Several groups have proposed recommendations on how to relieve some of the strains on the research enterprise. The reports we analyzed were:

Abbreviation	Report
Alberts	Alberts, B., et al. "Rescuing U.S. biomedical research from its systemic flaws." *Proc Natl Acad Sci*. 2014.
AAA&S	American Academy of Arts and Sciences. "Restoring the Foundation: The Vital Role of Research in Preserving the American Dream." 2014.
FASEB	Federation of American Societies for Experimental Biology. "Sustaining Discovery in Biological and Medical Sciences." 2015.
FoR	McDowell, G.S., et al. "Shaping the future of research: a perspective from junior scientists." *F1000 Res*. 2014.
NAS-A	National Academy of Sciences. "Research universities and the future of America: Ten breakthrough actions vital to our nation's prosperity and security." 2012.
NAS-B	National Academy of Sciences. "The Postdoctoral Experience Revisited." 2014.
NIH	National Institutes of Health. "Biomedical research workforce working group report." 2012.
NSB	National Science Board. "Reducing investigators' administrative workload for federally funded research." 2014.
PCAST	President's Council of Advisors on Science and Technology. "Transformation and opportunity: the future of the U.S. research enterprise." 2012.

Quotes taken from individual reports that support the consensus recommendations are presented below. Only one quote is shown from each report, although there may be multiple recommendations supporting a specific consensus recommendation. For all of the recommendations, see Supplemental Table 1.

Consensus recommendation 1: The federal government should make research funding predictable and sustainable

- Alberts – "In allocating federal funds for the research enterprise, greater emphasis should be placed on the predictability and stability of growth."
- AAA&S – "We recommend that the President include in the annual budget request to Congress a rolling long-term (five-to-ten-year) plan for the allocation of federal R&D investments"
- FASEB – "Congress and the Administration should provide sustainable and predictable funding for biological and medical research"
- NAS-A – "On an annual basis in the President's annual budget request, OMB should develop and present, in coordination with OSTP, a federal science and technology budget that addresses priorities for sustaining a world-class U.S. science and technology enterprise."

- PCAST – “Recognizing its political difficulty, PCAST nevertheless urges Congress and the Executive Branch to find one or more mechanisms for increasing the stability and predictability of Federal research funding, including funding for research infrastructure and facilities.”

Consensus recommendation 2: The federal government should increase overall research funding

- Alberts – “We strongly believe that increased funding would have great benefits in both the short and long run, that the remarkable opportunities in biomedical science justify enlarged budgets, and that vigorous arguments for such increases should be made.”
- AAA&S – “We recommend that the President and Congress work together to establish a sustainable real growth rate of at least 4 percent in the federal investment in basic research, approximating the average growth rate sustained between 1975 and 1992”
- FASEB – “Congress and the Administration should restore the lost purchasing power of agency research budgets”
- NAS-A – “Over the next decade as the economy improves, Congress and the administration should invest in basic research and graduate education at a level sufficient to produce the new knowledge and educated citizens necessary to achieve national goals.”
- PCAST – “Action #1.1. PCAST recommends reaffirming the President’s goal that total R&D expenditures should achieve and sustain a level of 3 percent of GDP.”

Consensus recommendation 3: Federal agencies should streamline, harmonize or eliminate burdensome regulations

- AAA&S – “We recommend that the White House Office of Science and Technology Policy (OSTP) and Office of Management and Budget lead an effort to streamline or eliminate practices and regulations governing federally funded research that have become burdensome and add to the universities’ administrative overhead while failing to yield appreciable benefits.”
- FASEB – “FASEB should identify specific regulations and policies that need to be eliminated, modified, or harmonized”
- NAS-A – “Federal government: The federal government should also harmonize regulations and reporting requirements across federal agencies so universities can maintain one system for all federal requirements rather than several, thereby reducing costs.”
- NIH – “The very different requirements and characteristics of training programs at each NIH IC constitute a substantial burden on the institutions. All NIH ICs should offer comparable training programs and fellowships and their requirements should be harmonized.”
- NSB – “The Board urges Federal agencies to accelerate efforts to harmonize and streamline the grant proposal and submission process and post-award requirements.”
- PCAST – “The Federal Government should identify and achieve regulatory policy reforms, particularly relating to the regulatory burdens on research universities.”

Consensus recommendation 4: Institutions and federal agencies should increase compensation for postdoctoral scholars

- Alberts – “Increase the compensation for all federally funded postdoctoral fellows, regardless of grant mechanisms.”
- FASEB – “Research sponsors and institutions should increase stipends for graduate and postdoctoral trainees”
- FoR – “All postdocs should receive at least the NIH minimum salary, with a geographical cost-of-living adjustment and certain basic benefits.”

