Study on Identifying the Opportunities for Acquiring/ Collaborating a Drug in Breast Cancer Indication

By

Malika Chhabra

Dissertation submitted in partial fulfillment of the requirements of the degree

MBA Hospital and Health Management

Academic year, 2018-2020

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PharmaACE

The certificate is awarded to

Dr. Malika Chhabra

In recognition of having successfully completed her Internship in the department of

Competitive Intelligence

and has successfully completed her Project on

Identifying the opportunities for acquiring/collaborating a drug in Breast Cancer Indication

starting from

February 17, 2020 to May 17, 2020

at

PharmaACE Analytics LLP

She comes across as a committed, sincere & diligent person who has a strong drive and zeal for learning

We wish her all the best for future endeavors.

Dinesh Pandey

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CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **"A study on identifying the Opportunities for Acquiring/ Collaborating a drug in Breast Cancer Indication" at PharmaACE, Analytics Center of Excellence, Pune** and submitted by **Dr. Malika Chhabra,** Enrolment No **0767** under the supervision of **Dr. Susmit Jain, Associate Professor** for award of MBA in Hospital and Health of the University carried out during the period from **17 Feb 2020** to **17 May 2020** embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.

Dr. Malika Chhabra

ABSTRACT

A study on identifying the Opportunities for Acquiring/ Collaborating a drug in Breast Cancer Indication

By- Dr. Malika Chhabra
Under the guidance of Dr. Susmit Jain

Introduction:

Oncology is one of the most lucrative and R&D heavy industries now a days. In 2017, there were an estimated 3,577,264 women living with female breast cancer in the United States. (SEER,2020). This growing demand motivate US Pharmaceutical firms to pursue business development opportunities in this indication.

During my Internship in PharmaACE, I was a part of Competitive Intelligence Team (CI Team). Basic role of the Competitive Intelligence team is to provide knowledge on the subject matter that is required by the approaching clients so they could take better strategic decisions based on sound knowledge, deciding the future for their firm. Tasks performed by CI team are such as market assessment reports, product analyses, review of the current product universe, therapeutic area intelligence reports, etc.

The aim of the study was the identify and assess the opportunities for acquiring or collaborating a drug in Breast Cancer Indication. The study is based on Secondary Research from different data sources and Inference was concluded from different data banks such as Clinical Trial.gov; Evaluate Pharma reports etc.

Objective:

i. To study the Competitive landscape of molecules in Breast Cancer Market
ii. To analyze the Opportunities for acquiring/ collaborating in Breast Cancer
iii. To determine the key products and players in the Breast Cancer Market

Methodology:

The study is descriptive and exploratory in nature. A rigorous secondary research was done with inference concluded from different databanks, research papers, books, journals, and websites to collect the data. Breast cancer market was assessed and the data for U.S. was extracted and analysed to arrive at conclusions.

Data Analysis- Screening Criteria was applied to shortlist molecules and then Attribute Analysis was conducted to identify top products.

Key-Findings and Results:

The agreed upon Screening criteria was applied for shortlisting the molecules, finally giving us the most desirable results, set according to the expectations.

Screening was performed based on Mechanism of Action; Route of Administration; Market capital and current Collaboration with other big firms of interest molecules. Rigorous Screening resulted in shortlisting of 36 molecules.

After shortlisting of above 36 molecules, **Attribute analysis** conducted based on company's and molecule's attributes, to identify top 9 products in Breast Cancer Indication in Early-mid stage and Late stage of development. Company attributes were such as willingness of Company to license and Molecular attributes were such as: First-in-class; First in Human in 2020; Efficacy; safety etc. were defined and scored accordingly, thus resulted in top products in Breast Cancer Indication. Attribute analysis resulted in top 7 products of Early-mid stage development and top 2 products of Late stage development.

Conclusion:

The study began with 1626 clinical trials out of which we identified 1425 unique trials. After which a carefully crafted screening criteria was applied, and 36 promising molecules were found as a result having no partnerships. These 36 molecules were again put to test using a deep dive attribute analysis in which scores and weightages were allocated to different attributes. As a result total of 9 molecules were identified at the end, fitting into the set criterions which were defined in the beginning of this project out of which 2 were in late stage development (Balixafortide; Todelvy) and 7 were in early-mid stage of development (H3B-6545; Trilaciclib; PMD-026; TPST-1120; ODM-209; OTS167PO; BT5528). Now the study findings would be utilized by client to review our top products and define their interest molecules.

(Key-words: Breast Cancer; Carcinoma of the Breast; HR+; TNBC; HER2-; Estrogen receptor positive)

ACKNOWLEDGMENTS

This dissertation opportunity with PharmaACE, Pune was once in a lifetime chance for learning, understanding and professional development. It helped me in learning duties as a professional working in a multinational consulting organization. This opportunity helped me to develop as a management professional. I am also grateful for having a chance to work with wonderful people and professionals who are among the most acknowledged names in the industry. This period has helped me in honing my skills.

I am extremely indebted and would like to convey my deepest warm gratitude to **Mr. Dinesh Pandey**, Chief of Staff, PharmaACE and **Mrs. Pratima Chaudhary**, Practice Head, PharmaACE, who in spite of being extraordinarily busy with their duties, took time out to hear and guide me. And I would also like to thank **Mr. Amit Pharande**, Team Lead, and my Industry mentor who worked tirelessly in carrying out my projects during this period. I would also like to express my heartfelt thanks to **Dr. Susmit Jain**, Associate Professor, and Faculty guide, IIHMR University, for his constant support and guidance throughout dissertation period. I choose this moment to acknowledge their involvement thankfully.

I see this opportunity as a huge step in my career development and I will strive to use my gained skills and knowledge in the best possible way to shape my career and use the best of my knowledge to help others in need as a token of appreciation for those who helped me gain these skills.

