and allows multiple individuals to edit the infographic at the same time. Alternative tools for the creation of the infographic were not considered.

8. How is your PULSE experiential assignment innovative and/or novel?

Describe what about the PULSE assignment is innovative/novel. Is there a particular component or content that is innovative/novel? How is it different from other content that already exists?

Our infographic on CJD is novel in the way that it combines information from many sources into a condensed summary of almost everything there is to know about the disease. Many scientific sources are very wordy and often use heavy scientific jargon which may make them difficult to approach, so we put in the effort to briefly summarize the main points of those sources and phrase the information in a way that most people could understand. We also added visuals and images to enhance comprehension. In short, our infographic is novel in the way that it condenses many scientific sources relating to CJD into a more visually pleasing format that undergraduate students or the general public would find easier to understand and could capture more attention.

9. If you used an AI tool, please copy and paste the prompt(s)/question(s) used along with the output(s)/answer(s) from the AI tool.

The response here is to allow others to replicate the team's work. If the prompts/outputs are lengthy (over 1 page), please attach it as a separate document and note below [Please see attached document].

N/A

10. If you did not use an AI tool, please attach a copy of the team's notes to the assignment.

The response here is to allow others to observe the 'behind the scenes' team's work.

Here are our crude notes and brainstorming for the infographic. Note: Ignore the source numbers as they may not be properly ordered. View the infographic for proper citation numbers.

DK:

Rare, fatal neurodegenerative disorder classified as a transmissible spongiform encephalopathy (TSE) (1)

- Caused by misfolded prion proteins (PrP^{Tsc}) that induce abnormal folding of normal proteins (1)
- Leads to spongiform changes, neuronal loss, and gliosis in the brain (1)
- Characterized by rapidly progressive neurological decline (3)
- Common clinical features:
    - Rapidly progressive dementia
    - Myoclonus (involuntary jerks)
    - Ataxia and motor dysfunction
    - Visual or psychiatric disturbances (3)
- Sporadic CJD (sCJD)
    - Most common form
    - Occurs without identifiable cause, likely due to spontaneous protein misfolding (1)
- Familial (genetic) CJD
    - Associated with mutations in the PRNP gene (1)
    - Inherited and accounts for a smaller proportion of cases (1)
- Iatrogenic CJD
    - Results from medical transmission (e.g., contaminated instruments, grafts) (1)
- Variant CJD (vCJD)
    - Linked to bovine spongiform encephalopathy (BSE) exposure (1)
    - Has distinct clinical and pathological features (1)

Etiology

Central mechanism: conversion of normal prion protein (PrP^{c}) into abnormal PrP^{Tsc} (2)

Misfolded prions act as templates, inducing a chain reaction of protein misfolding (2)

Abnormal prions:

- Are highly stable and protease-resistant (1)
- Accumulate in neural tissue forming aggregates (1)
- Cause synaptic dysfunction and neuronal death (1)

Lead to spongiform vacuolation and brain tissue damage (2)

Lack of nucleic acids → unique infectious protein-based disease (1)

Disease progression influenced by prion strain variation and host factors (1)

Risk Factors

- Genetic factors
    - Mutations in the PRNP gene increase susceptibility (1)

    - Familial inheritance patterns contribute to disease risk (1)
- Protein susceptibility / host biology
    - Individual variation in prion protein structure can affect likelihood of misfolding and disease progression (1)
- Age
    - Most cases occur in older adults, especially for sporadic CJD (3)
- Exposure to infectious prions
    - Medical procedures:
        - Transmission has occurred via contaminated neurosurgical instruments (2)
        - Cases linked to dura mater grafts have been reported (2)
        - Human growth hormone treatment has transmitted CJD (2)
    - Dietary exposure:
        - Consumption of BSE-contaminated beef → variant CJD (2)
- Route of transmission
    - Direct exposure to infected neural tissue increases risk (2)
    - Peripheral exposure (e.g., ingestion) associated with variant CJD (2)
- Sporadic mechanisms
    - Spontaneous protein misfolding events without known trigger (3)
- Strain variability
    - Different prion strains may influence transmissibility, incubation period, and disease phenotype (1)

DB:

Symptoms are quickly worsening: - vary based on type of cjd
Symptoms in CJD patients are usually characterized by quickly worsening neurological abilities such as:
Personality changes, Memory loss, Impaired thinking, Blurry vision or blindness.
Insomnia, Problems with coordination, Trouble speaking, Trouble swallowing.
heart/lung issues, Sudden, jerky movements. (1)
Walking and balance problems, Confusion, disorientation, and delusions
Problems with thinking, memory, and judgment
Behavior changes, such as depression, mood swings, and anxiety
Speech difficulty, Insomnia or changes in sleeping patterns
Vision changes, Hallucinations or distorted perception of the world
Dizziness, Tremor(3)

<u>Complications</u>:
Risk of infection, pneumonia, Mental deterioration, dementia, Lose independence
Coma (1), Weakness of the arms and legs, Blindness, Inability to move or speak
Problems swallowing (3)

