Statistical Methods of Cardiovascular Research

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Role of Biostatistics

A biostatistician partners with researchers in medicine and public health fields to advance scientific discovery through involvement in **designing studies, improving data collection methods, analyzing data, interpreting results** and collaborating in writing research reports and papers to disseminate research findings.

Keys of Biostatistics

Causality

Generalizability

Prospective Analysis

Statistical Data Analysis

What is Prospective Analysis Plan?

The scientific question must be posed.

The methodology set in place.

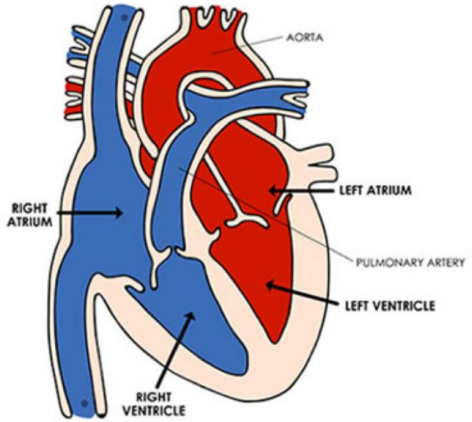
The instruments for analysis chosen.

The end points selected before the samples are obtained

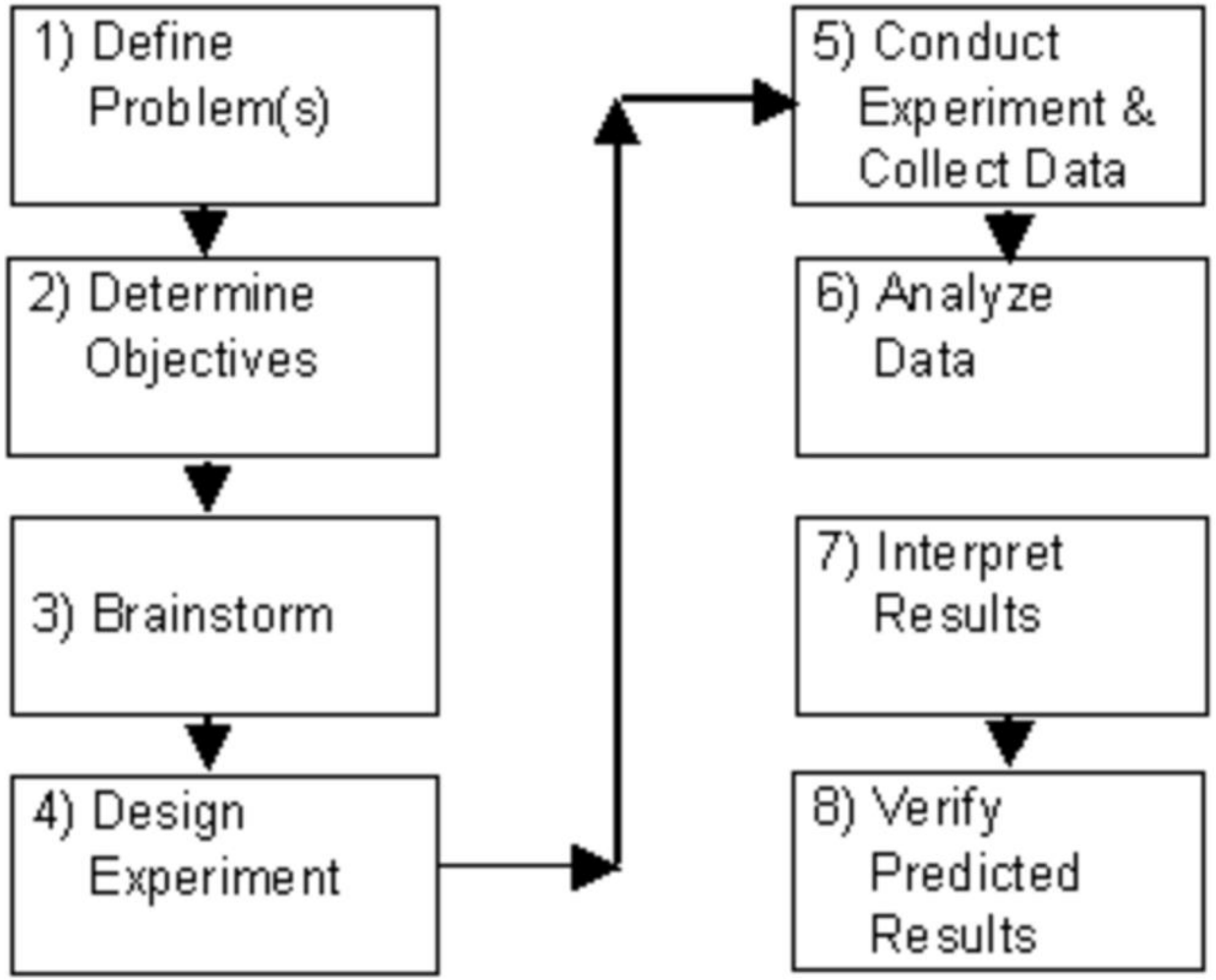
Design of Experiments

When analyzing a process, experiments are often used to evaluate **which process inputs have a significant impact** on the process output, and **what the target level of those inputs should be** to achieve a desired result (output).