Sincerely,

Dr. Malika Chhabra (767)

MBA-HM (2018-2020)

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Abbreviations

AACR	American Association for Cancer Research
ASCO	American Society of Clinical Oncology
Bn	Billion
BRCA	BReast CAncer gene
CI	Competitive Intelligence
DNA	Deoxyribonucleic Acid
ER	Estrogen Receptor
EU5	European Union 5
HBOC	Hereditary Breast and Ovarian Cancer
HER2	Human Epidermal Growth Receptor 2
HR	Hormone Receptor
HRT	Hormone Replacement Therapy
IV	Intravenous
MOA	Mechanism of Action
M. Cap	Market Capital
R & D	Research and Development
ROW	Rest of World
TNBC	Triple Negative Breast Cancer
UK	United Kingdom
US	United States

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Main Text (Project)- A study on identifying the Opportunities for Acquiring/ Collaborating a drug in Breast Cancer Indication

Chapter 1. Introduction

1.1 DISEASE (Overview and Pathophysiology)

Breast Cancer (Overview)

Cancer which starts in breasts. Cancer cells form tumor which can be seen on X-ray or felt as lumps. It can begin in the duct that carry milk to nipples or in the glands that make breast milk or other tissues of the breast(Azim Jr & Partridge, 2014). And can metastasize to nearby bones affecting the skeletal system and making its way to other organs as well(Brook, Brook, Dharmarajan, Dass, & Chan, 2018). On the other hand, the advances in genomics have made it possible to establish a new molecular classification of breast cancer(Merino Bonilla, Torres Tabanera, & Ros Mendoza, 2017).

Common Signs and Symptoms:

- Lumps; Nipple Discharge; Breast/Nipple Pain; Nipple Retraction/ Inversion; Swelling; Redness; Change in Skin texture; Lymph Node changes (Wörmann, 2017)

Fig.1(a) Breast Cancer can be divided into In-situ and Invasive

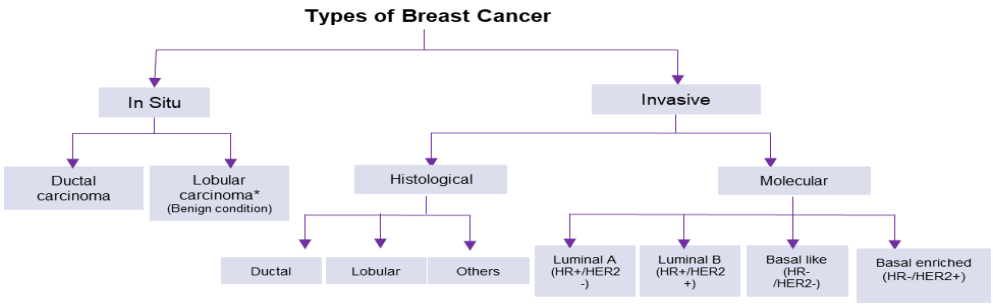
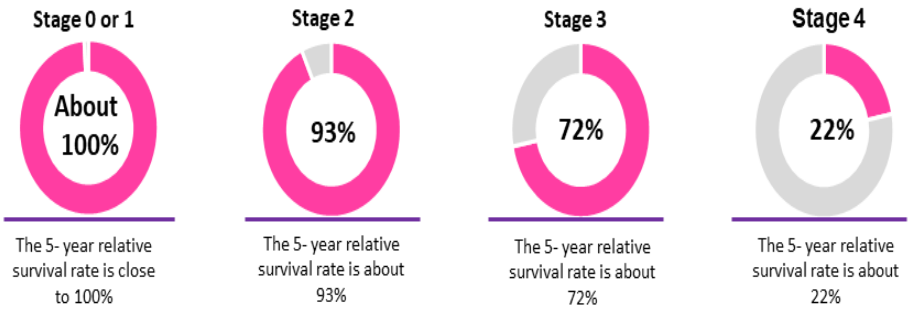
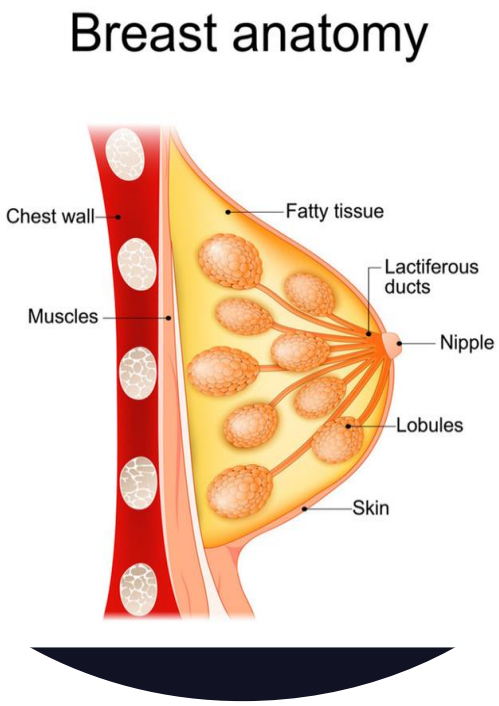


Fig.1(b) Stages of Breast Cancer with respect to 5-year survival rate



Breast Cancer (Pathophysiology)

Fig.1(c)



Breast cancer can be:

A. Hereditary Breast Cancer
B. Hormonal Breast Cancer

A. Hereditary Breast Cancer: Approximately five to ten percent of breast cancers are hereditary, i.e. genetic mutation causing increase cancer risk in the patient's family. Hereditary breast and ovarian cancer (HBOC) syndrome occur by mutations in two genes, BRCA1 and BRCA2. The genes code for a DNA repair pathway that is important for protecting against mutations. Either gene loss leads to a high risk of breast cancer (Cao, Huang, & Shao, 2017).