<u>Diagnosis</u>: (symptoms may look similar to Alz / Hunt (3)) (often several techniques to confirm)
MRI magnetic resonance imaging - diff levels in brain - DWI diffusion-weighted imaging - cortical ribboning (left pic), hockey stick sign (m right), pulvinar sign (right)(4)
look at diffusion restriction (signal intensity)

DWI a form of mri we can visualise certain characteristic signals, does not use radiation (6) - signals (4) cortex, striatum, thalamus, caudate (middle left pic, can be bilateral / unilateral)

Often use several tests for a more confident diagnosis

EEG electroencephalogram - certain abnormal wave complexes can be detected in patient brain electrical activity that are characteristic of CJD (5)

CSF test (lumbar puncture / spinal tap) - detect proteins 14-3-3 and tau protein markers indicating degeneration (3)
-> RT-QuIC Real-time quaking-induced conversion assay - detect specific prions (3)

Neurological test - identify reflexes, muscle twitching/spasms, bad coord, blindness (3) -myoclonus, visual or cerebellar signs, pyramidal/extrapyramidal signs, akinetic mutism, etc characteristic of CJD (4)

Histology / brain biopsy - rare, undesirable but when unclear a neurosurgeon can remove a piece of brain to be examined by pathologist (4)
New diagnostic targets under investigation: Blood, urine, nasal brushings, skin. (6)

KM:
Prognosis:

- CJD has a very poor outlook because the condition isn't curable or treatable. After symptoms start, you'll soon lose the ability to care for yourself, move and communicate.
- Most cases of CJD are fatal within months to a year after diagnosis. The exception is genetic CJD, which can have a survival time of one to 10 years after symptoms start.
- Death occurs in approximately 70% of patients within a year of diagnosis
- Death usually occurs within a year. People with Creutzfeldt-Jakob disease usually die of medical issues associated with the disease. They might include having trouble swallowing, falls, heart issues, lung failure, or pneumonia or other infections.
- CJD causes dementia and other neurologic problems. Once symptoms begin, it can lead to death in months to a year
- CJD occurs with an estimated rate of about 1 to 2 deaths per 1 million people per year. In the United States, about 500-600 cases are reported each year.

Treatment:

- CJD has no definitive treatment, and supportive care is the mainstay of clinical management
- Most trial drugs for CJD have not demonstrated any clear benefit to date
- Early detection of a PRNP mutation may help families at risk for the genetic form of CJD

- Psychosocial support and supportive care may improve patients' quality of life. Genetic counseling and family planning help prevent the transmission of disease to the offspring of individuals with the PRNP mutation
- At present, treatment involves trying to keep the person as comfortable as possible and reducing symptoms with medicines.
    - For example, psychological symptoms of CJD, such as anxiety and depression, can be treated with sedatives and antidepressants, and muscle jerks or tremors can be treated with medicines like clonazepam and sodium valproate.
    - Any pain experienced can be relieved using powerful opiate-based painkillers.
- Psychosocial support and supportive care may improve patients' quality of life. Genetic counseling and family planning help prevent the transmission of disease to the offspring of individuals with the PRNP mutation

Transmission:

- Strategies focus on prevention, with blood centers prohibiting first-degree relatives of individuals with CJD from donating blood. Hunters who plan to consume or handle elk or deer meat should consider having the meat tested for safety before consumption. Families at risk for the genetic type of CJD may practice contraception to prevent disease transmission to their offspring.
- CJD isn't easily contagious from person-to-person contact. The only way to spread it from person to person is through organ or tissue transplants or certain types of hormones taken from a donor who had CJD.
- Variant CJD may be passed in blood transfusions, but this is extremely rare. Variant CJD is also extremely rare on its own.

DR:

Normal PrP^{c} misfolds from an alpha-helical structure into the beta-sheet rich PrP^{sc} form. This abnormal protein is insoluble, protease-resistant, and induces further misfolding, causing prion aggregation, neuronal damage, and spongiform change in the brain. (4)

The types of different CJD: (summarize in a paragraph for infographic)

- Sporadic CJD: the initial pathogenic event happens spontaneously, when normal PrP^{c} misfolds into abnormal PrP^{sc} without a known external trigger. (16)
- Variant CJD (vCJD): the first misfolding event is triggered by exposure to BSE-associated infectious prions, which enter the body and seed the conversion of normal prion proteins into the abnormal form. (16)
- Familial CJD: an inherited PRNP gene mutation makes the prion protein structurally unstable and more likely to misfold into PrP^{sc}, starting the disease process. (16)
- Iatrogenic CJD: infectious prions are introduced from an outside source through contaminated medical tissue, grafts, hormones, or surgical instruments, which then initiate abnormal protein conversion. (16)

- Shared downstream mechanism: once PrP^{sc} is formed, it acts as a template that converts more normal PrP^{c} into the abnormal form, creating a self-propagating cycle of prion accumulation. (16)
- Pathological outcome: this progressive buildup causes neuronal dysfunction and loss, reactive gliosis, and the characteristic spongiform degeneration seen in affected brain tissue. (16)