e.g. Cardiovascular disease among patients with hypertension

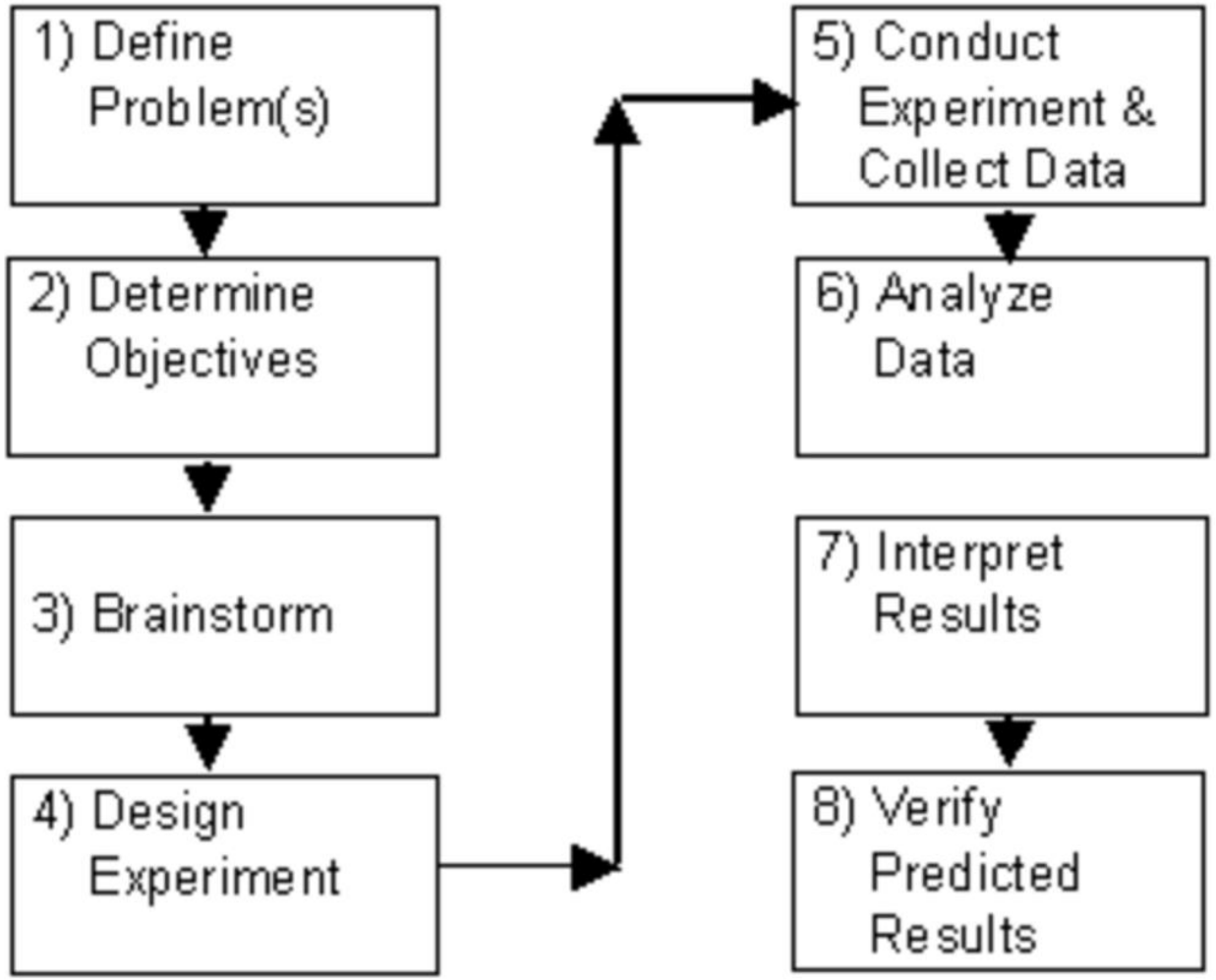


Design of Experiments



Design of Experiments