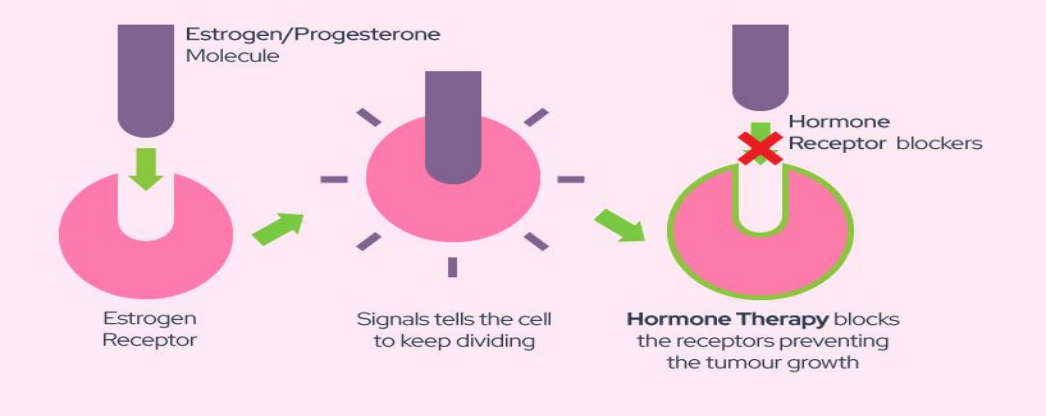
B. Hormonal Breast Cancer: Hormonal supply is required to develop tissue that arises out of. Breast cancer increases with lifetime estrogen exposure. Most of breast cancers are hormone sensitive, i.e. they express estrogen receptors and proliferate in response to estrogen stimulation(Pridjian & Puschett, 2002). Endocrine therapies are effective in treating hormone-sensitive breast cancer as they inhibit estrogen production.

B-1. Gene expression in breast cancer: Two Oestrogen Receptors (alpha and beta) (ERα and Erβ). Brain, lungs, kidneys, and several other organs express Erβ, while the breast, ovaries, and the endometrial wall express ERα. Both ER types have a DNA attaching area and exist in the nucleus and the cytosol. When oestrogen penetrates the cell, it binds with the ER and the formed complex travels into the nucleus and leads to the creation of transcription proteins that stimulates alterations in the cell(Sørlie et al., 2001)

B-2. Part of oestrogen in breast cancer progress and expansion: Two key assumptions try to describe the tumorigenic impacts of oestrogen:

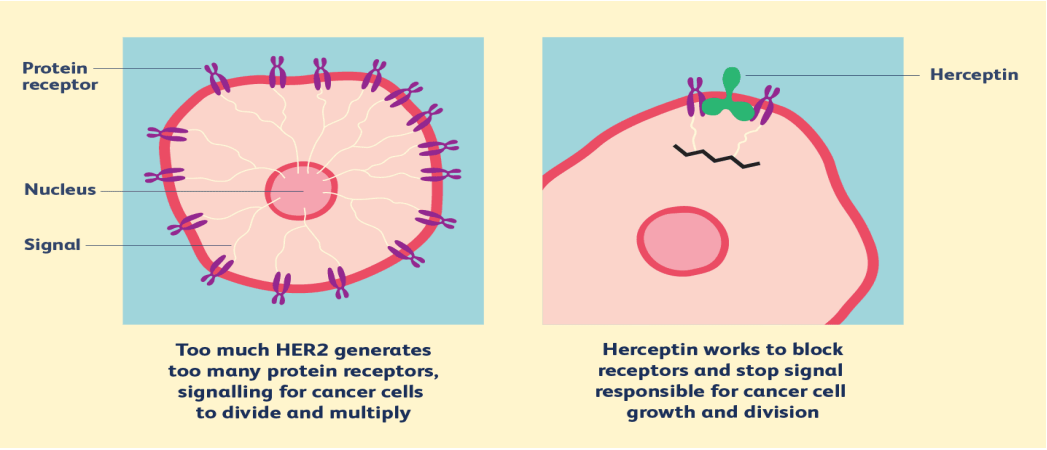
- Genotoxic effects of oestrogen metabolites via production of initiators
- The hormonal properties of estrogen generates production of cancerous cells (promoter)(Trauernicht & Boyer, 2003). (Fig.1(d))

Fig.1(d)



B-3. Role of Human Epidermal Growth Factor Receptor 2 (HER2): HER2 belongs to the epidermal growth factor receptor (EGFR) family of proto-oncogenes. The protein has been shown to form masses within the cell membranes in malignant breast tumors. Mechanism of carcinogenesis remains unknown, but overexpression is related with rapid tumor growth, reduced survival, and poor response to standard chemotherapeutic agents. (Fig.1(e))

Fig.1(e)



1.2 RATIONALE

Oncology is one of the most lucrative and R&D heavy industries now a days with most major companies competing to find the cure of one of most deadly diseases that the mankind is facing. Billions of dollars are spent annually for the research and development of these molecules. And billions are spent on them annually by the care seekers fighting the disease. In 2017, there were an estimated 3,577,264 women living with female breast cancer in the United States. Approximately 12.9 percent of women will be diagnosed with female breast cancer at some point during their lifetime. The rate of new cases of female breast cancer was 128.5 per 100,000 women per year. The death rate was 20.3 per 100,000 women per year (SEER,2020). 1 in eight women in US will develop breast cancer once in her lifetime. This growing demand motivate US Pharmaceutical firms to pursue business development opportunities in this indication.

During my Internship in PharmaACE I was a part of Competitive Intelligence Team (CI Team). Basic role of the Competitive Intelligence team is to provide knowledge on the subject matter that is required by the approaching clients so they could take better strategic decisions based on sound knowledge, deciding the future for their firm. These could include market assessment reports, product analyses, review of the current product universe, therapeutic area intelligence reports, etc. Nature of the work largely depends upon the requirement of the client.

Hence, a well-known name in Pharma Industry multinational giant approached PharmaACE's Competitive Intelligence team to understand business development opportunities. I was fortunate enough to work with the Competitive Intelligence team of PharmaACE on this Project.

To tackle such a task, the requirements of the client are understood through a formal meeting, the sole agenda of this preliminary meeting is to set the expectations with the upcoming project. In which the approaching client shares their expectations/requirements with the CI Team. And same was true for this project as well, a meeting was undertaken, and expectations were understood and prioritized.

The approaching client wished to understand what all opportunities are there in the market for Breast cancer which they can grab for business development. This is followed by numerous internal meetings to organize thoughts and workflow of the whole team during the project.

The aim of the study was the identify and assess the opportunities for acquiring or collaborating a drug in Breast Cancer Indication. The study is based on Secondary Research from different data sources such as Clinical Trials.gov; Evaluate Pharma reports etc. and Inference concluded from them.

1.3 AIM

To identify the Opportunities for Acquiring/Collaborating a drug in Breast Cancer Indication.

