

Safety and Motherhood in the Chemistry Research Lab

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As more and more women enter the workforce, issues regarding childbearing and caretaking have become more prominent. Challenges women face with the timing of pregnancy, finding affordable childcare, and meeting the multitude of demands inherent with raising children are starting to be addressed by many employers. In the university setting, structural and cultural factors pose barriers, yet also provide almost unheard-of flexibility. While some of these challenges are being addressed by employers, funding agencies, and communities, one area of particular concern is safety for women chemists. The hazards of working with chemicals during pregnancy and breast-feeding are unique to chemistry, and there is no easy fix. This chapter will review the safety concerns for women chemists, strategies women faculty have used to address safety challenges, current policies and strategies for dealing with safety challenges, and recommendations for departments and administrators.

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Safety Concerns for Mothers in Chemistry

Chemists are familiar with safety training, and highly publicized cases, including a fatal accident at UCLA, have recently led to an increased examination of safety practices and appropriate training. Often not addressed in safety training are issues for pregnant and breast-feeding women. Obviously, many hazards are directly associated with the chemicals used in the laboratory setting. Many organic solvents, heavy metals, and other hazardous compounds pose risks to developing fetuses and infants. Material Safety Data Sheets (MSDS) provide information regarding known hazards, but what about unknown hazards? MSDS do not make recommendations on protection or exposure levels, merely providing what type of hazard a chemical poses, if it's known.

One of the greatest challenges for women chemists who are pregnant or breast-feeding is the lack of standardized information. The Centers for Disease Control (CDC), the National Institutes of Health (NIH), the Environmental Protection Agency (EPA), and some university environmental health and safety offices have information about pregnancy hazards publicly available; however, this information does not include all chemicals used in research. These databases cover common hazardous chemicals, medications, and illegal substances. A comprehensive list is currently unavailable. The Agency for Toxic Substances and Disease Registry (<http://www.atsdr.cdc.gov/toxfaqs/index.asp>), maintained by the CDC, maintains a list of fact sheets addressing frequently asked questions about many chemicals. As with many references, it is not overly helpful with regard to pregnancy and breast-feeding. Consider the entry for acetone, where the last paragraph under the heading, "How can acetone affect my health?" says, "Health effects from long-term exposure are known mostly from animal studies. Kidney, liver, and nerve damage, increased birth defects, and lowered ability to reproduce (males only) occurred in animals exposed long-term." For a woman deciding whether it is safe to be around acetone while pregnant, this is so vague as to not be helpful. Similarly, the page for mercury includes the statement, "Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus." It is unclear what "exposure to high levels" means, although the outcomes are clearly severe. The National Institute for Occupational Safety and Health, part of the CDC, includes a statement in their document *The Effects of Workplace Hazards on Female Reproductive Health*, about exposure to hazardous chemicals during pregnancy, "Whether a woman or her baby is harmed depends on *how much* of the hazard they are exposed to, *when* they are exposed, *how long* they are exposed, and *how* they are exposed" (<http://www.cdc.gov/niosh/docs/99-104/pdfs/99-104.pdf>, p. 14). Again, it is a less than helpful warning for women chemists.

While working in a research laboratory, women have to look up possible hazards on the MSDS or through other available reference lists for any chemicals they are using. Either working with a safety officer or on their own, they then need to make a decision about whether they want to expose a developing fetus or breast-feeding infant to these chemicals. Often, these decisions are strained by a lack of

information about what specifically poses risk, what levels are dangerous, how mobile chemicals are in relation to skin and cell barriers, and what personal protective equipment would help and how effective it is. This can effectively put women chemists in a position of choosing their career or the health and development of their child(ren).

