



Exploration Of Drug Discovery And Clinical SAS

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ABSTRACT

For 30 years SAS has been used in pharmaceutical research setting for data management, analyze, visualize and reporting. Traditionally, these roles were staffed by BASE SAS programmer and the statistician. At the same time, dramatic shift in the researches informatics eco-system have occurred with advance in standards, such as CDISC. ICH and convergence of clinical trials data management systems and modernization strategies, such as electronic data capture and report in the form of CRF. This paper provides a broad-based view of how SAS can be used across the research information spectrum. We are focusing on Server, Data Integration Studio and SAS Business Intelligence products. The SAS Drug Development solution merges the accessibility of the Internet with the Clinical Trials Workflow. Whether we focus is beating data into submission or making it sing and in reports, this paper will make the connections to the various solutions from SAS and where each solution is most valuable in the pharmaceutical setting. This paper is appreciated for people at all levels and across the spectrum of job skill, including the production of clinical study reports, clinical trials management and laboratory data analysis. It is specifically designed for the programmer, statistician, manager and system administrator and submit all the reports to regulatory authorities like FDA.

KEYWORDS: Clinical SAS Drug Discovery ,Drug development, Preclinical trials,Clinical trials (Phase 1, Phase II, Phase III, Phase IV) , Regulatory authorities involved in drug discovery, CDISC , CDMS, CDSCO, SAS

INTRODUCTION

The FDA only accepts SAS reports only, Clinical SAS can generate reports using CDISC standards like SDTM and ADAM to standardize and evaluate clinical trial data. To write the SDTM and ADAM requirements and to create SAP (Statistical Analysis Plan), the department of BIO- Statistics uses clinical SAS. The CDM team uses SAS to analyze data before it is loaded into particular databases. It will be easier for the FDA to have a good picture of the clinical reports if the analysis is done with clean data and clinical trial data is validated. Therefore, most CROs choose clinical SAS as the ideal solution to utilize because of its effectiveness and safety compared to other software tools. One of the most effective and well-liked tools for statistical modelling and data analysis is the clinical SAS programming services. The program is among the fastest and most reliable for advanced analytics, business intelligence, data mining, data management, report writing, statistical analysis, applications development, business modelling, and data warehousing. Furthermore, due to its dominant position in the market for jobs in advanced analytics, SAS is a benefit in various job marketplaces. SAS Clinical software offers real-time decision-making access to all relevant clinical and nonclinical data. It provides a comprehensive view of the patient data and readmission patterns. A deeper wide of your clinical performance. Big data solutions & Analytics software for the healthcare sector that focus on your top priorities aid research efforts to improve patient outcomes. The major priorities in clinical trials that the SAS Clinical suite can extract include the following:

Chronic conditions

The clinical trial expert can identify many clinical and nonclinical elements that impact readmissions and prevent readmissions preferably and affordably.

Analytics in Visual

The trial expert will be able to quickly and easily visualize the results to special thanks to global video produced by the SAS Clinical software suite.

In Terms of Health

SAS Clinical also assists in analyzing large amounts of data (structured and unstructured), including clinical and operational data. This aids in tells us various hidden insights on indications, patient status/concerns, and other problems that may impact patient treatment. Then convert that insight into knowledge based on fact so you can forecast and enhance outcomes.

WHY NOT SIMPLY USE SPREADSHEETS LIKE THOSE FOUND IN MICROSOFT EXCEL OR GOOGLE SHEETS?

SAS allow you to use much more data than Excel more efficiently. Databases can handle volumes of information that would be unmanageable in a spreadsheet. Spreadsheets have record limitation that would be unmanageable in a spreadsheet. Spreadsheet have record limitation whereas databases do not. Compared to database, Spreadsheet can acquire massive amounts of data in an accessible and managed manner.

ROLE OF SAS PROGRAMMER:

Statisticians provide the methods of the data analysis, implement the analysis methods on the collected data and provide the study summary in the form of tables, graphs, and data listing to the clinicians to write study report.

SAS programmers closely work with statisticians and data managers to provide the link between raw data and the analysis.

SAS programmers will also write SAS programs to edit the database data according to the specifications provided by CDMs.

SAS play a significant role starting from defining the clinical study to till regulatory submission. The clinical study report is compiled using the data generated in the SAS environment.

A SAS programmer responds to the technical requirements of the healthcare sector.

The use of information technology in healthcare delivery enables the extraction of useful knowledge from data, the guidance of decision-making, the enhancement of patient care quality, and the practice of medicine.

In the healthcare industry, SAS analytic solutions support revenue generation, cost management, and strategic performance monitoring business objectives. SAS methods are used to examine clinical outcomes and risk tolerances to enhance the general standard of patient care.

WHY DO WE NEED CLINICAL TRIALS?

Clinical trials show us what works (and what doesn't) in medicine and health care. They are the best way to learn what works in treating diseases like cancer. Clinical trials are designed to answer some important questions:

- Does the new treatment work in people? If it does, doctors will also look at how well it works. Is it better than treatment now being used? If it's not better, is it as good and cause fewer side effects? Or does it work in some people who aren't helped by current treatments?
- Is the new treatment safe? No treatment or procedure – even one already in common use – is without risk. But do the benefits of the new treatment greater or risks?

- Is this treatment better than the standard treatment given for this disease? Clinical trials help show if a new drug or treatment, or a new treatment combination, works better than what is now used.

DRUG DEVELOPMENT PROCESS AND REGULATORY AUTHORITY

New drugs begin in the laboratory with scientists, including chemists and pharmacologists, who identify cellular and genetic factors that play a role in specific diseases. They search for chemical and biological substances that target these biological markers and are likely to have drug-like effects. Out of every 5,000 new compounds identified during the discovery process, approximately five are considered safe for testing in human volunteers after preclinical evaluations. After three to six years of further clinical testing in patients, only one of these compounds on average is ultimately approved as a marketed drug for treatment.