Mechanism of Prion Pathogenesis:

1. The normal cellular prion protein, PrP^{c}, which is alpha-helix rich, changes into PrP^{sc}, an abnormal beta-sheet rich form. This new form is insoluble, highly stable, and resistant to protease degradation, so it is not cleared normally and begins to accumulate in brain tissue. (12)
2. Once PrP^{sc} is present, it acts as a template or seed, binding to normal PrP^{c} and forcing it to adopt the same abnormal shape. This creates a self-propagating cycle in which each newly misfolded protein can convert more normal proteins. (16)
3. As more PrP converts into PrP^{sc}, the misfolded proteins aggregate into oligomers and larger deposits that spread through the central nervous system. Because these aggregates resist breakdown, they progressively build up and interfere with normal cell function. (4)
4. The buildup of abnormal prion protein causes cellular stress, including endoplasmic reticulum stress, disrupted intracellular trafficking, and calcium imbalance. These changes impair neuronal metabolism and signalling, eventually triggering neuronal apoptosis and degeneration. (11)
5. As neurons are damaged and lost, the brain develops many tiny vacuoles, giving affected tissue a sponge-like appearance on microscopy. This spongiform degeneration is one of the classic pathological features of prion disease. (16)
6. In response to ongoing prion injury, astrocytes and microglia become activated. This reactive gliosis is the brain's attempt to respond to damage, but it also adds to neuroinflammation and can worsen surrounding neuronal injury. (11)

11. How did the team ensure the veracity of the information presented in the PULSE assignment?

The response should highlight how the team has ensured that the information presented in the assignment is evidence-based and not spreading misinformation. You should specifically mention which databases (if any) or textbook materials you used, and how you kept track of the sources/references for each claim. If AI provided you with false information, please describe how the team has fact-checked the AI response and the legitimate (scientific) sources you used. A reference document should be provided in the reference section (15. References) below. Please ensure to include in-text citations in your assignment where applicable.

The team ensured the veracity of the information presented in the PULSE assignment by relying on evidence-based sources rather than unsupported online claims. We did not use artificial intelligence tools to generate scientific content because we understood that AI can sometimes provide false information or fabricated references. Instead, each section of the infographic was researched using credible scientific and

clinical sources, including peer-reviewed journal articles and reputable health organizations such as Viruses, The Lancet, The American Journal of Emergency Medicine, NINDS/NIH, CDC, Mayo Clinic, NHS, Cleveland Clinic, StatPearls/NCBI. These sources were selected because they are directly relevant to the topic of Creutzfeldt-Jakob disease and provide medically reviewed or scientifically published information on its pathogenesis, diagnosis, transmission, prognosis, and treatment.

To avoid spreading misinformation, the team made sure that each claim included in the assignment was supported by a source that specifically addressed that part of the topic. For example, peer-reviewed journal articles were used for scientific mechanisms and disease pathology, while established medical and public health organizations were used for clinical features, diagnosis, prognosis, and patient care information. This helped ensure that the references were not only traceable, but also appropriate and reliable for the specific type of claim being made. Our shared research notes and reference list helped us keep track of which source supported each section, and key facts were cross-checked across multiple sources when possible, before being included in the final infographic with in-text citations where applicable.

12. Write a meaningful team reflection about the PULSE session (max 250 words).

Prompts to help your team write the reflection: Were there any team/individual biases that surfaced when creating content for the assignment? Did the team implement any practices to ensure the content was equitable, diverse, and/or inclusive? How has the PULSE assignment helped with the team's learning? If the team had to estimate, how long did the assignment take? What worked well for your team? What would the team do differently next time? What were the opportunities and challenges with creating the PULSE assignment to help others' learning? Were there any barriers or limitations?

Reflection:

The PULSE assignment was a worthwhile experience for our team because it forced us to think carefully about how to teach others about Creutzfeldt-Jakob disease in a clear, and interesting way. One prejudice we had to be aware of was the assumption that every student would be familiar with complex scientific jargon or have prior understanding of neurology. In order to address this, we tried to simplify difficult concepts without eliminating crucial scientific information. In order to ensure that more students, regardless of their expertise in science, could comprehend the infographic, we also tried to make it inclusive and accessible by using simple language, properly organizing the material, and avoiding excessively technical explanations whenever feasible.

Our comprehension of prion disease, particularly its pathophysiology, diagnosis, and transmission, was strengthened by this assignment, which also enhanced our research, collaboration, and communication abilities. From conducting individual research to planning and perfecting the final infographic, we estimate that the entire project took several weeks. When scheduling made in-person meetings challenging, it was effective to divide duties by topic and stay in touch via our group chat or by planned phone calls. Converting a very complicated subject into something succinct

and visually appealing without sacrificing scientific truth was one challenge. If we were to do this again, we might think about utilizing a different medium, such as an interactive format or a brief slide show, which would enable us to teach the subject in greater detail while keeping it structured and interesting for students.