Strategies Used by Women Faculty to Address Safety Challenges

The impact of motherhood for women chemists is different depending on the type of institution, the teaching load, research expectations, and service responsibilities. While it might seem that motherhood would pose a greater challenge to women faculty members at research-intensive institutions, there are significant challenges to women at primarily undergraduate institutions (PUIs) as well. At research institutions, research productivity can be somewhat maintained by postdoctoral associates and graduate students in the absence of the research advisor/primary investigator (PI). The National Science Foundation (NSF) has also instituted policies allowing for grant funding to be used to hire a lab technician or for the grant to stop for a year. At PUIs, faculty members may have to maintain an undergraduate research program. In the absence of graduate students or postdocs, it falls to the PI to train student researchers and work with them in the lab. Thus, a pregnancy can force PIs out of the lab, essentially halting research progress. This is a challenge after pregnancy as well, when the PI tries to restart her research program.

One PUI faculty member, Ellen, took five years off from undergraduate research during two pregnancies due to the use of a mercury bubbler. While her department adjusted her workload by removing the research component and adding instructional and service responsibilities, this did not address the stalled research progress or the difficulty in restarting her research program. When telling her story, she said,

...I'm back this year for the first time basically in...five years, because I had two kids. So I was out of the lab [for] more or less five years straight, [because of] pregnancies and then breast-feeding, and then trying to get the second one, and...so I'm finally back. I was a big believer and didn't go near [the lab] the whole time...I'm an organometallic chemist who uses a mercury bubbler! Academic institutions do not understand how to deal with female faculty members, especially in the sciences, who choose to have children. They're just confused with how to deal with that...There's no road map...the difficulties of dealing with chemicals and the campus was very, very confused about...how to deal with that. That's probably been the biggest challenge...I picked up other teaching duties, I took responsibility of making sure that all the general chemistry laboratories were [updated], the lab manual, that became my baby. Writing the whole thing, proofing the whole thing, dealing with our stockroom support on making sure the labs get prepped, that became my job, but then I also picked up additional teaching load, and that I worked out with the dean [to compensate for not being in the research or teaching labs].

As she points out, there is no “road map” for science departments to address the concerns of women chemists who are pregnant and/or breast-feeding. Luckily, she was able to work out a compromise with her overall workload, but she went on to discuss how challenging it was to return to the undergraduate research lab.

Another PUI faculty member, Laura, discussed challenges associated with teaching organic laboratory courses while pregnant. At PUIs, faculty members are often the laboratory instructors, rather than graduate teaching assistants as is standard practice at research universities. She discussed feeling uncomfortable being in the teaching lab while breast-feeding as well as being limited in the research lab.

I think the number one thing is that if you're an organic chemist, and, really I would say a wet chemist, I don't think it applies to all fields, but it's a challenge, child-bearing. As a chemist, you know, you're doing wet chemistry or using things sometimes that you don't wanna expose your kids to. If you teach labs, then that's nine months that you're technically not teaching organic lab. In terms of, breast-feeding your child, I was in the lab when I was doing that, and every day I felt sick [for] my child. Subsequently the other female faculty did not teach with their second children, in the lab, while they were breastfeeding. So really that pretty much gives you two academic years almost where you are not teaching the lab, and it will limit the time you spend actually in the research lab also. I think time-wise, certainly at an undergraduate institution you don't have to work as long [in terms of] hours, but in terms of the impact child-bearing [has] on the ability to do your job, [it] is entirely different.

Her concerns about how pregnancy and breast-feeding impact female professors' careers echo those stated earlier. She discussed feeling an obligation to uphold her teaching responsibilities, but later wished she had worked out an alternate solution.

While Laura's colleagues changed their post-pregnancy plans based on her experiences, Irene worried about how her decision to not take maternity leave would affect her colleagues. She had no regrets about not taking time off, as her department was understaffed at the time and she worried about overburdening her colleagues. Irene did not express the same safety concerns as Laura and Ellen, but she is a plant biochemist and believed the chemicals she worked with safe to be handled during pregnancy. She described her experience, saying,

I think being one of the first faculty women, there's also pressure that you do it [and] do it right, so that you set a good precedent. I'm somewhat concerned about the precedent I've set with having kids since I didn't really have maternity leaves for two of the three, we did not hire a replacement for me, so that put pressure on my colleagues. And I'm now in the position [where] younger women faculty ask for advice. Am I giving good advice? I don't know. Well, I can tell you what I did, [but] I don't know if it's the best answer, or what I would do differently.