1.4 OBJECTIVE

i. To study the Competitive landscape of molecules in Breast Cancer Market
ii. To analyze the Opportunities for acquiring/ collaborating in Breast Cancer
iii. To determine the key products and players in the Breast Cancer Market

Chapter 2. Review of Literature

Review of literature for the present study has been organized under the following headings:

A. Descriptive Study of Breast cancer: Basics, screening, diagnostics, and treatment

A Descriptive Study on Breast cancer was conducted in the year 2017 which extensively described the nature and prognosis of the malignancy. The study concluded that Breast cancer is by far the most common malignancy in women. The median age is 64 years. Stage at diagnosis and biological features determine the prognosis. Patients with early breast cancer, with locally advanced disease and with locoregional relapse can be cured. Modern treatment incorporates surgery, radiation, and drug therapy. Patients with metastatic disease are treated with palliative intent. Aims are alleviation of symptoms and prolongation of survival. Breast cancer mortality has specifically continually decreased in the past 10 years. Five-year survival rate is 87% in Germany. Patients with early breast cancer have an even higher chance of cure.

B. A descriptive Study on Breast Cancer: Multiple types within a Tumor?

This descriptive study done in the year 2017 concluded that, breast cancers consist of many types within a tumor and these different entities could hypothetically be active due to the plastic nature of breast cancer cells. Application of single-cell tools for detection objectives will be essential in such a situation and may give improved direction when interpreting different combinatorial treatment modalities. However significant disparity is there within used research techniques and current clinical methods. Still there are real and scientific questions that need to be tackled.

C. A Study on Hormonal Therapies and Breast Cancer

This study concluded that, the lifetime chances for acquiring breast cancer are evidently up to 1 in 8 women in Northern America and 1 in 12 in West European subcontinent. Acc. to the ACS, 200,000 women (and 1,500 men) will be detected with breast cancer in one year. Prevalence of breast cancer in women has risen since the mid-1940s, though the death rate has decreased, probably due to improved diagnostics and treatment modalities.

Data from both, epidemiological and experimental parts of this study point to an important role of reproductive hormonal variations in the growth and support of human breast cancer. Hormonal influences, in the form of contraceptives, HRT, or oestrogens antagonists, affect the occurrence and prognosis of breast cancer and can be very important in prevention and treatment of this cancer.

D. Study on Biology and Management of Patients with Triple-Negative Breast Cancer

The study conclusively implied that TNBC is a small but heterogeneous subtype of breast cancer. Because of the lack of approved targeted therapy, chemotherapy remains the mainstay of treatment for early and advanced disease. Modern technology platforms have contributed immensely to our current understanding of the molecular diversity of this subtype. These molecular advances have enabled us to start ascertaining promising therapeutic targets in TNBC. Current research efforts are focused on optimizing the traditional drugs by applying them to patients and tumors that will benefit the most, and by studying newer drugs in biologically selected patient subgroups.

New-generation TNBC trials are beginning to embed the concept of heterogeneity, and investigations in smaller molecularly identified subgroups of TNBC are emerging. TNBC is a complex disease, and it is likely that several different targeted approaches will be needed to make meaningful strides in improving the outcomes.

E. Study on Multigene Expression Signatures in Early Hormone Receptor Positive HER 2 Negative Breast Cancer

The study positively implied that multigene signature assays provide prognostic information that augments the one from clinical-pathologic features and reflects tumor biology. Decisions that rely solely on clinical-pathological factors may often lead to overtreatment and in these cases the information provided by multi-gene signatures may reduce the use of unnecessary adjuvant chemotherapy without increasing the risk of relapse. In contemporary management of HR+HER2- early BC clinical decisions regarding adjuvant systemic therapy should be made after considering both genomic results and clinical-pathological features.

Chapter 3. Methodology

The study is descriptive and exploratory in nature. A rigorous secondary research was done with inference concluded from different databanks, research papers, books, journals, and websites to collect the data. Breast cancer market was assessed and the data for U.S. was extracted and analysed to arrive at conclusions

Research Question: What are the Opportunities for Acquiring/Collaborating a drug in Breast Cancer Indication?

3.1 STUDY DESIGN- Descriptive Exploratory study

3.2 PERIOD OF STUDY– February 2020 to May 2020

3.3 STUDY AREA- U.S. pharmaceutical market

3.4 DATA COLLECTION TECHNIQUE- Review of relevant documents has been done and qualitative information was collected based on resources inputs provided.

3.5 DATA SOURCE-Secondary sources include CT.gov; AdisInsight; Google Scholar; Pub-med; Evaluate Pharma reports; ASCO (American Society of Clinical Oncology); AACR (American Association for Cancer Research)

Chapter 4. Screening Criteria & Key- Findings

4.1 SCREENING CRITERIA

Fig.4(a) Screening Criteria (Funnel) represented in the figure below depicts the filters and cuts applied to #1626 clinical trials for shortlisting molecules for further analysis.

