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Research Topic: Nanoparticle Drug Delivery for Breast Cancer: A Strategy to Mitigate Treatment Toxicity and Improve Outcomes in Bangladesh

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Introduction

Breast cancer poses a rapidly escalating public health challenge in South Asia, including Bangladesh, where rising incidence rates are projected to increase the overall cancer burden despite improvements in other cancer types. (1) In Bangladeshi women, aged between 15-44 years, breast cancer has the highest prevalence of 19.3 per 100000 compared to any other type of cancer making Bangladesh one of the countries with the highest incidences of breast cancer in Asia. The standard of care often involves conventional chemotherapy, which, while effective against cancer cells, indiscriminately causes widespread damage to healthy cells. This results in severe side effects—including hair loss, nausea, nerve damage, and life-threatening heart damage—that degrade a patient's quality of life. In Bangladesh, where late-stage diagnosis is common and healthcare resources are stretched, these toxicities frequently lead patients to abandon treatment, drastically reducing survival chances. The purpose of this proposal is to seek an alternative to the traditional chemotherapy, with technologically advanced yet practical solution.

Research Question:

How are nanoparticle drug delivery systems poised to enhance therapeutic efficacy in addition to minimizing treatment-induced toxicity in breast cancer therapy for Bangladeshi women compared to conventional chemotherapy modalities?

Hypothesis:

It is hypothesized that nanoparticle systems, particularly liposomal doxorubicin (Doxil), have the ability to offer a more targeted treatment strategy for Bangladeshi patients with a potential to maximize compliance and survival by suppressing the incapacitating side effects as well as the severity of treatment-related toxicities of conventional chemotherapy.

Literature Review

Breast Cancer in Bangladesh: An Escalating Health Crisis:

Breast cancer is a public health concern that is severe and emergent in Bangladesh. The recent data from the Global Cancer Observatory (GLOBOCAN) reveal the rate of

incidence and breast cancer emerges as the most common diagnosis of Bangladeshi women. Its impact is expected to rise with time, as in 2020 alone, approximately 685,000 women died from breast cancer, accounting for around 16% of all cancer-related deaths among females. Compared to the incidences, it can be observed that the mortality rate is significantly higher in such developing countries (2). Although the incidence is rising due to epidemiological transitions in low- and middle-income countries (LMICs), breast cancer mortality is projected to increase by 53.6% between 2020 and 2040 (3). The mortality rate is expected to increase due to certain factors, which include lack of awareness, educational deficits, cultural barriers, and fear of diagnosis (4-7). Likewise, financial toxicity of cancer treatment, combined with the severe physical side effects of therapy, creates a high risk of treatment abandonment, ultimately leading to poor survival outcomes. A 2022 study in The Lancet Regional Health confirmed that financial toxicity severely impacts the quality of life and treatment adherence among breast cancer patients in Bangladesh (8).The side effects of chemotherapy are caused by conventional chemotherapy drugs that are administered intravenously, pouring into the blood and all throughout the body (9).Their mechanism consists of killing all rapidly proliferating cells, which is typical of cancer, yet they cannot distinguish between normal tissues and tumor tissues (10). Therefore, such drugs also kill other fast-dividing normal cells, such as those in hair follicles, the bone marrow, and the gastrointestinal tract. This lack of specificity in cell killing is directly responsible for debilitating side effects such as hair loss, nausea, and a compromised immune system (11).

The Paradigm of Nanomedicine in Oncology:

Nanomedicine introduces a novel cancer treatment paradigm based on the use of nanoparticles as targeted drug delivery carriers. These nanoparticles are microscopic carriers (1-100 nanometers) that can be engineered to deliver chemotherapy agents directly to tumors. They take advantage of the "Enhanced Permeability and Retention (EPR) effect," whereby the permeable blood vessels of tumors actively sequester and retain these particles, with site-specific release of the drug (12). The EPR effect is a passive targeting method where nanoparticles accumulate in tumors because of their leaky blood vessels. Their size then traps them there, concentrating the chemotherapy drugs on the cancer while limiting damage to the rest of the body (13).

The Doxil Model: Efficacy with Reduced Toxicity:

One of the leading drugs that has been used as a treatment for breast cancer during chemotherapy is Doxorubicin which is the chemical name for Adriamycin (14). Conventional doxorubicin is a highly effective chemotherapeutic agent, but its use is dose-limited by a cumulative and often irreversible cardiotoxicity (16). One of the methods used to minimize this side effect is liposome encapsulation. Several doxorubicin formulations that are encapsulated in liposomes exist and have different pharmacological

characteristics. Doxil encapsulates the chemo drug doxorubicin in a protective nanoparticle. This design retains the drug's cancer-fighting efficacy but significantly lowers its toxicity, leading to a much-reduced risk of cardiotoxicity and other severe side effects (17). This improved safety profile enables patients to receive more cycles of effective treatment, addressing a key factor in treatment adherence. Furthermore, liposomal formulations using thermosensitive molecules have been developed to deliver cytostatic drugs, remaining stable at normal body temperature (37°C) but destabilizing at the slightly higher temperatures found in tumors. This allows greater release and higher drug concentrations within the tumor (15).