As seen previously, she expressed doubt about her decisions. Lack of clear policies, recommendations, and precedents makes navigating pregnancy and breast-feeding challenging for women chemists.

At research-intensive institutions, women expressed more concern about the timing of pregnancy with regard to tenure rather than safety concerns with chemicals. They commented on a lack of structure or support within the university

regarding maternity leave and arranging teaching assignments, concerns regarding postponing pregnancy until after tenure, and having fewer children than they would have liked due to their careers.

Petra, a professor at a research-intensive university, discussed some of the challenges she specifically had while pregnant. She commented on the university structure at large and a general lack of support for mothers. She believed the hurdles for mothers in the university setting were part of the reason women left research institutions. She said,

...teaching assignments when I was pregnant, arranging maternity leave, there were just lots of discussions and issues that made these arrangements not ideal, so I think there is a lot of work to be done, [and] this was a little bit a cause of grief. . .there is so much to be done to make this job for a woman more human and more balanced, such as, dealing properly with day care situations, not only when a woman gets pregnant, but also when the baby's born, some facilities and even time off. . .I think if the structures and the system and colleagues and the whole machinery were more conducive to really understanding the needs of women or that family, and make sure that they can spend time with kids, perhaps women would stay.

Danielle, an associate professor at a research-intensive university, regretted postponing starting a family. She talked about her decision, saying,

I think we sacrificed quite a bit personally. Like right now, I'm pregnant, we're having a baby, it's really exciting, but, sometimes you feel like, I'm 36, right? Why did I wait this long? . . .I think we did make a lot of sacrifices personally, and I think we're [at] a stage right now where, granted, we've got to keep everything going and moving forward in the lab, but, I think we just need to take a breath here and assess what's going on. . . 'cause, you can't get that time back and you have to sit and realize, I think I've gotta physically make time for things other than this [job].

She chose to wait until she was through the tenure process, which despite her regret, did allow her some flexibility in terms of exposure to chemicals. She felt her research group was at a place where it was relatively self-sustaining, allowing her to minimize her time in the lab while pregnant.

Marie, an assistant professor, expressed similar concerns regarding the timing of starting a family and the tenure process.

...by the time I get tenure, I'll probably be 36? And I feel, if I waited until I got tenure, and then I got tenure, and then I had kids, then everything would be great. But, if I waited until I got tenure, and then I didn't get tenure, then I would have put off something that was really, really important to me and then I wouldn't have [kids] and I wouldn't have a job, so then I think I would be even more upset.

Interestingly, Marie did not discuss safety issues even though she works with very hazardous materials in her research lab.

Petra echoed the challenges with the tenure system and the university structure with regard to women getting pregnant and starting families. She advocated for more supportive and flexible pathways to tenure, saying,

I don't think a woman should ever compromise [her] biological clock for her job, but that's why I [support] having better structures that would facilitate all aspects of having children, when you're expecting and after you have them. I think [this is] sorely needed, because,

frankly, I think women are just discouraged from having kids when they are in [a] tenure-track situation. They are afraid about... the repercussions on their future. I had my second child [before tenure] because I wanted to have a second child and I was not young compared to American students, so it was just either you do it now or you won't do it, but if I had been a little younger, perhaps I would have waited. And some people may think, justly, that it's not fair that you have to wait to have kids because of your job. So I totally sympathize with that.

Catherine, a professor and department chair, discussed how her career and the challenge of finding jobs in the same location for her and her husband led to them having a smaller family than planned. She said,

...my husband and I lived apart for a number of years trying to get jobs in the same place, and I would definitely say I had fewer children than I would [liked to] have [had]. I have one daughter, I have fewer children than I would have [had], I think, if I weren't at a research institution... I had one fewer child than I wanted.