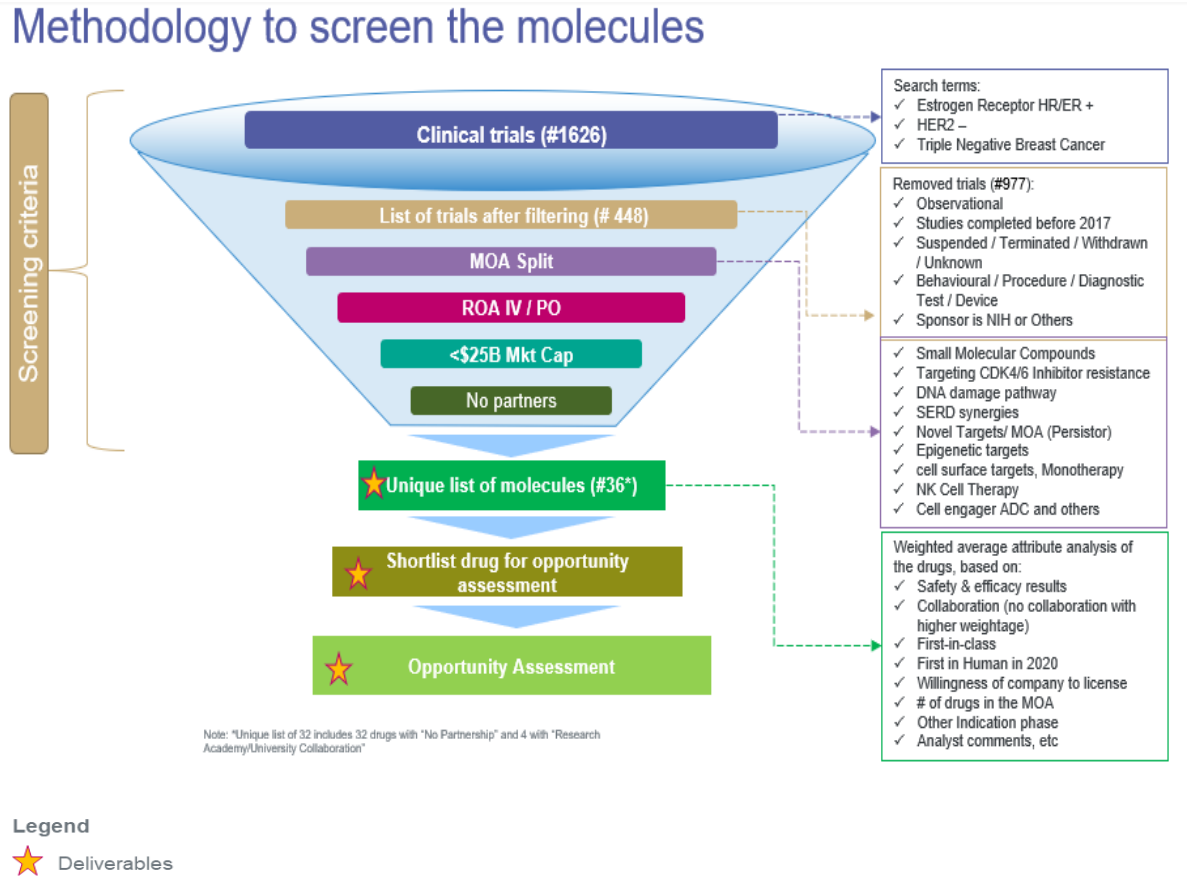


Fig.4(a): Inference: We had total #1626 clinical trials using all possible keywords/ search terms such as ER/HR+; HER2- and TNBC. First split/filter/cut is to remove all duplicates and out of scope trials such as observational or suspended/terminated. Second split/ filter/ cut is to remove put of scope mechanism of actions such as chemotherapy/vaccines/Autologous therapy etc. Third split/filter/cut is to remove those molecules with route of administration other than IV/PO (considering them to be in-scope). Fourth split/filter/cut is to remove molecules whose market capital is more than USD 25 Billion. And last fifth split/filter/cut is to remove those molecules which has collaborations/ partnership with another company/firm. So, we have molecules of interest with No Partnership.

4.2 KEY FINDINGS

Table.4(i): Using all possible keywords, total 1626 Clinical trials were obtained. Thus, screening was carried out and possible cuts/filters were applied according to client's requirements.

Categories	#
Triple Negative Breast Cancer trials	701
Estrogen Receptor-positive Breast Cancer trials	383
HER2-negative Breast Cancer trials	542
TOTAL	1626
Duplicate trials	201
Unique trials	1425
Observational trials	103
Terminated/Withdrawn/Unknown/Suspended trials	244
Completed before 2017 trials	257
Sponsors Other/NIH trials	326
Procedure/Behavioral/Test trials	11
Not in scope, duplicate drugs in early stage	36
Total excluded trials	977
Total to be cleaned trials	448
Focused MOA	392
IV & Oral	360
MCAP <$25Bn	75
No partnership	32
Yes (Research Academy/University Collaboration)	4
Yes (Clinical Trial Collaboration)	21
Yes (Product/Regional commercialization/in-licensed)	18

Table.4(i): Inference: This table depicts the churned outcome of the rigorous screening method employed in the previous steps.

And a Cut of Market capital less than $25 Billon was applied to select small companies to whom collaboration or acquirement would be easy

Out of which 32 molecules were those who have no partnership at all, and 4 molecules were those which has any university or Research academy collaboration. As a result of which 36 molecules of interest were found. (Highlighted in blue colour)

Table.4(ii): C.I. Landscape of Early Stage No Partnership Drugs (out of 32 molecules): There are 14 molecules in Phase-1 and 12 molecules in Phase 1|2 and most of them are studied in TNBC

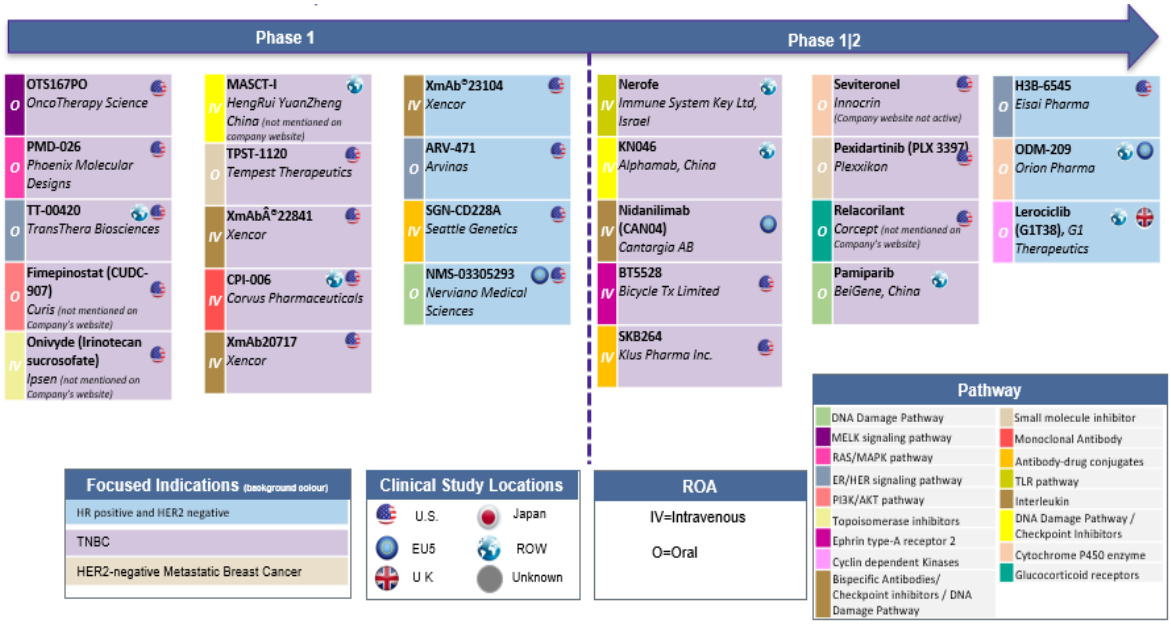


Table.4(iii): C.I. Landscape of Early Stage No Partnership Drugs (out of 32 molecules): There is one marketed drug, one molecule in Phase-3 & four in Phase-2 stage of development for TNBC and HR+/HER2-