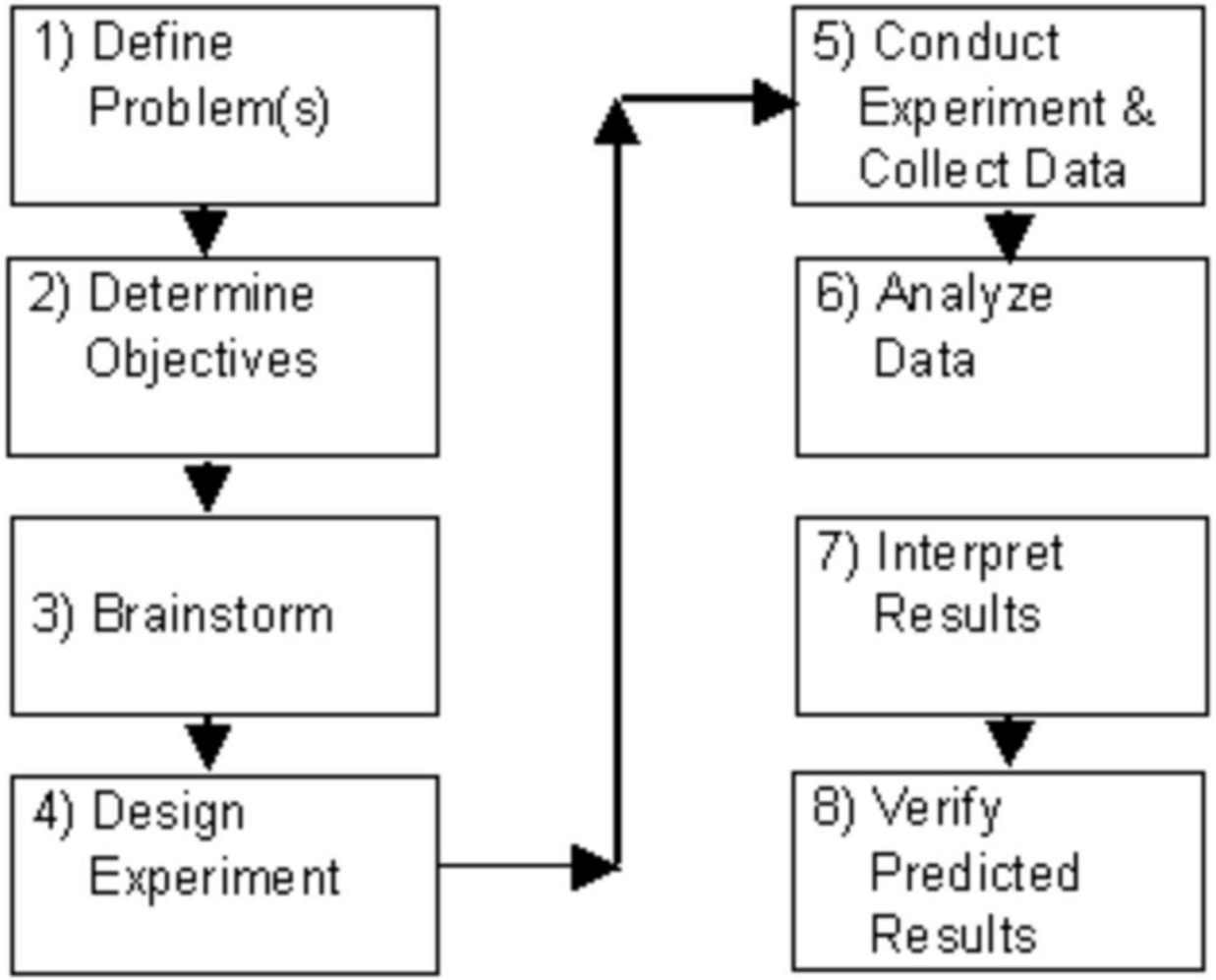
Whether the hypertension status of patients has effect on the prognosis of heart disease or not?



