1. Department of Health of Maharashtra Government plans to expand its telemedicine services to underserved rural communities. Before proceeding, the director needs to conduct a comprehensive analysis to identify the best technique that could influence the implementation plan.
    a. Which framework would be most appropriate for conducting this analysis (Select only one)?

    A) PICOT
    B) RE-AIM
    C) PESTEL
    D) PEO

    b. Provide suitable justification to support the selection of answer

2. Consider the following hypothesis: "A school-based obesity prevention program will be successful if it reaches a high proportion of at-risk students, effectively reduces BMI, is adopted by multiple schools, is implemented with fidelity across different settings, and produces sustainable behavioural changes over time."
    a. Which research framework does this hypothesis most closely align with?
        A) PICO
        B) RE-AIM
        C) PESTEL
        D) PICOT
    b. Provide suitable justification to support the selection of answer

3. A public health department is planning a county-wide screening program for hypertension. Based on previous screening initiatives, they expect that approximately 30% of adults in the county have hypertension (either diagnosed or undiagnosed). The department wants to estimate the true prevalence of hypertension with a margin of error of ±3 percentage points at a 95% confidence level.

a. Which of the following best describes how the required sample size would change if the expected prevalence of hypertension was actually 20% instead of 30% (keeping the same margin of error and confidence level)?

   A) The required sample size would increase.

   B) The required sample size would decrease.

   C) The required sample size would remain the same.

   D) The required sample size would parameters to be recalculated using a new survey.

b. Provide suitable justification to support the selection of answer

Non-MCQs

4. In 1954, Dr. Jonas Salk led one of the largest medical field trials in history to test his inactivated polio vaccine. The trial included 1.8 million children, with approximately 440,000 receiving the vaccine, 210,000 receiving a placebo, and 1.2 million serving as observed controls. Among the vaccinated group, 33 cases of polio were reported (0.0075%), while the placebo group had 115 cases (0.055%). A modern pharmaceutical company is developing a new vaccine for an emerging infectious disease with similar characteristics to polio. They plan to conduct clinical trials with the following parameters:
    - Estimated disease incidence in the population: 0.05%
    - Expected vaccine efficacy: 85%
    - Planned trial size: 15,000 participants (7,500 vaccine, 7,500 placebo)
    - Trial duration: 6 months

    Evaluate whether the planned sample size and trial duration are sufficient to justify the safety and efficacy of the new vaccine.

    a. Calculate the expected number of cases in each group based on the given parameters.
    b. Discuss at least two statistical and ethical considerations related to sample size adequacy for establishing vaccine safety.
    c. Recommend any modifications to the study design to better justify safety, referring to relevant statistical principles and historical precedents like the Salk vaccine trial.

5. Design: School Nutrition Program Evaluation in Rural India

The Ministry of Women and Child Development in collaboration with the Ministry of Education has implemented a new comprehensive school meal program called "PoshanShakti" in government schools across several districts in rural India to address childhood malnutrition. This program expands upon the existing Mid-Day Meal scheme with enhanced nutritional components. The program has been running for 12 months in 75 randomly selected schools (intervention group) across Bihar, Uttar Pradesh, and Madhya Pradesh, while 75 comparable schools continue with the standard Mid-Day Meal scheme (control group).

The PoshanShakti program features:

- Balanced meals with locally sourced pulses, millets, and vegetables based on nutritional guidelines from the National Institute of Nutrition
- Iron, iodine, and vitamin A fortification
- Milk or dairy products three times per week
- Eggs twice weekly (in non-vegetarian areas) or protein equivalents in vegetarian areas
- Kitchen gardens at schools to supplement fresh produce
- Nutrition education for students, parents, and Anganwadi workers
- Regular health check-ups and growth monitoring in coordination with local Primary Health Centers

Preliminary data suggests improvements in nutritional status, attendance rates, and academic performance in participating schools. The Ministry now wants to conduct a comprehensive evaluation of the program's effectiveness before deciding on nationwide implementation.

Available Preliminary Data

- Baseline and 12-month anthropometric measurements (height, weight, BMI, mid-upper arm circumference) for students aged 6-14
- School attendance records
- Academic performance indicators
- Socioeconomic data of students' families collected through Socio-Economic Caste Census
- Food consumption patterns at school and home (through surveys)
- School infrastructure details
- Teacher and Anganwadi worker feedback through satisfaction surveys
- Program implementation costs

Key Preliminary Findings (after 12 months)

Anthropometric Measurements (Intervention vs. Control)

Indicator	Intervention Group	Control Group
Average weight gain	3.2 kg	2.4 kg
Height increase	5.1 cm	4.7 cm
Reduction in stunting prevalence	8.3%	2.1%
Reduction in underweight prevalence	10.2%	3.5%
Improvement in BMI	7.4%	2.8%

Other Outcomes (Intervention vs. Control)

Indicator	Intervention Group	Control Group
School attendance improvement	12.5%	3.2%
Academic score improvement	8.7%	3.8%
Parent satisfaction (scale 1-10)	8.4	5.7
Teacher-reported student alertness (scale 1-10)	7.8	5.2
Cost per student per year	₹8,400	₹3,300

Based on the information provided above, answer the following questions:

a. Develop an appropriate hypothesis to test the effectiveness of the PoshanShakti program in reducing malnutrition in rural Indian schoolchildren.
b. Which research framework (PICOT, PICO, PEO, PESTEL, or RE-AIM) would be most appropriate for this study? Justify your selection and explain how the elements of your chosen framework would apply to this specific case.
c. i) What additional data would you recommend collecting to strengthen the evaluation, considering the unique challenges of the rural Indian context?
   ii) For each new data type, briefly explain the collection method and its importance for the evaluation.
   iii) Identify potential ethical considerations in collecting this data from school children in rural Indian communities.
d. Recommend three specific data visualizations (charts or plots) that would effectively communicate the program's outcomes to Indian policymakers and stakeholders. For each, explain what variables would be plotted and how the visualization would help stakeholders understand the results.
e. i) If the Ministry plans to expand the study and wants to detect a 5% difference in stunting prevalence between groups with 90% power at a 95% confidence level, calculate the required sample size per group. Assume the baseline stunting prevalence is 35% in the control group (aligned with rural India statistics).
   ii) How would the required sample size change if they wanted to detect a smaller difference of 3%?
f. i) Identify two potential confounding variables that might affect the evaluation of this nutrition program in rural India.
   ii) For each confounding variable, explain how it might influence the results and propose a specific strategy to control for or mitigate its effects in the study

design or analysis, considering the practical constraints of conducting research in rural India.