Again, the career and institutional structures have changed women's plans for starting and building a family.

While women at research institutions felt there were significant challenges with regard to being a professor and mother, they did not bring up the issues of safety that were highlighted by women at PUIs. While these safety challenges were not nonexistent, they were less salient for professors at research universities. One primary reason for this difference between faculty concerns is the structure of research labs at PUIs compared to research institutions. At PUIs, faculty maintain the research program continuously. They tend to work with inexperienced and transient undergraduates, which means that they are in the research lab training student researchers and maintaining research progress when in between students. At research institutions, postdocs and experienced graduate students can help train new graduate students and undergraduate researchers. This lessens the need for PIs to be physically in the research lab, affording more flexibility during and post-pregnancy.

Additionally, instructional roles are very different between PUIs and research institutions. As noted previously, instructional labs at research universities are usually taught by graduate teaching assistants, particularly at the introductory levels. At PUIs, lab courses may or may not be taught by undergraduate teaching assistants at the introductory level. More likely than not, faculty members need to be present in the instructional laboratory. As a result of this structure, it is again more flexible for faculty at research institutions to avoid contact with hazardous chemicals during pregnancy and breast-feeding. The main concern for women at research institutions was the high research expectations for tenure and deciding to postpone starting a family, whereas for women at PUIs, safety in the presence of hazardous chemicals was the primary concern. If the tenure process at research institutions was seen as more family-friendly and supportive of women, it's likely that safety would become more of a focal point for women at these institutions.

Current Policies and Strategies for Dealing with Safety Challenges

One major challenge for women chemists is the lack of information regarding hazards during pregnancy. Publicly available recommendations are few and far between, and those that are available are vague. They leave the determination of safety up to the individual, but it is a challenging position to be in to decide the fate of an unborn child when you have incomplete or minimal information. For example, Virginia Polytechnic University has a public statement on Safe Pregnancy for Laboratory Workers (<http://www.chem.vt.edu/facilities/resources/safety-pregnancy-accommodation.pdf>). It is just over a page long and includes the following paragraph:

The Chemistry Department seeks to minimize the risks of working in its laboratories for all employees and students, especially for pregnant women because of the known sensitivity of the fetus to specific chemicals, in particular teratogens. All laboratory workers are expected to know the hazards of chemicals they are using, including the pregnant woman. Material Safety Data Sheets (MSDS) are essential, but may not provide a complete set of recommendations. Additional protective equipment may be available, but alternatives to laboratory work such as spectroscopic or computational studies, library work, writing, or seminar preparation may be requested by the pregnant laboratory worker. Each woman's situation will be different, so the Department can be creative and flexible. We encourage a pregnant woman to consider those accommodations that she might request for her well being, and for the well being of her fetus.

Also in this statement are recommendations for pregnant graduate students, encouraging them to consult with their research director or graduate program director regarding questions they may have. As has been discussed, research and graduate program directors are likely to have few answers and may not be able to provide answers that graduate students are seeking.

Also available online is a website from The University of California, San Francisco Office of Research: Environmental Health and Safety (<http://or.ucsf.edu/ehs/9399-DSY/11389>). It provides the following statement regarding pregnant women working with chemicals:

Pregnant workers should avoid unnecessary exposure to chemicals. Since the beginning of the 20th century, thousands of new synthetic chemicals have been developed, and only a small portion of these chemicals have been adequately studied to determine whether they pose a risk of cancer or birth defects. Therefore, it is advisable to limit any unnecessary chemical exposure during pregnancy. Some chemicals are well known to increase the risk of cancer or birth defects.

While these types of statements are meant to be helpful, the lack of concrete recommendations can be unsettling for women. There are few chemistry departments or universities that have a statement regarding pregnant workers at all, so it is positive that some statements exist to address the needs of pregnant women in chemistry. It is more common to find recommendations for accommodating graduate students rather than faculty members. Currently, the American Chemical Society does not have a specific document regarding reproductive hazards in the

chemical workplace, although there is a list of websites and resources related to reproductive health available on the ACS website. The lack of resources is highly problematic for women trying to make decisions about safety during pregnancy and breastfeeding.