Design of Experiments

Whether the hypertension status of patients has effect on the prognosis of heart disease or not?

Time(high blood pressure) > Time(normal blood pressure) **?**



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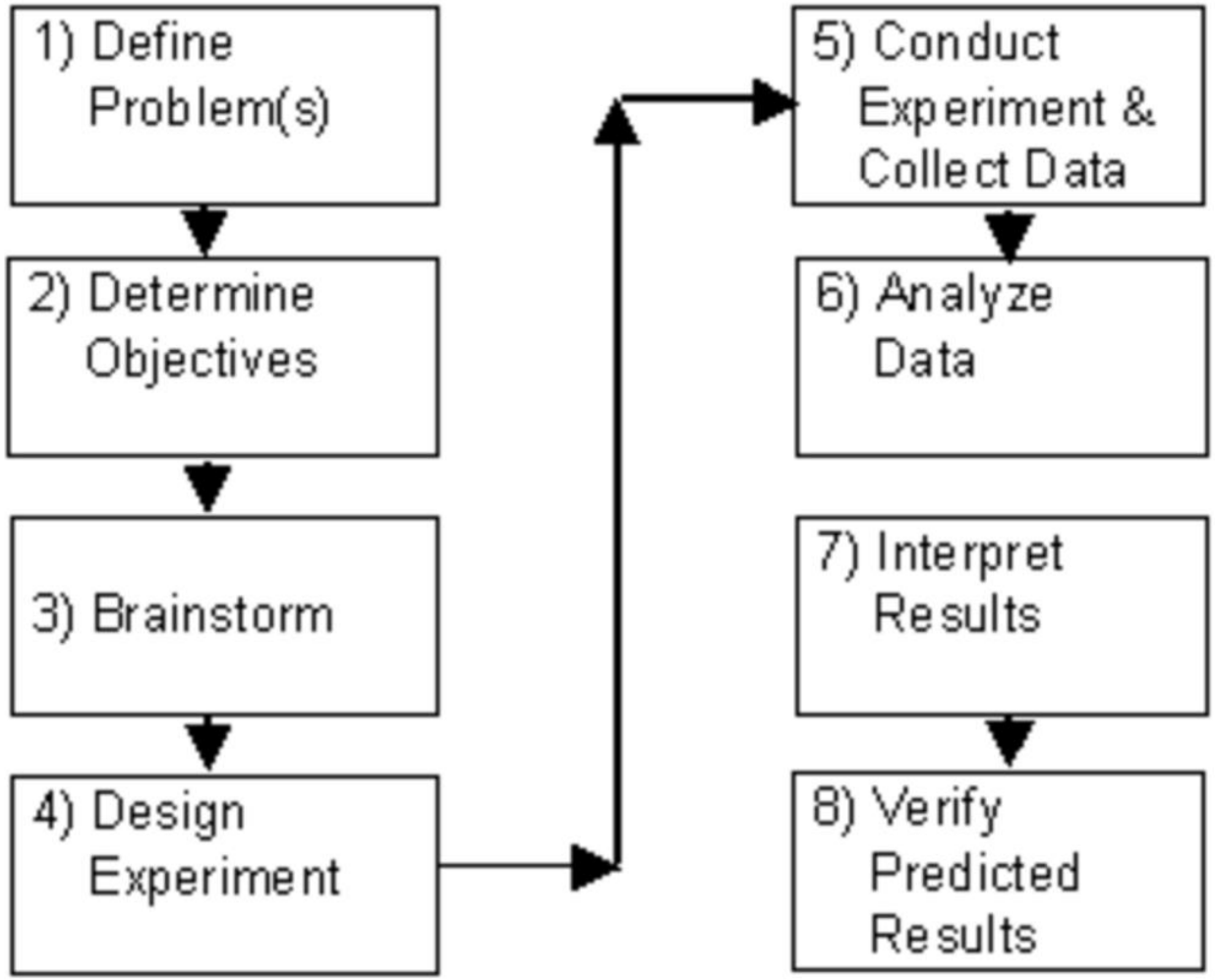
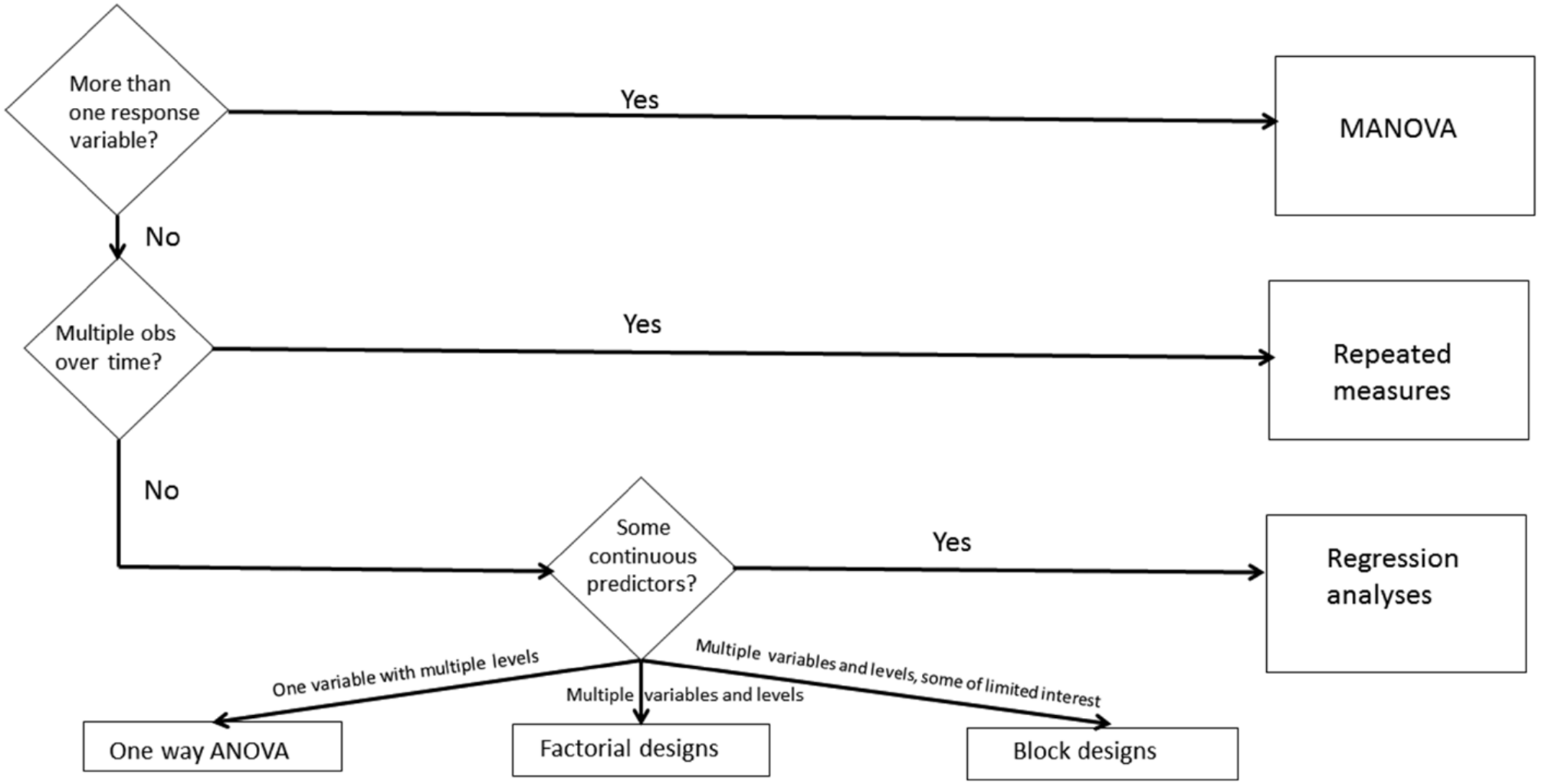
Sampling Strategy?
ANOVA?