- Drug development phase
- In this phase, drug is developed for the market use

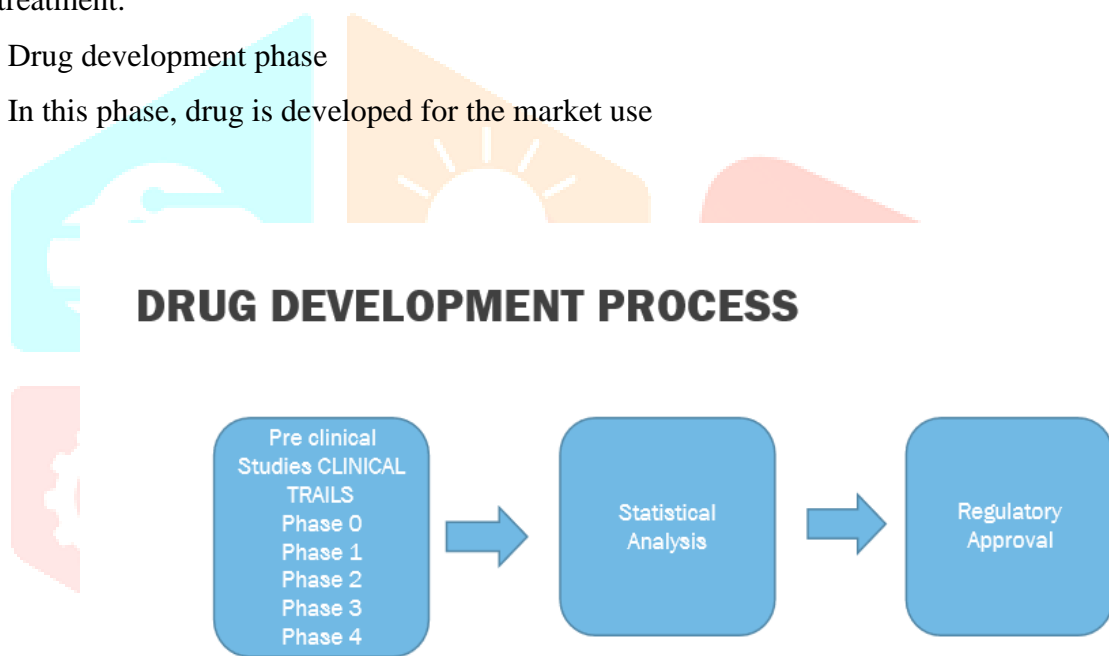


Fig. 1 :- Drug Development Process

I) Pre-clinical evaluation phase**II) Clinical trial phase 1****I) Pre-clinical trial phase:**

Before testing a drug on peoples, we have to confirm that drug is safe and it does not give any harmful effects to the peoples.

For this purpose, firstly drugs are tested on animals instead of humans.

Aim:

- To check the safety and effectiveness of the drug
- Check toxicology
- Evaluation of therapeutic index

Two types of preclinical testing:**I) In-vitro –**

experiment is conducted outside the animal. In this collect animal's tissue, plasma etc. And test drug on that in laboratory.

II) In-vivo–

experiment is conducted inside the animals by introduce drug animals.

Animals used for trails:

- Guinea pigs, mice, rats, dogs, monkey, Cat etc.
- After all this collect information, now these studies must provide details information on cloning and toxicity levels.

Pre-clinical (or laboratory) studies

Clinical trials are done only after pre-clinical findings suggest that the new drug or treatment is likely to be safe and will work in people.

Pre-clinical studies, also called laboratory studies, include:

•Cell studies:

These are often the first tests done on a new treatment. To see if it might work, researchers look for effects of the new treatment on cancer cells that are grown in a lab dish or a test tube. These studies may be done on human cancer cells or animal cancer cells.

• Animal studies:

Treatments that look promising in cell studies are tested next on cancers in live animals. This gives researchers an idea of how safe the new treatment is in a living creature.

Pre-clinical studies give a lot of useful information, but not all that is needed. A treatment that works against cancer in a mouse might or might not work in people. There could also be side effects and other problems that didn't show up when the treatment was used in mice but could show up in people. If the pre-clinical studies are completed FDA must give permission for clinical study before the treatment can be tested people.

PRECLINICAL PHASE OF THE DRUG DEVELOPMENT PROCESS –

The drug development process has several stages which can take decades to complete. Understanding the stages novel drugs must go through is essential to understand how new therapeutics and vaccines enter the market. Below we take a look at the steps involved in the preclinical phase of drug development.

Background

Nowadays, drug development is a hugely expensive business. This is not a small investment even at the lower end of the scale.

What's more, this expensive process can take decades. And even then, only around 4% of the drugs launched into the marketplace make a return on their initial investment.