- NAS-B – "[Postdoctoral] salaries should be increased to (1) reflect the qualifications of postdoctoral scholars, (2) address the slow progress the community has made toward implementing salary increases as recommended in several National Research Council reports, and (3) adjust the relative wage of postdoctoral researchers to appropriately reflect their value and contribution to research."
- NIH – "The current stipends for NIH-supported postdoctoral fellows need to be adjusted to levels that better reflect their years of training."

Consensus recommendation 5: Institutions and federal agencies should reduce graduate student and postdoc training periods

- Alberts – "Limit the total number of years that a postdoctoral fellow may be supported by federal research grants. Beyond this limit, salaries would be required to rise to that of research staff scientists, as is already the case at some institutions."
- AAA&S – "We recommend that universities and the National Institutes of Health (NIH) gradually adopt practices to foster an appropriately sized and sustainable biomedical research workforce. Key goals should include reducing the length of graduate school and postdoctoral training..."
- NAS-A – "Research universities should restructure doctoral education to…shorten time-to-degree…"
- NAS-B – "Postdoctoral appointments for a given postdoctoral researcher should total no more than 5 years in duration, barring extraordinary circumstances."
- NIH – "To encourage timely completion of graduate degrees, NIH should cap the number of years a graduate student can be supported by NIH funds (any combination of training grants, fellowships, and research project grants), with an institutional average of 5 years and no one individual allowed to receive support for more than 6 years."
- PCAST – "[The community should] confront difficult career-development and workforce issues, including length of time to Ph.D."

Consensus recommendation 6: Institutions and federal agencies should train students and postdocs for the breadth of careers available to them

- Alberts – "We should aim for a future in which graduate students have opportunities to explore a variety of career paths, with only those seeking careers that demand additional research training taking up postdoctoral research positions."
- AAA&S – "Enhance early exposure of graduate students (including doctoral students) to a broad range of non-research career options in business, industry, government, and other sectors, and ensure that they have the necessary skills to be successful"
- FASEB – "PhD programs should help students acquire skills for professional success"
- FoR – "Institutions should make adequate, appropriate training available and insist that PIs allow attendance."
- NAS-A – "Business, government agencies, and nonprofits that hire master's- and doctorate-level graduates should more deeply engage programs in research universities to provide internships, student projects, advice on curriculum design, and real-time information on employment opportunities."
- NAS-B – "Host institutions, especially those with graduate student populations, should provide multiple engagement activities to help students explore all avenues of career development. Funding agencies should help to support these efforts."

- NIH – "NIH should create a program to supplement training grants through competitive review to allow institutions to provide additional training and career development experiences to equip students for various career options, and test ways to shorten the PhD training period."
- PCAST – "Action #5.2. Augment the educational mission to today's world [including training] for entrepreneurship and technology transfer [and preparing] for national needs and grand challenges."

Consensus recommendation 7: Institutions and federal agencies should shift support of trainees toward fellowships and training grants

- Alberts – "To give federal agencies more control over the number of trainees and the quality of their training, we propose moving gradually to a system in which graduate students are supported with training grants and fellowships and not with research grants."
- AAA&S – "We recommend that universities and the National Institutes of Health (NIH) gradually adopt practices to foster an appropriately sized and sustainable biomedical research workforce. Key goals should include… shifting support for education to training grants and fellowships."
- FoR – "Funding for postdocs should not be tied to PI research grants."
- NAS-A – "The federal government should significantly increase its support for graduate education through balanced programs of fellowships, traineeships, and research assistantships provided by all science agencies dependent upon individuals with advanced training."
- NIH – "To ensure that all graduate students [and postdocs] supported by the NIH receive excellent training, NIH should increase the proportion of graduate students supported by training grants and fellowships compared to those supported by research project grants, without increasing the overall number of graduate student positions."
- PCAST – "Each agency should adopt policies that increase the agility of funding new fields, unexpected opportunities, and the creativity of new researchers [including increasing] funding for fellowships (including portable) and training grants."

Consensus recommendation 8: Institutions and federal agencies should increase the use of staff scientists

- Alberts – "We recommend increasing the ratio of permanent staff positions to trainee positions, both in individual laboratories and in core facilities that serve multiple laboratories."
- AAA&S – "We recommend that universities and the National Institutes of Health (NIH) gradually adopt practices to foster an appropriately sized and sustainable biomedical research workforce. Key goals should include… enhancing the role of staff scientists in university laboratories and core facilities."
- FASEB – "The research community should employ more staff scientists and consider more extensive use of career technicians"
- FoR – "Permanent staff scientist positions should be created with funding structures that remove the competition between the staff scientist and cheaper postdocs or graduate students."
- NAS-B – "Host institutions should create or identity professional positions for individuals who are conducting research but who are not receiving training, and these individuals should receive appropriate remuneration, benefits, and privileges."
- NIH – "The working group encourages NIH study sections to be receptive to grant applications that include staff scientists and urges institutions to create position categories that reflect the value and stature of these researchers."

- PCAST – “[The community should] confront difficult career-development and workforce issues, including…the reliance of the S&T enterprise on the labor of early-career training positions.”