ANOVA


More than one response variable?
Yes
MANOVA
No
Multiple obs over time?
Yes
Repeated measures
No
Some continuous predictors?
Yes
Regression analyses
One variable with multiple levels
Multiple variables and levels
Multiple variables and levels, some of limited interest
One way ANOVA
Factorial designs
Block designs

Design of Experiments

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Sampling Strategy?
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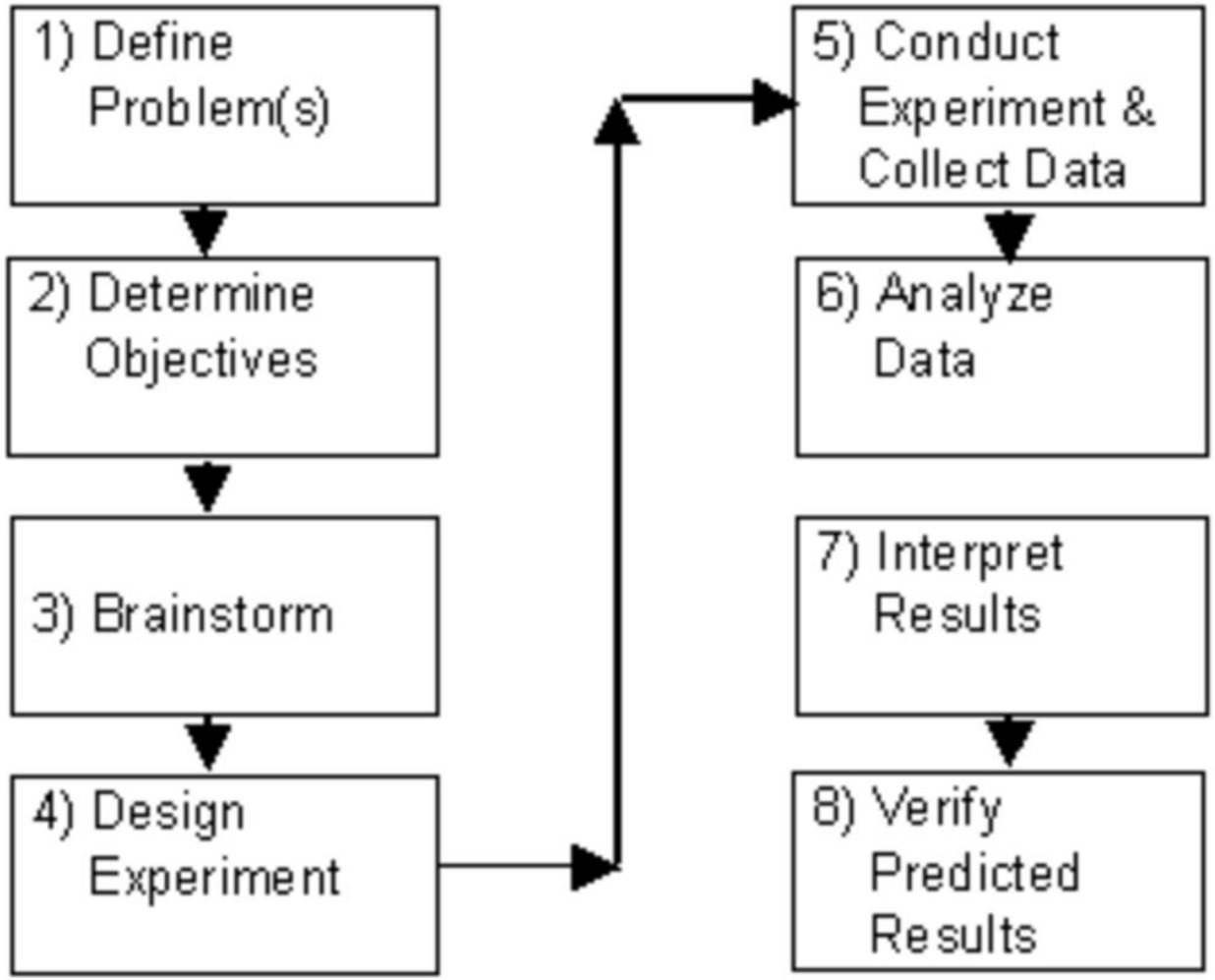

Data Cleaning
Missing Data

Analysis of Data

Question to be Answered	Procedure	Advises on Application
1-sample testing		
Normality assumption valid		
Is the population mean different than expected?	1-sample *t* test	Requires the sample size, mean, and SD
Distribution free		
Is the median of this distribution different than expected?	1-sample Wilcoxon-signed rank sum test	Requires the entire sample
2-Sample testing		
Normality assumption valid		
Do the means of 2 paired samples differ?	Paired *t* test	Requires sample, mean difference and SD of that difference
Do the 2 independent samples have different means?	Unpaired *t* test	Test variance first. Use equivariant solution for test on means if variances equal. Use unequal variance solution otherwise
Distribution free		
Are the elements of 2 sequences mutually independent?	Spearman Rank Correlation Test	Requires entire data set; computes correlation based on ranks
Are the paired samples from populations with equal medians?	Two sample signed-rank test	A paired difference test requiring all of the data
Are the unpaired samples from populations with equal medians?	Wilcoxon Rank Sum test (Mann–Whitney *U* test)	Requires entire data set; computes a sum of signed ranks of the observations