Gaps in Prior Research:
While it is clearly established that nanoparticle-based drug delivery systems enhance concentration of the drug at the tumor site with low levels of systemic exposure, there remains a critical knowledge gap in the literature. There is no synthesized analysis of how this targeted therapeutic result is translated into meaningful, patient-relevant outcomes, especially in resource-constrained settings like Bangladesh. Particularly, it is not known yet if this system allows for quicker recovery times for patients and better treatment compliance because of less toxicity. In addition, the real-world effectiveness impact of physiological variables like fluctuating pH on nanocarrier stability is commonly disregarded. This review will fill these gaps to create an integrated review of nanomedicine's real-world promise for enhancing breast cancer care.

Methodology

This study will employ a qualitative systematic literature review methodology. The design is structured so that the study will comprehensively review and synthesize scientific literature to enable a critical comparison between conventional chemotherapy and nanoparticle-mediated drug delivery systems for breast cancer with special reference to the translation of these findings into the Bangladeshi health care environment.

Data Collection: A rigorous, multi-phased approach will be used to gather relevant literature from peer-reviewed articles (2014-2024) sourced from PubMed, Google Scholar, and reports from the WHO and Bangladeshi health authorities using keywords: "nanoparticle breast cancer Bangladesh," "Doxil cardiotoxicity," "chemotherapy side effects." Peer-reviewed articles, clinical trials, and meta-analyses (2014-2024) that directly compare the efficacy and toxicity of conventional and nano-formulated chemotherapies will be included and pre-clinical studies, on the other hand, articles not published in English, and research unrelated to breast cancer or toxicity outcomes will be excluded.

Data Analysis: Thematic analysis will be conducted. Efficacy (tumor response rates) and toxicity (side effect profiles) data for nanodrugs and conventional chemotherapy will be extracted and synthesized into side-by-side comparative tables. The implication of these findings for the Bangladeshi healthcare environment will be critically evaluated.

Research Practicalities: The research will be carried out using a laptop with access to the internet to enable free academic databases and word processing packages to be accessed. The task will be completed within six weeks in three successive phases: (1) search and collation of literature, (2) extraction of data and compiling into comparative tables, and (3) analysis, writing, and completion. To minimize risks, a proper spreadsheet will be maintained to address sources and prevent information overload, and in case there is minimal Bangladesh-specific data, studies conducted in similar regional contexts will be included to strengthen the analysis.

Roadblocks and potential limitations

Despite being a potential therapeutic advancement, adopting nanodrugs in Bangladesh is fraught with difficulties, chief among them being their high cost in comparison to traditional chemotherapy, which calls for measures like local production and government subsidies. Additionally, prioritizing stable formulations and a gradual deployment in key cities priority, infrastructure needs like cold storage may be met. Despite the study's limitations, it provides a fundamental review that emphasizes the necessity of more pilot projects to produce localized clinical evidence in Bangladesh.

Conclusion

This research will critically evaluate nanomedicine not merely as a treatment alternative but as a foundational upgrade to the standard of care—one that strategically realigns therapeutic goals with patient realities in Bangladesh. By systematically demonstrating how targeted delivery of therapeutic nanoparticles shifts the paradigm away from toxic exposure to targeted cancer treatment, this will generate the fundamental evidence required to catalyze the shift toward a more effective, tolerable and ultimately sustainable model for cancer care. The final report will hence stand as a definitive framework, empowering Bangladeshi healthcare stakeholders to adopt a technology that promises to preserve the quality of life and not just to fight cancer but to equip fighters with a therapy that preserves their strength for the battle ahead**.**

References

[1] https://labaidcancer.com/cancer-details/Breast-Cancer

[2] M. S. Hossain, S. K. Trisha, and M. N. Hasan, "Understanding Delays in Breast Cancer Diagnosis: Insights from Bangladesh," *researchgate.net*, 2024[Online]. Available: https://www.researchgate.net/publication/385415537_Understanding_Delays_in_Breast_Cancer_Diagnosis_Insights_from_Bangladesh

[3] M. Arnold and E. Morgan, "Current and future burden of breast cancer: Global statistics for 2020 and 2040 - PubMed," *PubMed*, 2025[Online]. Available: https://pubmed.ncbi.nlm.nih.gov/36084384

[4] Donkor A. Factors Contributing to Late Presentation of Breast Cancer in Africa: A Systematic Literature Review. Arch Med. 2015, 8:2.