Recommendations for Departments and Administrators

As seen here, there are few concrete recommendations for women chemists regarding reproductive health, pregnancy, and breast-feeding. This poses a unique challenge for women chemists, as well as departmental and university administrators who must help find accommodations for them. The hazards posed by many chemicals during pregnancy and breast-feeding are unknown and are likely to remain unknown. It is up to individuals to decide what they are comfortable with in terms of exposure to chemicals during pregnancy and breast-feeding. This is an uncomfortable position for women to be in, as they are trying to make difficult decisions with incomplete data.

From interviews with chemistry professors who are also mothers, it is clear that open communication between faculty members and department chairs is key to addressing safety concerns and making accommodations during pregnancy. It is also imperative to foster an environment of support and community, where women feel they can communicate with administrators and have support from colleagues. There needs to be recognition of the challenges inherent in pregnancy and motherhood across departments and universities so that adequate support systems and accommodations can be implemented.

As seen from faculty members' reports, the challenges to motherhood are partially systemic, due to structural issues with tenure. One of the major challenges is the disruption of research progress, especially during the pre-tenure years. If research progress stops for motherhood, it can be hard to get it restarted. Even stopping the tenure clock does not fix this. Timing is important in the sciences, and breaks from research pose significant challenges in research progress, publishing, and grant awards. This is a very real challenge outside of the safety concerns women chemists face.

Conclusions

In conclusion, pregnancy and breast-feeding pose unique challenges to women chemists. These challenges are exacerbated by incomplete information about chemical hazards, a lack of policies and concrete recommendations, and the tenure system structure. Women have chosen accommodations based on their individual needs and concerns. While it is appropriate to be flexible and meet each individual's circumstances, it is problematic to not have overarching policies or

recommendations. It leaves each woman to advocate for herself and be subject to colleagues, chairs, and administrators who may be less than accommodating.

As seen from the reports of women faculty, there are several strategies used to address the safety concerns of working in the laboratory during pregnancy. Finding alternate teaching or service responsibilities and avoiding chemical exposure was a popular choice, but it came at the expense of research progress. At research-intensive institutions, it was more common to postpone starting a family until after tenure based on the rigorous tenure expectations as well as the added flexibility that tenure brings. These women stressed the importance of communication and a supportive chair in finding accommodations they were comfortable with during pregnancy and breast-feeding. Rather than waiting for a faculty member to become pregnant and address it at that time, discussions at the department and university level are encouraged to develop possible strategies. It is recommended that departments include a statement about accommodating pregnancy in their policy statements. This would not only provide clearer strategies for handling pregnancy, but would demonstrate a willingness to support female faculty members, a critical element in recruiting and retaining female chemists. Finally, a statement or policy from ACS or other professional organizations is encouraged as a way to recognize the challenges mothers in chemistry face and to open discussion about how departments can best accommodate and support female faculty.

Main Steps in Megan's Career

Megan is an Assistant Professor at Western Michigan University, with a joint appointment in the Department of Chemistry and the Mallinson Institute for Science Education. She completed her B.S. at the University of Indianapolis, where she was an All-American swimmer and NCAA Woman of the Year finalist. She attended Indiana University School of Medicine for a semester before starting her graduate work at Purdue University. She completed her M.S. and Ph.D. in Chemistry at Purdue University, conducting Chemical Education Research. Before starting her position at WMU, she was a postdoctoral researcher at the American Chemical Society Examinations Institute at Iowa State University. Current projects at WMU include women chemists' academic and career choices, motivational theories in undergraduate and graduate STEM education, feminist critiques of academic science, laboratory curriculum development, graduate student professional development, student outcomes from participating in Problem-Based Learning laboratory units, and instructor and institutional adoption of evidence-based teaching practices.