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Corresponding author(s): Prabhas V. Moghe,PhD., Vidya Ganapathy,PhD., Mark C. Pierce, PhD.

☐ Initial submission ☐ Revised version ☒ Final submission

Life Sciences Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form is intended for publication with all accepted life science papers and provides structure for consistency and transparency in reporting. Every life science submission will use this form; some list items might not apply to an individual manuscript, but all fields must be completed for clarity.

For further information on the points included in this form, see Reporting Life Sciences Research. For further information on Nature Research policies, including our data availability policy, see Authors & Referees and the Editorial Policy Checklist.

Experimental design

1. Sample size

Describe how sample size was determined.

For all in vivo studies, animal number was determined by using G-power analysis (ANOVA, one-way, omnibus), providing at least 70-80% power and an effect size of 0.8–0.85, with α set at 0.05.

2. Data exclusions

Describe any data exclusions.

Grubb's test for outliers was used to determine the inclusion or exclusion of data within groups of all data sets.

3. Replication

Describe whether the experimental findings were reliably reproduced.

For in vivo experiments no variability from animal to animal was observed, which indicates reproducibility of the data.

4. Randomization

Describe how samples/organisms/participants were allocated into experimental groups.

For all in vivo studies, mice were randomly assigned to each experimental or control group.

5. Blinding

Describe whether the investigators were blinded to group allocation during data collection and/or analysis.

Investigators were not blinded to the groups through the process of acquiring and analysis of the data, due to limited personnel.

Note: all studies involving animals and/or human research participants must disclose whether blinding and randomization were used.

6. Statistical parameters

For all figures and tables that use statistical methods, confirm that the following items are present in relevant figure legends (or in the Methods section if additional space is needed).

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement (animals, litters, cultures, etc.)
☒	☐	A description of how samples were collected, noting whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☒	☐	A statement indicating how many times each experiment was replicated
☐	☒	The statistical test(s) used and whether they are one- or two-sided (note: only common tests should be described solely by name; more complex techniques should be described in the Methods section)
☒	☐	A description of any assumptions or corrections, such as an adjustment for multiple comparisons
☐	☒	The test results (e.g. *P* values) given as exact values whenever possible and with confidence intervals noted
☐	☒	A clear description of statistics including central tendency (e.g. median, mean) and variation (e.g. standard deviation, interquartile range)
☐	☒	Clearly defined error bars

See the web collection on statistics for biologists for further resources and guidance.

Software

Policy information about availability of computer code

7. Software

Describe the software used to analyze the data in this study.	Three MATLAB image-processing scripts are available on Github (https://github.com/markpierce50/Nature-BME-2017/releases/latest).

For manuscripts utilizing custom algorithms or software that are central to the paper but not yet described in the published literature, software must be made available to editors and reviewers upon request. We strongly encourage code deposition in a community repository (e.g. GitHub). *Nature Methods* guidance for providing algorithms and software for publication provides further information on this topic.

Materials and reagents

Policy information about availability of materials

8. Materials availability

Indicate whether there are restrictions on availability of unique materials or if these materials are only available for distribution by a for-profit company.	All raw materials are available for research purposes.

9. Antibodies

Describe the antibodies used and how they were validated for use in the system under study (i.e. assay and species).	Rabbit monoclonal anti-human ERα IgG (Catalog no: ab16660, Clone SP1, Spring Bioscience, CA). Rabbit monoclonal anti-human CXCR4 IgG antibody (Catalog no : ab181020, Clone EPUMBR3, Abcam, Cambridge,UK).

10. Eukaryotic cell lines

a. State the source of each eukaryotic cell line used.	SCP2 and SCP28, animal-derived, provided by Yibin Kang; MCF7-5624a, animal-derived, provided by Vidya Ganapathy; MDA-MB-231 and MCF7- ATCC.
b. Describe the method of cell line authentication used.	The authenticity of the animal-derived line to the parental line was tested using cell-line authentication services utilizing Short Tandem Repeat (STR) profiling (ATCC, VA).
c. Report whether the cell lines were tested for mycoplasma contamination.	Cell lines have not been tested for mycoplasma contamination.
d. If any of the cell lines used are listed in the database of commonly misidentified cell lines maintained by ICLAC, provide a scientific rationale for their use.	No commonly misidentified cell lines were used.

Animals and human research participants

Policy information about studies involving animals; when reporting animal research, follow the ARRIVE guidelines

11. Description of research animals

Provide details on animals and/or animal-derived materials used in the study.	3–4-week-old female homozygous athymic nude mice were used for all in vivo experiments.

Policy information about studies involving human research participants

12. Description of human research participants

Describe the covariate-relevant population characteristics of the human research participants.	This study did not use human research participants.