Time(high blood pressure) >
Time(normal blood pressure) **?**

Analysis of Data

ANOVA

Regression Analysis

Survival Analysis

Subgroup Analysis

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Design of Experiments

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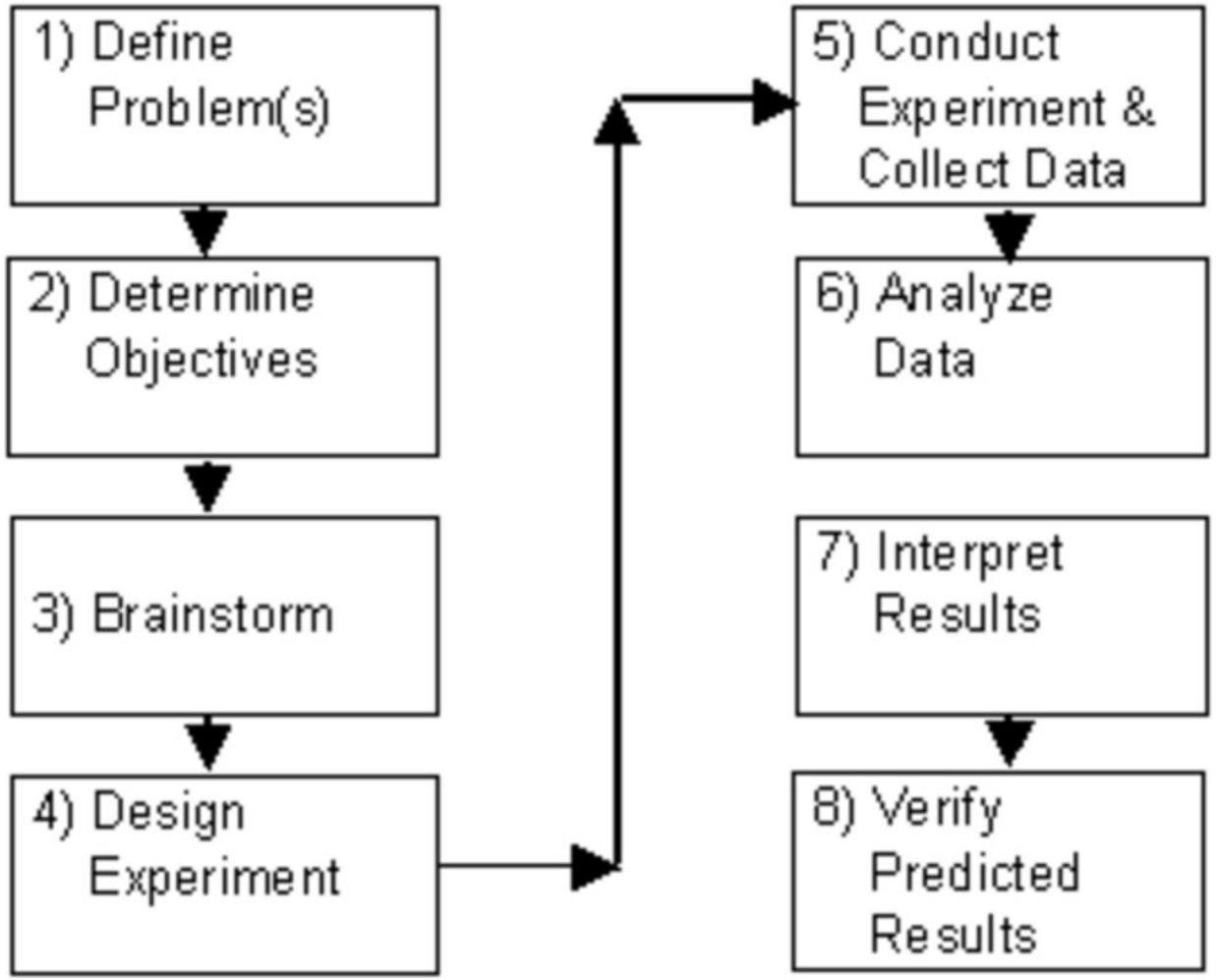
Sampling Strategy?
ANOVA?



Data Cleaning
Missing Data

Analysis of Data

Statistically
Cardiologically
Reproducibly