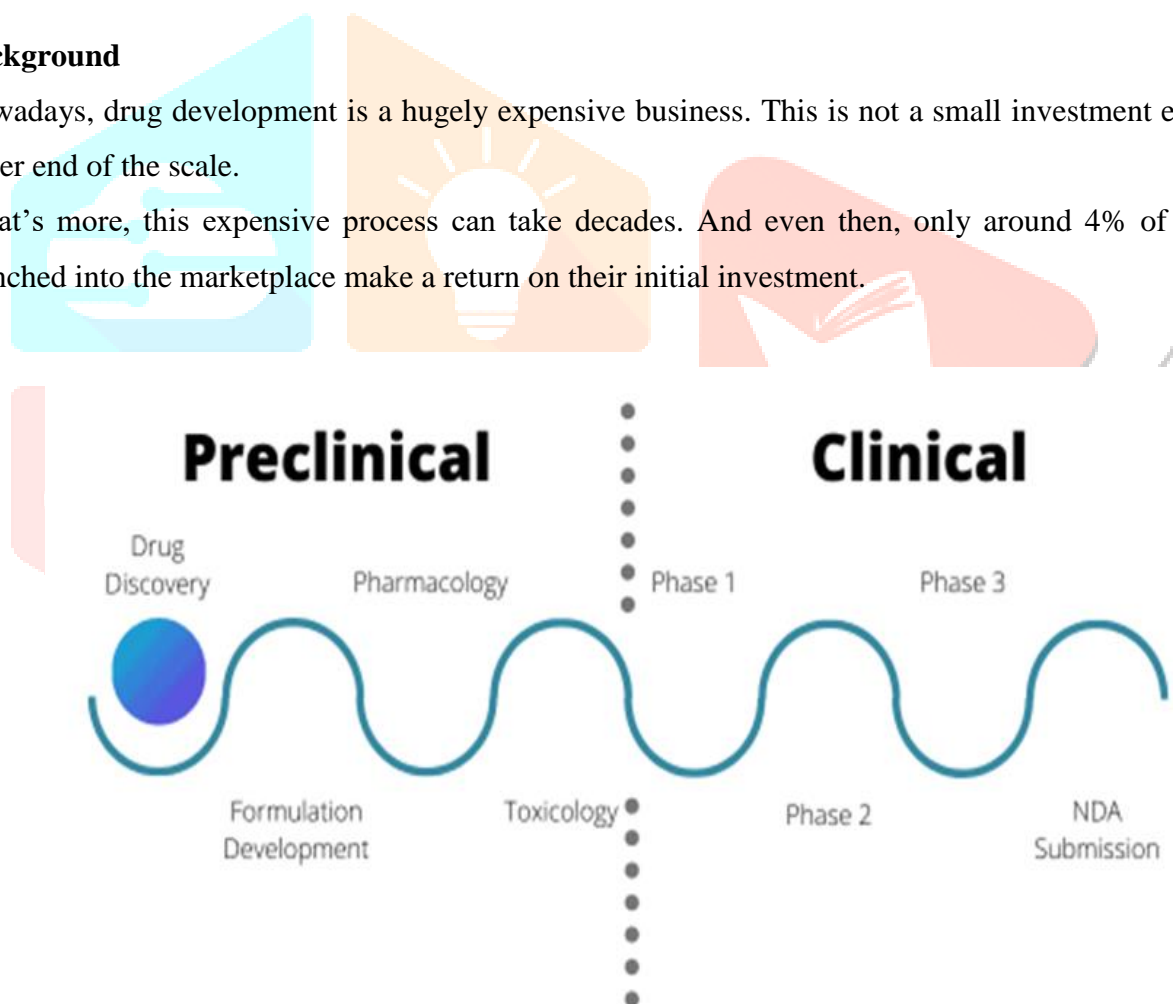


Fig. 2 :- Preclinical and Clinical trails

THE DRUG DEVELOPMENT CYCLE:

There are two broad sections to the drug development cycle: the preclinical phase and the clinical phase. Generally, biotechnological companies specialize in the preclinical phase and develop numerous drug candidates, running preliminary studies to test viability. Once a compound has reached a specific stage, they will partner with pharmaceutical companies to develop the candidates further or sell the assets on.

Formulation Development in Preclinical Phase:

Formulation development assesses the best way to prepare a drug in the preclinical phase for its intended clinical use in patients. Factors such as solubility, frequency and mode of administration, stability of the formula, and palatability are all assessed. Developing the formula is only half the story – manufacturing is also vital here. At the R&D stage, a drug may only be produced in milligram quantities, but for development, kilograms are needed. Manufacturing needs to adhere to Good Manufacturing Procedures (GMP) and must test every batch of the potential drug to ensure the purity, quality and potency.

Pharmacology

The pharmacology stage assesses the safety of a drug as well as its ADME (Absorption, Distribution, Metabolism, and Excretion) ADME is the backbone of pharmacology.

ADME

Absorption concerns the bioavailability of the drug once administered. The bioavailability of the drug measures the fraction of an administered drug dose that reaches the target system, while also measuring the uptake in the target cells and organs.

Once the body has absorbed a drug, the latter distributes from one part of the body to another.

Metabolism studies the metabolites produced by the drug's breakdown. It then evaluates whether they are active or harmful, and the breakdown's location in the body. Finally, excretion looks at how the drugs and the metabolites produced exit the body. While ADME is not a regulatory requirement for a first-time, in man (FTIM) study, have to conducted to improve the quality of the safety information and give further information to pharmacology and toxicology studies.

Toxicology In the Preclinical Phase:

Since researchers need to conduct IND tests in animal models, they must conduct studies in two species. This part of the testing is highly regulated. Researchers must use one species that is non-rodent and their use of primates as an animal model is heavily restricted. The toxicology studies aim to look at the effects of longer-term drug exposure on the body, including repeat dose studies. During these studies, researchers assess parameters such as food and water consumption, body weight, hematology and urine analysis. These aim to monitor for any adverse effects that could arise as a result of taking the drug. Researchers will also monitor immune responses, such as infection occurrences, tumor incidences and

histological changes in the immune system.60% of potential drugs fail in the preclinical phase of pharmaceutical product development.

The investigational new drug (IND) application:

Before a clinical trial can be started, the research must be approved. An investigational new drug or IND application or request must be filed with the FDA when researchers want to study a drug in humans. The IND application must contain certain information, such as:

- Results from studies so that the FDA can decide whether the treatment is safe for testing in people.
- How the drug is made, who makes it, what's in it, how stable it is, and more.
- Detailed outlines for the planned clinical studies, called study protocols, are reviewed to see if people might be exposed to needless risks.
- Details about the clinical trial team to see if they have the knowledge and skill to run clinical trials.

INDA –

- Investigational New drug application is applied and after the preclinical studies show success and if the INDA submission is accepted the product is further forwarded to the clinical trials.
- Both drug discovery and preclinical phase takes approximately 6.5 years
- Now approximately 5 compounds send in the clinical trials.

II) Clinical trials phase:

In this phase, drugs are applied on humans

It involves four phases:

- Phase I
- Phase II
- Phase III
- Phase IV

Clinical Trial Phases

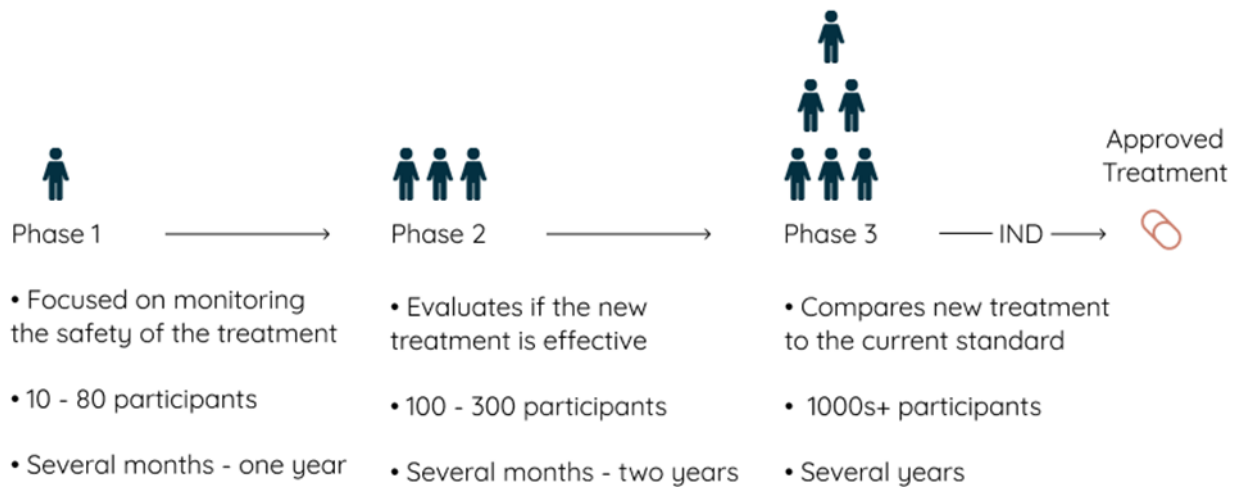


Fig.3 :- Clinical trial

Clinical research is crucial to the development of treatments and medication as we know them today. In order for a mechanical treatment to be approved for use by the public, it must go through four phases of clinical trial in order to determine its safety and efficacy, and whether it affects everyone the same way.

PHASE I

Phase I is when a treatment is tested for the first time. This phase is generally done with a small group of volunteers. It primarily assesses safety and side effects of the treatment in question.

- In this phase, Drug is tested on 10-80 healthy volunteers
- Main purpose of this phase to check the safety and side effect (toxicity) of the drug.

Purpose

Studies of pharmacokinetic Practice and pharmacodynamics, tolerability, side effects and toxicity at different doses.

(70% drugs passed this)

PHASE II

The treatment is tested with a large group of volunteers. This assesses its effectiveness and further evaluation its safety.

- Therapeutic investigation study
- In this phase, approximately 100- 300 patients are selected with that targeted disease.
- Now drug is tested on patients.
- Length of this phase (months- 2years)
- Main purpose of this phase to check the efficacy and side effect of drugs

Purpose

- finding the dose range (minimum and maximum effective dose)
- Maximum Tolerated Dose (MTD)
- Common short time side effects.
- Approximately 33% of drugs are passed this phase and move to next phase

Phase III

Compares the new treatment to existing treatment. This is done with an even large group of volunteers, and generally for a longer period of time. As a result, rare and long-term side effects are more likely to be discovered. Phase 3 is the final phase before a treatment receives FDA approval.

Therapeutic confirmatory

- In in this phase approximately 1000 -5000 patient is selected with that targeted disease
- Now drug is tested on patient
- Length of this phase is 1 -4 years

Purpose

- Long term safety
- Tolerability-common site effect
- Drug interaction
- Assessment of safety and efficacy
- After completing the phase III trials, drug is undergoing for the approval of FDA i.e., food and drug administration
- After FD approval the product is launch into the market
- Following FDA approval, a treatment goes through Phase IV

Submission for FDA approval: new drug application (NDA)

In the United States, when phase III clinical trials (or sometimes phase II trials) show a new drug is more effective or safer than the current treatment, a new drug application (NDA) is submitted to the Food and Drug Administration (FDA) for approval. The FDA reviews the results from the clinical trials and other relevant information.

Based on the review, the FDA decides whether to approve the treatment for use in patients with the illness the drug was tested on. If approved, the new treatment often becomes a standard of care, and newer drugs may be tested against it before they can be approved.

If the FDA feels that more evidence is needed to show that the new treatment's benefits outweigh its risks, it may ask for more information or even require that more studies be done.

PHASE IV

- Post marketing therapeutic use
- In this face collect the data of drug that drug is safe or not

Purpose

- Perform qualitative of life trial
- Collection of long-term safety information

This phase involves the largest group of participants. It can last for several years as research continue to monitor the efficacy and safety of the treatment. Depending on the type of treatment being studied, a study could range from several weeks to several years; volunteers may or may not participate in every phase of the study. If you are considering volunteering for a clinical trial, make sure you know which phase the study is currently in. Also, understand the duration of your participation.

DRUG APPROVAL PROCESS IN INDIA:

The Drug and Cosmetic's Act 1940 and Rules 1945 was announced by the Indian parliament to control the import, manufacture, supply, and sale of drugs and cosmetics. Central Drugs Standard Control Organization (CDSCO) and the office of its head, the Drugs Controller General of India (DCGI) was established. An Indian company if wishes to manufacture/import a new drug should apply for approval from the licensing authority (DCGI) by filling in Form 44 and also submitting data as provided in Schedule Y of Drugs and Cosmetics Act 1940 and Rules 1945. To validate the efficiency and safety of the new drug in Indian population, clinical trials should be conducted as per the requirements and guidelines specified by Schedule Y. These guidelines for clinical trials were revised in 2005 to make it equivalent to the procedure recognized across the world. According to the Rule-122A of the Drugs and Cosmetics Act, it is not necessary to conduct clinical trials for new drugs that are approved and being used for many years in other countries. Section 2.4(a) of Schedule Y of Drugs and Cosmetics Act 1940 and Rules 1945 states that drugs discovered in India should undergo all phases of clinical trials. Section 2.4(b) of Schedule Y of Drugs and Cosmetics Act 1940 and Rules 1945 states that for drags discovered outside India, the applicant should submit the data presented by other countries and the lichening authority may replicate all the studies or allow the applicant to start from Phase III clinical trials.