13. Write the contributions of individual team members using unique initials.
Example: All team members contributed to the design of the prompts used in the technology tool, ChatGPT (GPT-3.5). T.K and T.K2 fact checked the information presented by ChatGPT using published literature on PubMed (PMID 29211319, 32477271). Y.Z finalized and formatted the final infographic and compiled the prompts and outputs. P.E was involved in…

All team members contributed to designing the assignment on Canva in order to ensure that information was organized in a clear and visually appealing format.

DB - Proposed project topic (CJD). Selected infographic template. Researched and prepared sections on Symptoms, Complications and Diagnosis. Answered questions 1 and 8 on assignment template. Finalized correct source numberings in infographic.

KM - Researched the prognosis, treatment and transmission of CJD. Also designed and organized the information in regards to prognosis, treatment and transmission of CJD on the infographic. Answered questions 3, 6 and 7 of the assignment template. Wrote annotations for sources 9-14.

DK - Etiology (Page 1 of infographic). Answered questions 2, 4, and 5 on the assignment template. Wrote annotations for sources 1-3.

DR - Overview of prions and protein misfolding and Mechanism of prion pathogenesis (designed and organized Page 2). Answered questions 11 and 12 of the PULSE assignment template. Wrote annotations for sources 4-8.

14. Other comments (Optional)
Any comments the team would like to let the coordinator and/or TAs know.

15. References

Please provide a numbered reference list with Nature citation style. [Please feel free to use citation management software (i.e., free citation manager, e.g., Zotero and Mendeley)]

1. Bellini P, Ruggiero F, Benedetti A, Cereda CW, Gobbi C, Bianco G, et al. Human Prion Disease: Pathogenesis, Diagnosis and Public Health. Viruses. 2026 Feb 6;18(2):216. Available from: https://www.mdpi.com/1999-4915/18/2/216
2. Collinge J. Variant Creutzfeldt-Jakob disease. The Lancet [Internet]. 1999 Jul 24 [cited 2020 Nov 7];354(9175):317–23. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0140673699051284
3. Salehi P, Clark M, Pinzon J, Patil A. Sporadic Creutzfeldt-Jakob disease. The American Journal of Emergency Medicine. 2022 Feb;52:267.e1–3. Available from: https://pubmed.ncbi.nlm.nih.gov/34334283/
4. NHS Choices. Causes - Creutzfeldt-Jakob disease [Internet]. NHS. 2019. Available from: https://www.nhs.uk/conditions/creutzfeldt-jakob-disease-cjd/causes/
5. Mayo Clinic. Creutzfeldt-Jakob disease [Internet]. Mayo Clinic. 2023. Available from: https://www.mayoclinic.org/diseases-conditions/creutzfeldt-jakob-disease/symptoms-causes/syc-20371226
6. Sitammagari KK, Masood W. Creutzfeldt Jakob Disease [Internet]. Nih.gov. StatPearls Publishing; 2019. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507860/
7. National Institute of Neurological Disorders and Stroke. Creutzfeldt-Jakob Disease [Internet]. www.ninds.nih.gov. 2023. Available from: https://www.ninds.nih.gov/health-information/disorders/creutzfeldt-jakob-disease
8. Ho ML. Creutzfeldt-Jakob disease | Radiology Reference Article | Radiopaedia.org [Internet]. Radiopaedia. [cited 2020 Nov 6]. Available from: https://radiopaedia.org/articles/creutzfeldt-jakob-disease
9. Mundlamurri RC, Shah R, Adiga MS, Chatterjee A, Gautham B, Raghavendra K, et al. EEG Observations in Probable Sporadic CJD. Annals of Indian Academy of Neurology [Internet]. 2020 [cited 2021 Apr 6];23(6):760–6. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7900740/
10. Diagnosis [Internet]. CJD Foundation. Available from: https://cjdfoundation.org/diagnosis/
11. McQuain J, Galicia-Castillo M, Morris D. Palliative Care Issues in Creutzfeldt-Jakob Disease | Palliative Care Network of Wisconsin [Internet]. Palliative Care Network of Wisconsin. 2023. Available from: https://www.mypcnow.org/fast-fact/palliative-care-issues-in-creutzfeldt-jakob-disease/
12. CDC. Classic Creutzfeldt-Jakob Disease [Internet]. Creutzfeldt-Jakob Disease (CJD). 2024. Available from: https://www.cdc.gov/creutzfeldt-jakob/about/index.html
13. NHS. Treatment - Creutzfeldt-Jakob disease [Internet]. NHS. 2019. Available from: https://www.nhs.uk/conditions/creutzfeldt-jakob-disease-cjd/treatment/

14. Cleveland Clinic. Creutzfeldt-Jakob Disease (CJD): Types, Causes, Symptoms & Outlook [Internet]. Cleveland Clinic. 2022. Available from: https://my.clevelandclinic.org/health/diseases/6001-creutzfeldt-jakob-disease

16. Annotated Bibliography

An annotated bibliography is a list of sources (books, articles, websites, etc.) that you used for your project. Each entry has two parts:

1. *Citation – written in the required citation style (same formatting and order as the Nature citation style in your list of references).*
2. *Annotation – a short paragraph that summarizes, evaluates, and explains how the source is useful for your assignment.*

Why do this?