[5]. E. Ermiah, F. Abdalla, A. Buhmeida, E. Larbesh, S. Pyrhönen, and Y. Collan, "Diagnosis delay in Libyan female breast cancer," *BMC Research Notes*, vol. 5, no. 1, pp. 452, 2012, doi: https://doi.org/10.1186/1756-0500-5-45

[6]. E. R. Ezeome, "Delays in presentation and treatment of breast cancer in Enugu, Nigeria - PubMed," *PubMed*, 2010[Online]. Available: https://pubmed.ncbi.nlm.nih.gov/20857792/

[7]. J. Jassem, V. Ozmen, F. Bacanu, M. Drobniene, J. Eglitis, K. C. Lakshmaiah, Z. Kahan, J. Mardiak, T. Pieńkowski, T. Semiglazova, L. Stamatovic, C. Timcheva, S. Vasovic, D. Vrbanec, and P. Zaborek, "Delays in diagnosis and treatment of breast cancer: a multinational analysis," *European Journal of Public Health*, vol. 24, no. 5, pp. 761-767, 2013, doi: 10.1093/eurpub/ckt131

[8] Begum, S. A., et al. (2021). "Financial Toxicity and Treatment Non-Adherence among Bangladeshi Breast Cancer Patients: A Qualitative Study." *BMJ Open*, 11(3), e043092.

[9] National Cancer Institute, "Chemotherapy to Treat Cancer," *cancer.gov*, 2025[Online]. Available: https://www.cancer.gov/about-

cancer/treatment/types/chemotherapy#:~:text=Chemotherapy%20works%20by%20killing%20or,stop%20or%20slow%20its%20growth.

[10] National Cancer Institute, "Chemotherapy to Treat Cancer," *cancer.gov*, 2025[Online]. Available: https://www.cancer.gov/about-cancer/treatment/types/chemotherapy#:~:text=Chemotherapy%20works%20by%20killing%20or,stop%20or%20slow%20its%20growth.

[11] Reviewed by Kevin Fox, MD, "About side effects of chemotherapy," *workers.dev*, 2025[Online]. Available: https://www.cancerresearchuk.org/about-cancer/treatment/chemotherapy/side-effects/about

[12] D. Peer, J. M. Karp, S. Hong, O. C. Farokhzad, R. Margalit, and R. Langer, "Nanocarriers as an emerging platform for cancer therapy," *Nature Nanotechnology*, vol. 2, no. 12, pp. 751-760, 2007, doi: https://doi.org/10.1038/nnano.2007.387

[13] Y. Matsumura, "A new concept for macromolecular therapeutics in cancer chemotherapy: mechanism of tumoritropic accumulation of proteins and the antitumor agent smancs - PubMed," *PubMed*, 1986[Online]. Available: https://pubmed.ncbi.nlm.nih.gov/2946403/

[14] Reviewed by Kevin Fox, MD, "Adriamycin: What to Expect, Side Effects, and More," *Breastcancer.org*, 2025[Online]. Available: https://www.breastcancer.org/drugs/adriamycin

[15] S. Brown and D. R. Khan, "The Treatment of Breast Cancer Using Liposome Technology," *Journal of Drug Delivery*, vol. 2012, no. 12, pp. 1-6, 2012, doi: https://doi.org/10.1155/2012/212965

[16] S. M. Swain, F. S. Whaley, M. C. Gerber, S. Weisberg, M. York, D. Spicer, S. E. Jones, S. Wadler, A. Desai, C. Vogel, J. Speyer, A. Mittelman, S. Reddy, K. Pendergrass, E. Velez-Garcia, M. S. Ewer, J. R. Bianchine, and R. A. Gams, "Cardio protection with dexrazoxane for doxorubicin-containing therapy in advanced breast cancer.," *Journal of Clinical Oncology*, vol. 15, no. 4, pp. 1318-1332, 1997, doi: 10.1200/JCO.1997.15.4.1318

[17] M. O'Brien, N. Wigler, E. Grischke, A. Santoro, R. Catane, D. Kieback, P. Tomczak, S. Ackland, F. Orlandi, L. Mellars, L. Alland, and C. Tendler, "Reduced cardiotoxicity and comparable efficacy in a phase III trial of pegylated liposomal doxorubicin HCl versus conventional doxorubicin for first-line treatment of metastatic breast cancer," *Annals of Oncology*, vol. 15, no. 3, pp. 440-449, 2004, doi: 10.1093/annonc/mdh097

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