REAL TIME WORK FLOW

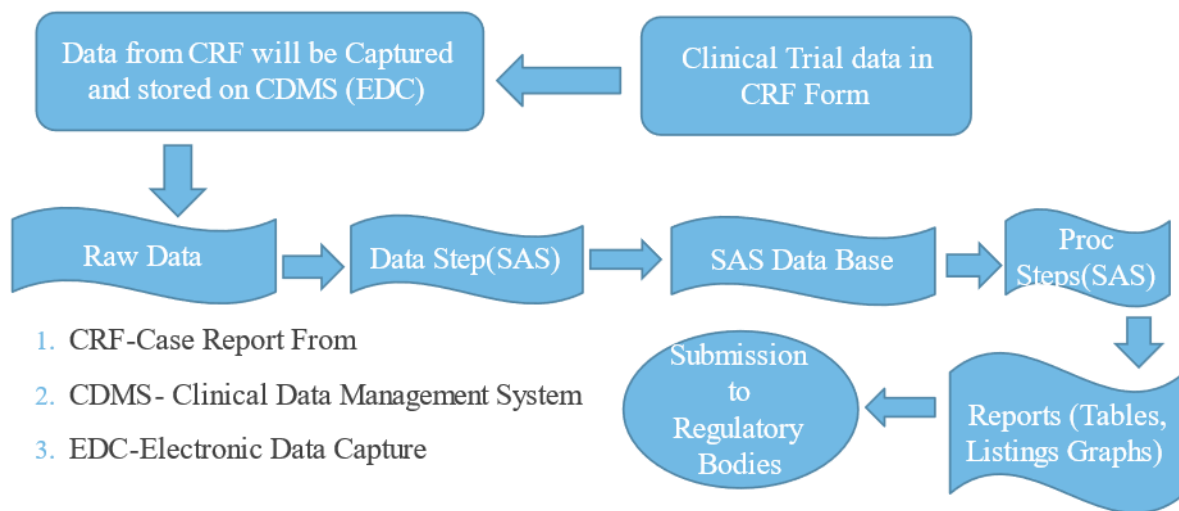


Fig :- 4

CONSIDERATIONS FOR PARTICIPATION:

Participating in a clinical study contributes to medical knowledge. The results of these studies can make a difference in the care of future patients by providing information about the benefits and risks of therapeutic, preventative, or diagnostic products or interventions. Clinical trials provide the basis for the development and marketing of new drugs, biological products, and medical devices. Sometimes, the safety and the effectiveness of the experimental approach or use may not be fully known at the time of the trial. Some trials may provide participants with the prospect of receiving direct medical benefits, while others do not. Most trials involve some risk of harm or injury to the participant, although it may not be greater than the risks related to routine medical care or disease progression. (For trials approved by IRBs, the IRB has decided that the risks of participation have been minimized and are reasonable in relation to anticipated benefits.) Many trials require participants to undergo additional procedures, tests, and assessments based on the study protocol. These requirements will be described in the informed consent document. A potential participant should also discuss these issues with members of the research team and with his or her usual health care provider.

CLINICAL SAS AND ITS SCOPE

SAS (Statistical Analysis System) is software developed by SAS Institute for advanced analytics, multivariate analyses, business intelligence, data management, and predictive analytics of the top 100 Fortune Global 500 companies, 94 are SAS customers. SAS customers span the globe with more than 83,000 instances installed in 149 countries. SAS is widely used in clinical trial data analysis in pharmaceutical, biotech and clinical research companies.

Need for clinical SAS:

SAS programmers play an important role in clinical trial data analysis; hence a Clinical SAS training is essential. The opportunities for SAS programmers to address the technical needs of the healthcare industry are ever expanding. The application of information technology in the healthcare delivery system can help this industry to gain valuable knowledge from data, and use this insight to recommend action or guide decision making, and improve quality of patient care. From a commercial point of view, SAS can help meet healthcare professionals meet business goals, control costs, generate greater revenue and enhance strategic performance management. It provides specialized interfaces that further churn out the work more effectively from the metadata. It thus gives an easy access to relevant clinical information and prove to be quite helpful to work with particular data and findings.

Scope and Future of SAS in Healthcare Industry

Statistical analysis system (SAS) is one of the most successful and popular tools used for data analysis and statistical modeling. It is one of the fastest and robust software for advanced analytics, multivariate analyses, business intelligence, data mining, data management, report writing, statistical analysis, applications development, business modeling and data warehousing. SAS is an asset in various job markets as it holds the most significant market share regarding jobs in advanced analytics.

Role of SAS in the healthcare industry:

SAS is extensively used in clinical trial data analysis in the pharmaceutical and clinical research companies. SAS programmers play a vital role in clinical trial data analysis.

- A SAS programmer addresses the technical needs of the healthcare industry.
- Implementation of information technology in the healthcare delivery system helps to gain valuable knowledge from data, and insight to recommend action or guide decision making, and patient care quality improvement and practice of medicine.
- SAS analytic solutions help achieve business goals in healthcare related to revenue generation, cost control, and strategic performance management.
- SAS tools are used to explore clinical outcomes and risk tolerances to improve the patient care.

Jobs profile:

Clinical SAS provides a number of analytical tools that are used to explore drug result and risk tolerances to improve the quality of patient care. A clinical SAS training will enable you to formulate ideas and methods for data analysis, and implement the analysis methods on the collected data and provide the study summary tables, data listing and graphs to the statisticians and or clinicians to write

study report. SAS programmers work closely with statisticians and data managers. Sometimes SAS programmers are also required to design databases. SAS programmers need to write programs to read database data to SAS data sets, generate a SAS format library and to clean the database data according to the edit specifications provided by CDMs. SAS play a major role in clinical trials, right from defining the clinical study to till regulatory submission. The clinical study report is compiled using data generated in the SAS environment. SAS also plays a role in protocol development, randomization process, CRF designing, adverse event reporting etc.

Required skills set:

For maintaining high standard of healthcare and making the healthcare industry flourish, a number of tools and techniques are being devised. And Clinical SAS is one such robust software which is widely being used in this domain for reports and analysis. SAS, a computer programming language used for statistical analysis, is turning out to be completely indispensable for the healthcare industry. 'Data Management' and 'Predictive Analysis' are the ineluctable processes for better clinical performance. The need of learning and adapting to the SAS programming culture in the clinical research is because this research is done to answer specific questions about the biomedical, including new treatment techniques, nutrition related information and medical devices. This Clinical database management assures collection, integration and availability of data and their statistical manipulation. The clinical research also involves clinical trials which the experiments and observations performed in the research. The assessments in the research generate data on safety and degree of accuracy of any desired product (drugs or devices) or medical procedures or services.