- *Helps you keep track of your research.*
- *Shows your instructor you read and understood your sources.*
- *Develops critical thinking by requiring you to evaluate the quality and relevance of each source.*

Write the annotation (about 150–200 words each)

- *Summary: Briefly describe the main argument or purpose of the source.*
- *Evaluation: Comment on the credibility, strengths, or weaknesses of the source.*
- *Relevance: Explain how you will use this source in your assignment.*

Source 1: Bellini P, Ruggiero F, Benedetti A, Cereda CW, Gobbi C, Bianco G, et al. Human Prion Disease: Pathogenesis, Diagnosis and Public Health. Viruses. 2026 Feb 6;18(2):216. Available from: https://www.mdpi.com/1999-4915/18/2/216

Summary: This contemporary source offers an overview of the classification and risk factors of human prion diseases. It correlates well with your notes under "Familial CJD," where the mutation of PRNP gene makes individuals vulnerable to this type of illness. The source talks about different modes of transmission, from natural inheritance to medical practices such as dura mater transplantation or treatment with human growth hormones. In addition, age is confirmed as another major risk factor associated with sCJD. The source covers the "Pathological Features" of the disease from your notes, mentioning the process of accumulation of abnormal prions and their aggregation in the brain, followed by the development of neurodegeneration and synapse dysfunction and resulting in spongiform vacuolation.

Evaluation: This is a very recent source, which makes it relevant in relation to your topic. The source is quite authoritative, being an open-access, peer-reviewed article on the results of contemporary international surveillance of human prion diseases. Its major advantage lies in the in-depth discussion of "Risk Factors" and "Host Biology."

Relevance: This source will help me develop further the "Risk Factors" and "Genetic Factors" sections of my assignment with the necessary details.

Source 2: Collinge J. Variant Creutzfeldt-Jakob disease. The Lancet [Internet]. 1999 Jul 24 [cited 2020 Nov 7];354(9175):317–23. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0140673699051284

Summary: This basic review article revolves around the topic of vCJD, and discusses how the condition is linked to BSE infection, commonly from ingestion of infected meat. Collinge explains that the basis of the pathology involves the transformation of the physiological PrPc form of prion protein into an alternative form referred to as protease-resistant PrPSc. This source relates to the notes you took about the "protein-only" characteristic of this illness because the infective agents do not contain nucleic acids and act as templates for propagation of misfolding. The article also touches on another aspect you noted, which is the resistance of the infectious prions to common sterilization methods due to their high stability.

Evaluation: As a review published in The Lancet, this is an authoritative source. Though it is an older study, its explanation of the "Etiology" and the "Strain Variation" mentioned in your notes remains a scientific standard. It is particularly strong in explaining the route of transmission and the public health implications of variant and iatrogenic CJD.

Relevance: This source will be the cornerstone for the sections on "Etiology" and "Variant CJD." It provides the necessary depth to explain how peripheral exposure, such as ingestion, leads to neural tissue damage and the unique infectious nature of the prion protein.

Source 3: Salehi P, Clark M, Pinzon J, Patil A. Sporadic Creutzfeldt-Jakob disease. The American Journal of Emergency Medicine. 2022 Feb;52:267.e1–3. Available from: https://pubmed.ncbi.nlm.nih.gov/34334283/

Summary: This clinical paper presents the case study of a 57-year-old man to highlight the complexity of diagnosing sporadic CJD. As per your record, sCJD is the most common type with no known cause. According to the article, sporadic CJD is considered a rare but fatal neurodegenerative disease classified as TSE. The authors emphasize the term "rapidly progressive neurological decline," referring to rapidly progressing dementia, myoclonus, ataxia, and motor dysfunctions. The source elaborates by mentioning that the disease is caused by the aggregation of prion protein Sc (PrPSc), leading to structural abnormalities in healthy proteins resulting in spongiosis and neuron loss. As per the source, the disease ultimately leads to the death of patients within months to a year after symptom onset.

Evaluation: This scholarly article from a reputable and peer-reviewed medical journal offers high credibility for use in clinical practice. Its value is in connecting molecular mechanisms with clinical aspects in an emergency department scenario. The source gives detailed explanations about the "common clinical features" mentioned in your notes but does not offer enough information regarding genetic mutations in familial cases.

Relevance: I am going to use this source to describe the basic features of CJD and offer a clinical profile in support of the "Sporadic CJD" and "Common Clinical Features" parts of the assignment. This source provides key information about the fast development of CJD.

Source 4: 1.NHS Choices. Causes - Creutzfeldt-Jakob disease [Internet]. NHS. 2019. Available from: https://www.nhs.uk/conditions/creutzfeldt-jakob-disease-cjd/causes/

Summary: This source gives an overview on how protein misfolding and prions cause CJD. It explains certain steps of pathogenesis and how it leads to damage in brain tissue. This source also describes different types of CJD and Mad Cow Disease.