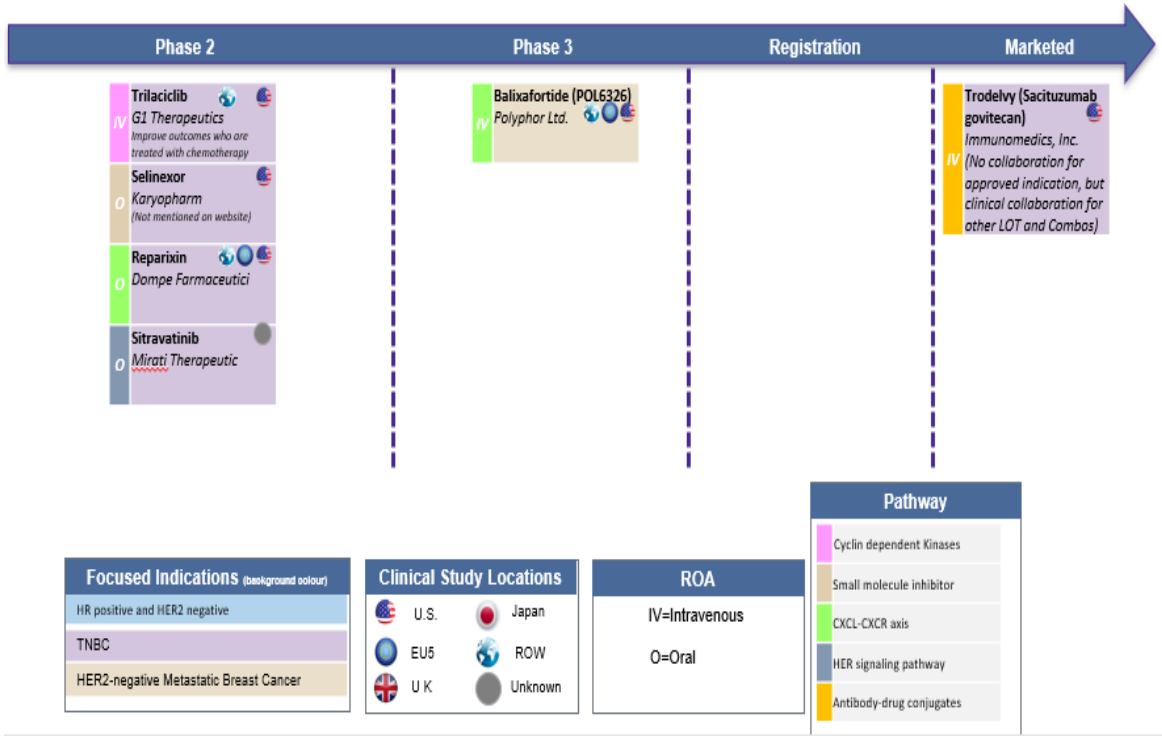
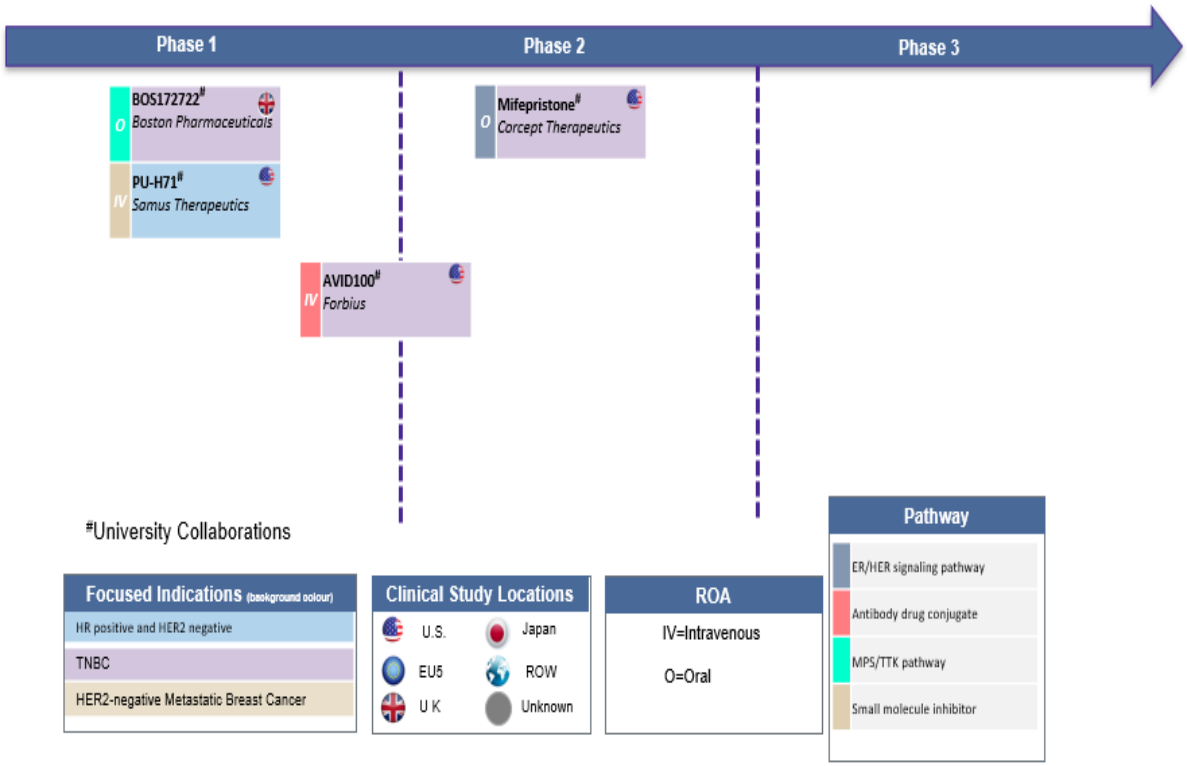


Table.4(iv): C.I. Landscape of drugs in research collaborations with Universities: There are four molecules which are studied in TNBC & HR+/HER2- patients with university collaboration



Chapter 5. Attribute Analysis & Results

5.1 ATTRIBUTE ANALYSIS

#36 (32+4) shortlisted products were taken up further. Attribute Analysis was conducted for the filtered-out molecules and Scoring criteria and Weightages were defined through brainstorming.