Opportunities:

A Clinical SAS training can help you bag some impressive jobs in this industry. There are numerous roles to choose from. You could be a part of a large clinical data analytics team and work as 'Analytics Programmer'. Generally, employers seek candidates with sound SAS programming skills. A background in biotechnology, biostatistics or pharmaceuticals is an added bonus. You can sit for certificate exams after earning a college degree. The average salary for an SAS Programmer is Rs 442,563 per year. Experience strongly influences pay for this job. Clinical SAS can provide a promising career. The clinical SAS programming industry, in India, has seen a rapid growth in the last decade and the trend seems set to continue, for the next couple of years, due to cost advantage and the availability of skilled labour. Due to the increased demand for skilled resources, the wants of the programmers have taken a different shift toward diversifying exposure, unsustainable wage inflation due to multiple opportunities and generally high expectations around career progression. As health care providers, payers and patients reconfigure how to best access, deliver and finance health care; SAS professionals are finding employment opportunities above and beyond crunching numbers and generating reports.

WHAT SAS CAN DO?

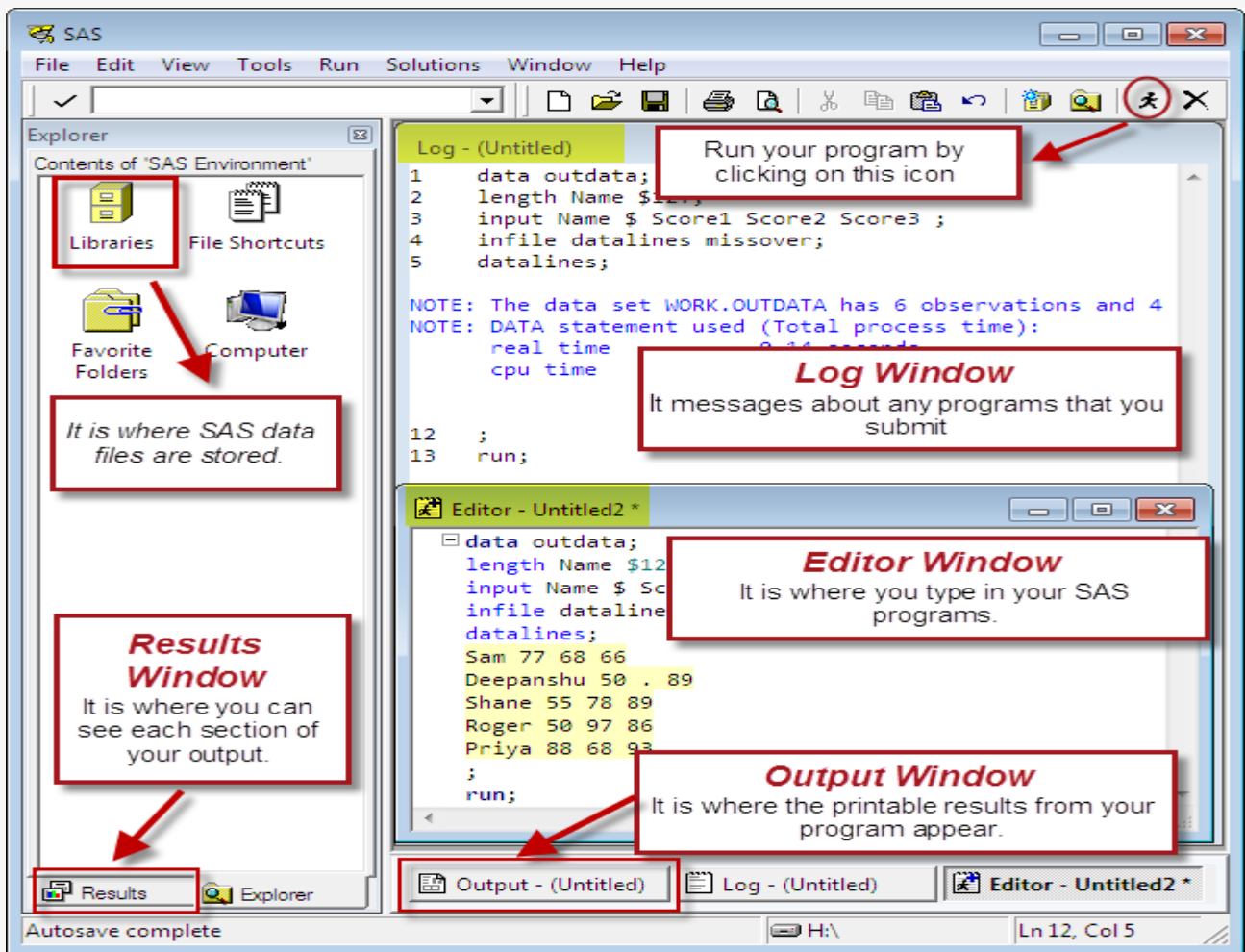
It can perform the following tasks:

- It allows you to enter, retrieve and manage your data easily
- It can read data from various external sources (Excel, CSV, Text files, Databases, Webpage etc)
- You can explore and manipulate data in SAS.
- It can analyze your data statistically and mathematically. Includes various statistical techniques.
- It can generate beautiful graphs and tables.
- You can run SQL queries on SAS datasets.
- You can automate repetitive tasks with SAS Macros.
- It can develop entirely new software applications.

FUNDAMENTALS OF SAS PROGRAMMING:

SAS has three windows:

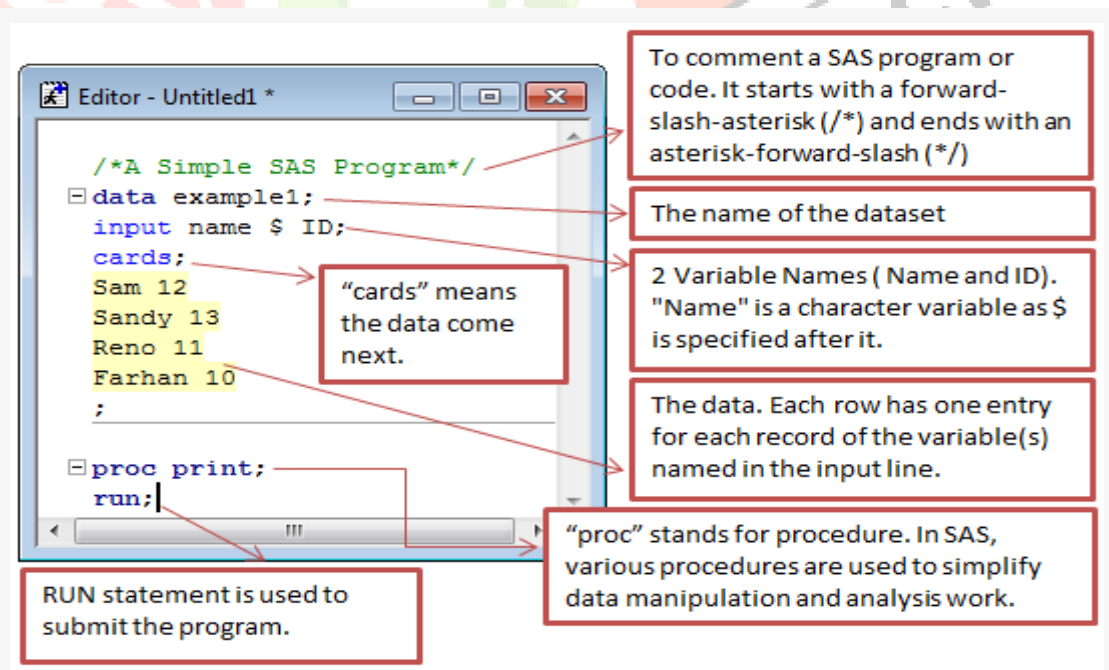
1. **Editor Window:** where you type programs for analyzing data
 2. **Log Window:** where error messages and executed SAS commands are printed
 3. **Output Window:** where the result of SAS programs is printed. There is one more window linked to this window
- **Result Window.** In result window, you can see each section of your output.



Getting Started in SAS

Fig :- 5

Let's look at a simple SAS program:



A Simple SAS Program

Fig :- 6

Submit the program

To submit the program, press **F3** or **F8** shortcut key. Alternatively, you can click on the icon of “the little guy running” at the top of the SAS tool bar.

SAS Log Window

It is where error messages and executed SAS commands are printed.

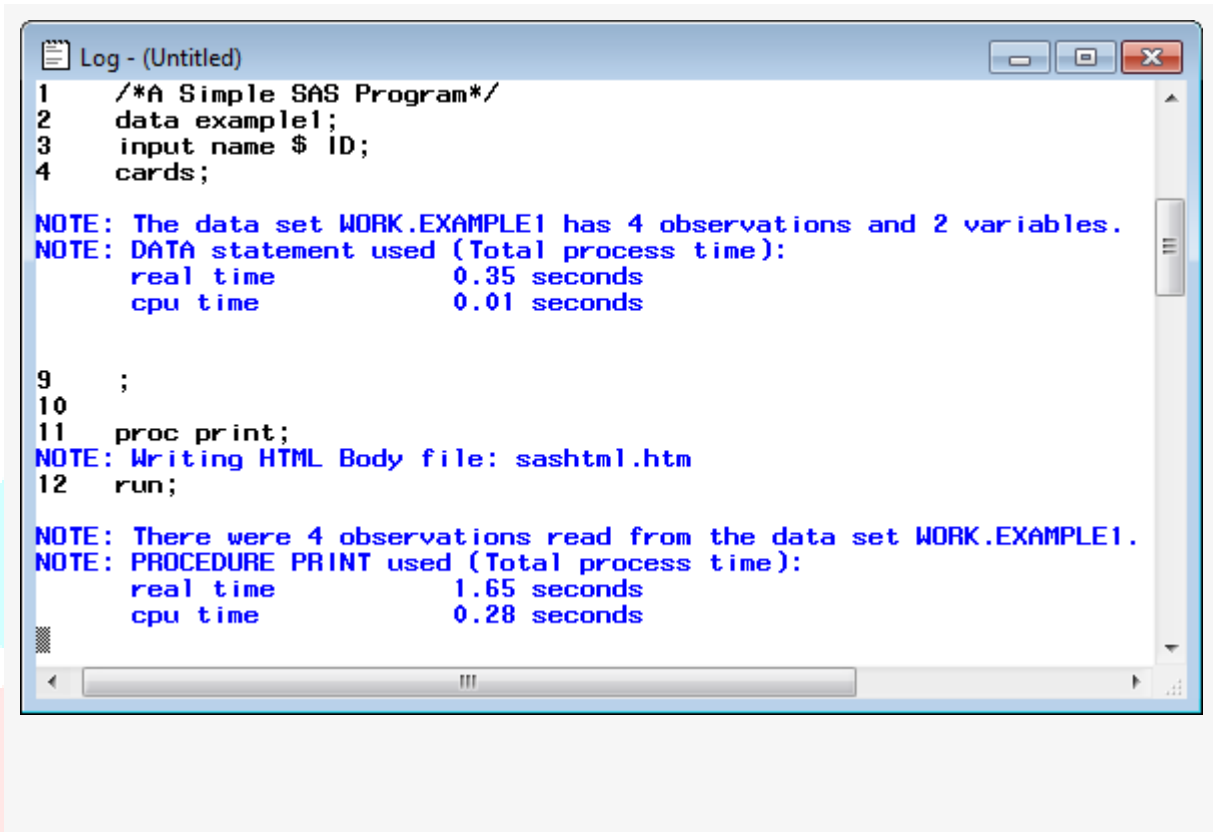


Fig :- 7

SAS Output Window

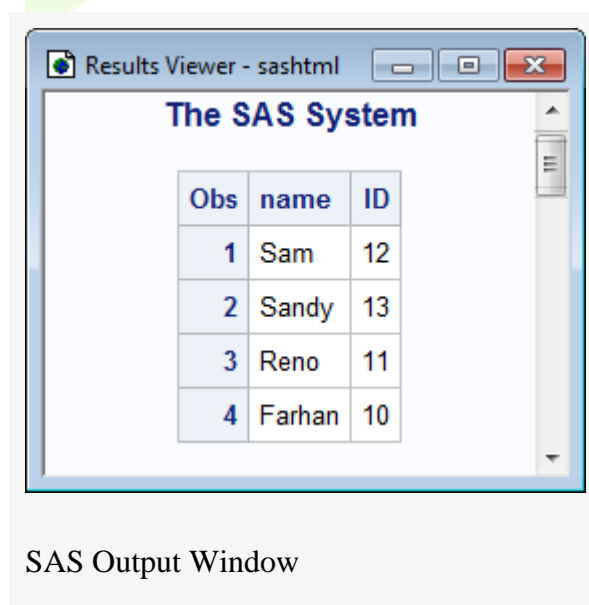


Fig :-8

Where SAS data sets are stored?