Evaluation: The source is from the National Health Service UK, which is the publicly funded healthcare system located in the United Kingdom. This means the source is somewhat credible, considering it is from a public health organization. It is only somewhat credible as the authors of the source are not stated in addition to citations. A strength of this source is its simplicity, it is easy to understand and it does not use confusing wording. A weakness of this source is that it is too simple and brief from a scientific point of view. It does not go into great detail of each aspect of the disease.

Relevance: This source will be used for part of the pathogenesis section.

Source 5: Mayo Clinic. Creutzfeldt-Jakob disease [Internet]. Mayo Clinic. 2023. Available from: https://www.mayoclinic.org/diseases-conditions/creutzfeldt-jakob-disease/symptoms-causes/syc-20371226

Summary: This source provides a general overview of CJD, focusing on its symptoms, causes, and progression. It explains that CJD is a rare neurodegenerative disorder caused by misfolded prion proteins, leading to rapid cognitive decline and motor dysfunction. The source also explains that the disease is not easily transmitted through casual contact.

Evaluation: This source is published by the Mayo Clinic, which appears to be a credible source of information considering that its authors consist of multiple medical professionals. One of its strengths is that it provides clear explanations and accessibility for a general audience. One of its weaknesses is that it is not as in-depth in comparison to other sources available. The source is good for obtaining information for the general public, but not good for other medical professionals.

Relevance: This source will be used for the prognosis section as it provides details that demonstrate that most CJD patients die from complications of the disease.

Source 6: Sitammagari KK, Masood W. Creutzfeldt Jakob Disease [Internet]. Nih.gov. StatPearls Publishing; 2019. Available from: https://www.ncbi.nlm.nih.gov/books/NBK507860/

Summary: This source provides an overview of CJD. It explains CJD's clinical presentation, diagnosis, management, and prognosis.The article explains that there is no effective treatment, and supportive care is the primary approach. It also explains the poor prognosis, stating that most patients die within months to a year after diagnosis.

Evaluation: The source is available from the National Library of Medicine, specifically the NCBI (National Center for Biotechnology Information), which demonstrates that this is a credible source. Both authors of this source are affiliated with medical universities, which supports the fact that this source must provide credible information. Sources are also provided for this website, which demonstrates where information was obtained from. A strength for this source is that it provides detailed and clinically relevant information. It also covers multiple aspects of the disease.

Relevance: This source will be used for the prognosis, treatment and transmission section. It provides statistical data on survival for the prognosis section and outlines preventive measures relevant to transmission. It also states methods on how to manage CJD for treatment.

Source 7: National Institute of Neurological Disorders and Stroke. Creutzfeldt-Jakob Disease [Internet]. www.ninds.nih.gov. 2023. Available from: https://www.ninds.nih.gov/health-information/disorders/creutzfeldt-jakob-disease

Summary: This source gives a thorough explanation of Creutzfeldt-Jakob disease, including what it is, who is most likely to have it, how to diagnose and treat it, and what research is currently being done. It describes CJD as a rare, quickly developing prion disease that results in dementia, myoclonus, loss of coordination, and cognitive deterioration. The site lists early and late symptoms, explains that variant CJD is associated with bovine spongiform encephalopathy, and highlights the three primary ways that CJD develops: sporadic, inherited, and acquired. Additionally, it covers diagnostic techniques such as cerebrospinal fluid tests, including RT-QuIC, EEG, MRI, and neurological exams. Furthermore, the site claims that there is presently no cure for CJD and that comfort care and symptom management are the main goals of treatment. It also contains details regarding current prion biology research, diagnostic procedures, and potential treatment targets.

Evaluation: The National Institute of Neurological Disorders and Stroke, a division of the National Institutes of Health, is the publisher of this source, making it a very reliable official and scientific source. This source's ability to integrate clinical data with contemporary research updates is one of its main advantages, making it helpful for both background knowledge and current advancements in the area. It is also all-inclusive, including information on symptoms, causes, diagnosis, therapy, prognosis, and current research in one location. One drawback is that it lacks the same degree of information

as a professional, peer-reviewed journal paper since, like many public health tools, it is created to be accessible to a wide audience. Even so, it remains highly reliable for medically reviewed and scientifically grounded information.

Relevance: The overview, symptoms, diagnosis, therapy, prognosis, and current research on CJD are among the areas of the assignment that will be supported by this source. Because it offers precise descriptions of the disease process along with diagnostic tools like MRI, EEG, CSF testing, and RT-QuIC, it is especially helpful. Along with providing useful background information regarding how researchers are now attempting to better understand and treat prion illnesses, it also supports claims about the rarity, quick progression, and deadly nature of CJD.

Source 8: Ho ML. Creutzfeldt-Jakob disease | Radiology Reference Article | Radiopaedia.org [Internet]. Radiopaedia. [cited 2020 Nov 6]. Available from: https://radiopaedia.org/articles/creutzfeldt-jakob-disease

Summary: This source concentrates on Creutzfeldt-Jakob disease's radiologic and diagnostic characteristics, paying special attention to MRI results. It describes CJD as a transmissible spongiform encephalopathy that, although most cases are sporadic, typically results in fast increasing dementia and death within a year of onset. The article highlights how diffusion-weighted imaging (DWI) typically displays hyperintense signals, frequently including the thalamus, striatum, and cerebral cortex. Additionally, it explains distinctive radiologic indicators as the pulvinar sign, hockey stick sign, and cortical ribboning. The article also notes that MRI is the preferred imaging modality for suspected CJD and describes diagnostic criteria, typical clinical symptoms, and the use of EEG, CSF testing, and RT-QuIC.