Table.5(i): Depicts Illustrations of (Company)Attribute Analysis for M. Cap <$25 Bn and Collaboration with weightages and Scoring pattern [1/2]

Sr no	Focused Parameters	Rationale	Weightage	Score	Potential sub-parameters	Illustration	Filters
1.	**Mcap >$25Bn**	Division between Big Pharma and Mid-Small companies	-	-	Yes	Capivasertib *(AstraZeneca)*	*Excluded*
				-	No	Trilaciclib (G1 Therapeutics)	*Included*
2.	**Collaboration**	To identify opportunities, can be about innovation, sponsored research or combination therapy to use it in treatment	**10%**	3	No	NMS-03305293 (Nerviano Medical)	*Included*
				2	Collaboration in different LOT in TNBC/HR+/HER2-	Trodelvy (Seattle Genetics)	*Included*
				1	Collaboration with university/ Research academy	Avid 100 *In research collaboration with National Research Council, Canada*	*Included*
				-	Yes *(In-licensed)*	S81694 *Product of NMS group, In-licensed with Servier*	*Excluded*
				-	Yes *(Regional Commercialization)*	Olinvacimab (SSS-23) *Product of PharmAbcine, partnered with Asia 35BIO*	*Excluded*
				-	Yes *(Co-development)*	Camidanlumab tesirine (ADCT-30) *ADC therapeutics and Genmab are co-developing*	*Excluded*
				-	Yes *(Clinical Trial Collaboration)*	ZEN3694 *Product of Zenith Epigenetics is in trial collaboration with Pfizer*	*Excluded*

Table.5(ii): Depicts Illustrations of (Company)Attribute Analysis for Willingness of Company to License and Clinical development status of drug with weightages and Scoring pattern [2/2]

Sr no	Focused Parameters	Rationale	Weightage	Score	Potential sub-parameters	Illustration
3.	**Willingness of company to License**	To identify how inclined a company is to partner/ collaborate	**15%**	3	High	Lerociclib (G1T38) *Company mentioned in SEC filings: "Exploring partnering opportunities to continue to advance clinical development of lerociclib"*
				2	Medium/Moderate	BT5528 *(For different portfolio they partnered with Genentech, hence will look for partners)*
				1.5	Insufficient Information	Seviteronel (Innocrin Pharmaceutical) (Company's website not active)
				1	Low	Onivyde (Irinotecan sucrosofate) *(Already commercialized in other indications)*
4.	**Clinical development status of the drug**	Status of drug in development phase as mentioned on company's website	**10%**	3	Ongoing Trial and Active on website	AVID100 *(Molecules and BC indication mentioned on website)*
				2	Mentioned on company website or clinical trials as Solid tumors (covers TNBC/HER2-/HR+)	SGN-CD228A *(mentioned on website as solid tumors- no focused indication)*
				1	Company website is not active, but trial is active	Seviteronel (Innocrin Pharmaceutical) (Company's website is inactive, but trial is active on Clinical trials.gov)

Table.5(iii): Depicts Illustrations of (Molecules)Attribute Analysis for Fist in class, # of drugs with same MOA, First in Human 2020 and Studies in other Indication with weightages and Scoring pattern [1/4]

Sr no	Focused Parameters	Rationale	Weightage	Score	Potential sub-parameters	Illustration
1.	First-in-class	Drugs that use a new and unique mechanism of action for treating a medical condition according to FDA 2011 Novel New Drugs	10%	3	Yes	Trilaciclib *("First in class" CDK 4/6 Inhibitor)*
				0	No	CPI-006
2.	# of drugs with same MOA	To determine the uniqueness of the molecule, based on how many drugs are acting with same mechanism	10%	3	None	H3B-6545 *(First-in-Class)*
				2	Drug with dual MOA	XmAbÂ®22841* *(CTLA-4 & LAG-3 targeted bispecific antibody)*
				1.5	One to three	CPI-006* *(Two others)*
				1	Four to Six	NMS-03305293* *(Six others)*
				0	More than 6	ARV-471*
3.	First-in-Human 2020	Project scope mentioned to focus on First in Human 2020 drugs **(Excluded in Late stage molecules)**	15%	3	Yes	SKB264 *(Actual study start date was Feb 28, 2020)*
				1.5	No, but First in 2019	PMD-026 *(Actual study start date was Nov 14, 2019)*
				0	No	Fimepinostat (CUDC-907) *(Actual study start date was Nov-2014)*
4.	Studies in other Indication Phase	Other conditions in which the molecules is studied to discern future scope	5%	3	Yes (irrespective of phase & # of indications)	OTS167PO (Acute Myeloid Leukemia –P1)
				0	No	H3B-6545

Table.5(iv): Depicts Illustrations of (Molecules)Attribute Analysis for Efficacy of Early-mid stage with weightages and Scoring pattern [2/4]

Sr no	Focused Parameters	Rationale	Weightage	Potential sub-parameters	Score	Illustration
5.	**Efficacy**					
	a) Early mid stage molecules	Based on pre-clinical anti-tumor activity on Xenografts models	30%	i. Tumor Growth Inhibition (TGI) ii. Tumor Volume Reduction (TVR)	3- Positive Quantified study results in Breast Cancer	OTS167PO
					2- Positive Qualitative study results in Breast Cancer	SGN-CD228A
					1- Positive results in other indications	Fimepinostat (CUDC-907)
					0- No Information available	SKB264
		It is a sum of Complete response + partial response + Stable disease thus reflecting anti tumor effect of drug	70%	i. Complete Benefit Rate (CBR)	3 - >=50% in Breast cancer	H3B-6545 (56%)
					2 - >30% and <50% in breast cancer and >50% in another indication	Seviteronel (33% in TNBC)
					1- <=30% in breast cancer or <50% in another indication	Selinexor (30%)
					0- If no information is available	ODM-209