SAS files are stored in a SAS library. A SAS library is simply a collection of SAS files (data sets) that are stored in a folder. SAS files are stored either temporarily or permanently. By default, it is stored in a temporary library called **Work**.

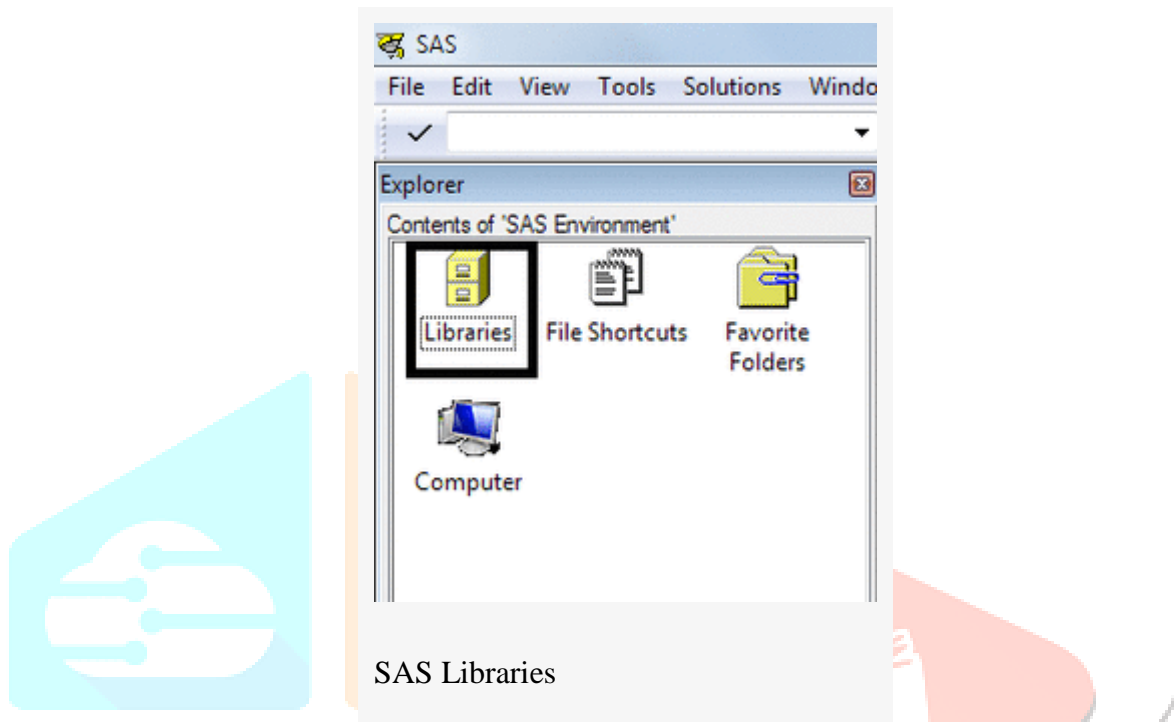


Fig:-9

How to create a SAS library

1. Temporary: When you don't specify a library name at all, then the file is stored in a temporary SAS library called **Work**. When you close out the SAS session in which you created the SAS file, the temporary library and all of its files are removed from your computer's memory.

data example;

In this case, example is a data set that is stored in **work** library.

2. Permanent: If you use a library name other than the default library name 'Work' when creating a SAS file, then the file is stored permanently until you delete it. That is, you can use permanent SAS libraries and their contents in subsequent SAS sessions.

You can specify the library name followed by **dot (.) sign** and then data set name.

data my data .example;

In this case, example1 is a data set that is stored in **my data** library.

Basic SAS Program Rules

I. Rules for SAS statements

All SAS statements (except those containing data) must end with a **semicolon (;)**.

Example: "DATA example1;" is an example of a SAS statement.

Any number of SAS statements can appear on a single line provided they are separated by a **semicolon**.

Example: "DATA example1; Input Name \$ ID;" is an example of a SAS statement.

- SAS statements typically begin with a SAS keyword. (DATA, PROC)
- SAS statements are not case sensitive, that is, they can be entered in lowercase, uppercase, or a mixture of the two.

Example: SAS keywords (DATA, PROC) are not case sensitive

II. Rules for SAS names

- All names must contain between 1 and 32 characters.
- The first character appearing in a name must be a letter (A, B, ...Z, a, b, ... z) or an underscore (_). Subsequent characters must be letters, numbers, or underscores. That is, no other characters, such as \$, %, or & are permitted. Blanks also cannot appear in SAS names.
- SAS names are not case sensitive, that is, they can be entered in lowercase, uppercase, or a mixture of the two. (SAS is only case sensitive within quotation marks.)

III. Rules for SAS variables

If the variable in the **INPUT** statement is followed by a dollar sign (\$), SAS assumes this is a character variable. Otherwise, the variable is considered as a numeric variable.

Difference between 'PROC' steps and 'DATA' steps

DATA Steps

Any portion of a SAS program that begins with a DATA statement and ends with a RUN statement is called a **DATA Step**.

DATA steps are used to manage data. In detail, DATA steps are used to read raw or external data into a SAS data set, to modify data values, and to subset or merge data sets.

PROC Steps (Procedures)

Any portion of a SAS program that begins with a PROC statement and ends with a RUN statement is called a **PROC Step or Procedures**. PROC steps are in-built programs that allow us to analyze the data

contained in a SAS data set. PROC steps are used to calculate descriptive statistics, to generate summary reports, and to create summary graphs and charts.

FUTURE SCOPE OF SAS:

The clinical SAS programming industry in India has seen rapid germination in the last few decades and the trend seems to continue, for the next couple of years, due to cost advantage and the availability of skilled labor. Due to the heightened demand for skilled resources, the wants of the programmers have taken a different shift toward diversifying exposure, unsustainable wage inflation due to multiple opportunities and high expectations around career progression. According to a recent study, SAS analytics skills are the most valuable skills to have in today's job market. The traditional healthcare paradigm is expanding the range of career choices for SAS programmers. To gauge the current state and future vision of healthcare analytics, SAS is has become a valuable tool.

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