Evaluation: Radiopaedia, a popular radiological reference website for medical practitioners, has published this source. Its ability to give comprehensive and clinically relevant imaging data that is directly related to diagnosing CJD, particularly through MRI interpretation, is one of its key advantages. It is particularly helpful in elucidating the particular brain areas and signal alterations linked to the illness. One drawback is that the source is more focused on radiology and imaging than on patient care or more general disease treatment. Additionally, it is a reference-style summary rather than an actual research study. Nevertheless, because it discusses the distinctive neuroimaging results associated with CJD, it is very helpful for the diagnosis section.

Relevance: The diagnosis portion of the assignment, particularly the section outlining MRI results in CJD, will be supported by this source. The hockey stick and pulvinar indications, cortical ribboning, and diffusion-weighted imaging anomalies are particularly useful in diagnosing probable instances. This source also lends credence to claims that MRI is among the most sensitive and practical methods for identifying distinctive brain abnormalities in CJD.

Source 9: Mundlamurri RC, Shah R, Adiga MS, Chatterjee A, Gautham B, Raghavendra K, et al. EEG Observations in Probable Sporadic CJD. Annals of Indian Academy of Neurology [Internet]. 2020 [cited 2021 Apr 6];23(6):760–6. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7900740/

Summary: This source focuses on the importance of electroencephalography (EEG) in supporting diagnosis and looks at EEG results in individuals with suspected sporadic Creutzfeldt-Jakob disease. EEG revealed specific or nonspecific abnormalities in 88% of the 50 patients with suspected sCJD examined in the study. While MRI abnormalities supporting CJD were observed in 96% of instances, periodic sharp wave complexes, the most typical EEG finding, were found in 66% of patients. According to the article, even though an EEG may appear normal or only reveal vague anomalies in the early stages of the disease, it can be a helpful and reasonably priced diagnostic tool. Additionally, the study compares EEG results with the clinical characteristics frequently observed in the group, such as dementia, psychiatric disorders, myoclonus, and ataxia.

Evaluation: This source is a peer-reviewed journal article and is highly relevant because it focuses specifically on EEG findings in probable sporadic CJD. Its use of a specific patient cohort and provision of hard data on the diagnostic sensitivity of MRI and EEG are two of its advantages. It is especially helpful for comprehending the limitations and diagnostic utility of EEG, particularly periodic sharp wave complexes. Its ability to compare electrophysiological results with MRI abnormalities, which aids in placing EEG in the larger diagnostic context, is another asset. The study's retrospective design and lack of autopsy confirmation, serial EEGs, and comprehensive biomarker testing in all patients are limitations. It is nonetheless a reliable scientific source for the assignment's diagnosis portion in spite of these drawbacks.

Relevance: The diagnosis portion of the assignment, particularly the section on EEG abnormalities in sporadic CJD, will be supported by this source. It helps explain that while periodic sharp wave complexes are a typical EEG feature, EEG may be less sensitive than MRI and may not reveal certain abnormalities early in the course of the illness. Additionally, this source explains why EEG is utilized in conjunction with other diagnostic methods rather than alone and supports claims regarding similar neurological characteristics seen in likely sCJD.

Source 10: Diagnosis [Internet]. CJD Foundation. Available from: https://cjdfoundation.org/diagnosis/

Summary: An overview of the primary diagnostic methods for prion illnesses, including Creutzfeldt-Jakob disease, is given in this source. It clarifies that general practitioners should identify questionable symptom patterns and send patients right away to a neurologist. The source outlines a number of crucial diagnostic techniques, such as MRI, diffusion-weighted imaging, electroencephalography, and cerebrospinal fluid testing using RT-QuIC, tau, and 14-3-3 protein markers. It claims that RT-QuIC is a highly diagnostic tool for prion illness and can identify real prions in spinal fluid. The source

also discusses other techniques such as protein misfolding cyclic amplification and more recent diagnostic targets that are being studied, such as skin, blood, urine, and nasal brushing.

Evaluation: This source is produced by the CJD Foundation, a group dedicated to raising awareness of CJD and providing assistance to families impacted by prion disease. This source's clear focus on prion disease diagnostics and its straightforward and well-organized presentation of important clinical tools are among its strong points. It is particularly helpful for providing an understandable summary of diagnostic tests like RT-QuIC, MRI, and EEG. One drawback is that it is more instructional than research-based and is not published in a peer-reviewed scientific publication. Nevertheless, it remains valuable as a disease-specific campaigning and instructional tool, particularly when bolstered by additional scientific sources.