Table.5(v): Depicts Illustrations of (Molecules)Attribute Analysis for Efficacy of Late stage with weightages and Scoring pattern, [3/4]

Sr no	Focused Parameters	Rationale	Weightage	Potential sub-parameters	Score	Illustration
5.	**Efficacy**					
	b) Late and Registration stage molecules	In later stages, CBR has minimal implication on Clinical Benefit	15%	Complete Benefit Rate (CBR)	3 - More than 50% in Breast cancer	Balixafortide (POL6326) (63%)
					1.5 - Less than 50% in breast cancer	Trodelvy (Sacituzumab govitecan) (IMMU-132) (45.4%)
					0 - no results	-
		Primary endpoints that FDA believes to be most appropriate measure of Clinical Benefit	50%	Median Overall Survival (Median OS)	3 - 12 to 18 months	Balixafortide (POL6326) (18 months) Trodelvy (Sacituzumab govitecan) (IMMU-132) (13 months)
					2 - 6 to 12 months	-
					1 - 0 to 6 months	-
		Primary endpoint in evaluating treatment of metastatic cancer (PFS is often used as surrogate endpoint to Median OS)	35%	Progression Free Survival (PFS)	3 – 1+ year	-
					1.5 – 3 to 12 months	• Balixafortide (POL6326) (6.2 months) • Trodelvy (Sacituzumab govitecan) (IMMU-132) (5.5 months)
					0 - <3 months	-

Table.5(vi): Depicts Illustrations of (Molecules)Attribute Analysis for Safety and Analyst Comments with weightages and Scoring pattern, [4/4]

Sr no	Focused Parameters	Rationale	Weightage	Potential sub-parameters	Score	Illustration
6.	**Safety**	Molecules achieves significant safety levels as compared to placebo in the subjects	10%	Positive data from clinical stage	3	H3B-6545 *No dose-limiting toxicities and only one Grade 3 treatment related adverse event (TRAE) have been observed (lymphocyte count decrease)*
				Positive data from preclinical stage	2	KN046 *Good safety, tolerability and preliminary efficacy*
				No data found but drug is in clinical stage	1	PU-H71
7.	**Analyst Comments**	Industry experts / KOLs mentioning or commenting on the drug / company **(Included in Late stage molecules)**	5%	Positive	3	Balixafortide (POL6326)
				Neutral	2	-
				No comments	1	-
				Negative comments	0	-

5.2 RESULTS

Table.5(vii): Top 7 products from Attribute Analysis of Early-mid stage molecules Scored =>2 (Highlighted in green color)

Rank	Scores	Molecule Names
1	2.3	H3B-6545 (Eisai Pharma)
2	2.2	Trilaciclib (G1 Therapeutics)
3	2.2	PMD-026 (Phoenix Molecular Designs
4	2.1	TPST-1120 (Tempest Therapeutics)
5	2.1	ODM-209 (Orion Pharma)
6	2.0	OTS167PO (OncoTherapy Science)
7	2.0	BT5528 (Bicycle Tx Limited)
8	1.9	Lerociclib (G1T38) (G1 Therapeutics)
9	1.9	Reparixin (Dompe Farmaceutici)
10	1.9	Nerofe (Immune System Key)
11	1.9	Selinexor (Karyopharm)
12	1.9	Sitravatinib (Mirati Therapeutic)
13	1.9	Pamiparib (BeiGene)
14	1.8	Pexidartinib (PLX 3397) (Plexxikon)
15	1.8	KN046 (Alphamab)
16	1.8	Nidanilimab (CAN04) (Cantargia AB)
17	1.8	TT-00420 (TransThera Biosciences)
18	1.8	SKB264 (Klus Pharma)
19	1.6	NMS-03305293 (Nerviano Medical Scie
20	1.6	PU-H71 (Samus Therapeutics)
21	1.6	Fimepinostat (CUDC-907) (Curis, Inc.)
22	1.6	Relacorilant (Corcept Therapeutics)
23	1.5	XmAb®23104 (Xencor)
24	1.5	ARV-471 (Arvinas Inc)
25	1.5	Onivyde (Irinotecan sucrosofate) (Ips
26	1.4	CPI-006 (Corvus Pharmaceuticals)
27	1.4	SGN-CD228A (Seattle Genetics)
28	1.3	XmAbÂ®22841 (Xencor)
29	1.3	XmAb20717 (Xencor)
30	1.3	AVID100 (Forbius)
31	1.3	Seviteronel (Innocrin)
32	1.1	Mifepristone (Corcept Therapeutics)
33	1.1	BOS172722 (Boston Pharmaceuticals)
34	1.0	MASCT-I (HengRui YuanZheng)

Table.5(viii): Top 2 products from Attribute Analysis of Late stage molecules Scored =>2 (Highlighted in green color)

Late stage products		
Rank	**Scores**	**Molecule Names**
1	2.7	Balixafortide (POL6326) (Polyphor)
2	2.3	Trodelvy (Sacituzumab govitecan) (IMMU-132)

Chapter 6. Conclusion

The study began with 1626 clinical trials out of which we identified 1425 unique trials. After which a carefully crafted screening criteria was applied, and 36 molecules promising molecules were found as a result having no partnerships.

These 36 molecules were again put to test using a deep dive attribute analysis in which scores and weightages were allocated to different attributes.

As the result of this rigorous exercise a total of **9 molecules** were identified at the end fitting into the set criterions which were defined in the beginning of this project out of which **2 were in late stage development (Balixafortide; Todelvy)** and **7 were in early-mid stage of development (H3B-6545; Trilaciclib; PMD-026; TPST-1120; ODM-209; OTS167PO; BT5528).**

Now the study findings would be utilized by client to review our top products and define their interest molecules.

Chapter 7. Bibliography

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