Relevance: The diagnosis portion of the assignment will be supported by this source, particularly the description of the main diagnostic instruments used in cases of suspected CJD. Summarizing RT-QuIC, tau, 14-3-3, MRI, DWI, and EEG in one location is quite beneficial. The notion that early detection and professional referral are crucial in the diagnosis of prion illness is also supported by this source.

Source 11: McQuain J, Galicia-Castillo M, Morris D. Palliative Care Issues in Creutzfeldt-Jakob Disease | Palliative Care Network of Wisconsin [Internet]. Palliative Care Network of Wisconsin. 2023. Available from: https://www.mypcnow.org/fast-fact/palliative-care-issues-in-creutzfeldt-jakob-disease/

Summary: This source outlines palliative care for CJD. It focuses on symptom progression, management, and overall care throughout managing CJD. This source explains that CJD is a rapidly progressing, incurable neurodegenerative disease, with symptoms such as cognitive decline or motor dysfunction worsening over weeks to months. It emphasizes the importance of early palliative care involvement to address symptom control, provide anticipatory guidance, and support both patients and caregivers throughout the disease course

Evaluation: This source is published by Palliative Care Network of Wisconsin, which appears to be a credible source. I think this because the three authors of the source all have credible degrees (MDs and DO), thus the information provided must also be credible. The source also states its references, demonstrating where certain ideas come from and proving that they are not made up. One of its strengths is that the source provides straight to the point facts, there are not many filler words which makes reading and gaining ideas easier. One of its weaknesses is that the source is very brief and lacks in-depth analysis.

Relevance: This source will be used to support the prognosis section by providing information on disease progression and expected outcomes.

Source 12: CDC. Classic Creutzfeldt-Jakob Disease [Internet]. Creutzfeldt-Jakob Disease (CJD). 2024. Available from: https://www.cdc.gov/creutzfeldt-jakob/about/index.html

Summary: This source provides an overview of CJD. It describes the different types of CJD (sporadic, familial, iatrogenic) as well as statistical data related to each different type. This source also provides statistical data on how many individuals are affected by CJD each year. This source briefly goes over how CJD affects one's body, the testing and diagnosis process, treatments for CJD, and similar diseases.

Evaluation: The source is published by the Centers for Disease Control and Prevention, which is a credible website. Unfortunately, this source has multiple weaknesses in comparison to other sources available. For example, this source provides very brief information on the different aspects of CJD. It does not go in-depth into how CJD can affect one's body and how CJD develops (in terms of prions). In addition, this website does not display the author(s), thus it is difficult to determine if those who wrote this source are credible or not. In addition, only 2 sources were used to gather information for this website, further supporting that this source is incredibly brief.

Relevance: This source will be used in the prognosis section as it provides statistical data on how many individuals are affected by CJD each year.

Source 13: NHS. Treatment - Creutzfeldt-Jakob disease [Internet]. NHS. 2019. Available from: https://www.nhs.uk/conditions/creutzfeldt-jakob-disease-cjd/treatment/

Summary: This source focuses on the treatment and management available for CJD. It explains that there is no cure for CJD and care is focused on symptom relief. The source describes how psychiatric symptoms such as anxiety and depression may be treated with sedatives and antidepressants, while motor symptoms like muscle jerks and tremors can be managed with medications such as clonazepam and sodium valproate. The source also explains that overall pain can be temporarily relieved with strong opioid medications.

Evaluation: The source is from the National Health Service UK, which is the publicly funded healthcare system located in the United Kingdom. This means the source is somewhat credible, considering it is from a public health organization. It is only somewhat credible as the authors of the source are not stated in addition to citations. A strength of this source is its simplicity, it is easy to understand and it does not use confusing wording. A weakness of this source is that it is too simple and brief from a scientific point of view. It does not go into great detail of each aspect of the disease.

Relevance: This source will be used for the treatment section as the source provides different methods of symptom relief for those struggling with CJD.

Source 14: Cleveland Clinic. Creutzfeldt-Jakob Disease (CJD): Types, Causes, Symptoms & Outlook [Internet]. Cleveland Clinic. 2022. Available from: https://my.clevelandclinic.org/health/diseases/6001-creutzfeldt-jakob-disease

Summary: This source provides a detailed overview of CJD. It explains that CJD is a rare neurodegenerative disorder caused by misfolded prion proteins that damage brain cells. It goes over multiple aspects of the disease, including symptoms and causes, different types, diagnosis, treatment/management, prognosis and prevention.

Evaluation: This source is available from the Cleveland Clinic, which appears to be a credible organization. The website shares its sources publicly to demonstrate where information is obtained from, in addition to claiming that the information has been medically reviewed. Cleveland Clinic also claims that their articles are “based on evidence-backed information,” which further supports its credibility. Unfortunately, the authors/editors of the article are not publicly stated, thus it is difficult to determine if the article was written by medical professionals and was truly medically reviewed. A strength of this source is its organization of information. It provides simple visuals that help readers to thoroughly understand certain symptoms of the disease and what it looks like.

Relevance: This source will be used for the transmission section as it provides helpful information in regards to prevention of CJD.