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# Research Misconduct Oversight: Defining Case Costs

*Elizabeth Gammon and Luisa Franzini*

This study uses a sequential mixed method study design to define cost elements of research misconduct among faculty at academic medical centers. Using time driven activity based costing, the model estimates a per case cost for 17 cases of research misconduct reported by the Office of Research Integrity for the period of 2000–2005. Per case cost of research misconduct was found to range from \$116,160 to \$2,192,620. Research misconduct cost drivers are identified.

**Key words:** *research misconduct, time driven activity based costing, cost*

**R**esearch misconduct (RM) undermines the integrity of scientific and medical research and threatens public confidence in the scientific and medical community and its products. In 1981, Congressional scrutiny opened the black box of research misconduct in publicly funded research and the ensuing three decades reflected an evolving oversight of integrity in research. The Health Research Extension Act (HREA) of 1985 directed both government and academia to investigate “scientific fraud.” A federal agency was created to oversee investigations when allegations arose and a series of administrative law provisions settled the legal definition of research misconduct and create policies and procedures for policing RM.<sup>1</sup> Institutions receiving federal funds accede to the work of compliance imposed through an unfunded mandate, which clouds the issue of the cost of RM.

In 2012, National Institutes of Health reported funding 44,450 awards at over 2,500 institutions.<sup>2</sup> Each of these institutions must address allegations of RM using the consistent, time-constraint-bounded, multi-step process prescribed by administrative law in 42 CFR Part 93. The institutional process is overseen by an institutional research integrity officer (RIO).

Within the maturing regulatory environment, there has been little discussion of the cost of RM nor its economic impact.<sup>3</sup> The

existing literature considers motivations to commit RM, various forms and definitions of RM, and the consequences of RM.<sup>4</sup> However, little regard has been paid to estimating the financial impact or cost.

Recently, the subject of cost has been broached. Marshall highlights one-year prevention costs of \$500,000 for an ethics training program at the University Minnesota medical school.<sup>5</sup> Titus, *et al.*, examining the incident of RM in their study observes “...institutional leaders may wish to ignore or minimize allegations of possible research misconduct to protect the revenue that the researcher generates; some may avoid investigations because they are costly in terms of time and money.”<sup>6</sup> Michalek, *et al.*, use a case study approach to propose a three-part model to assess costs of scientific misconduct and hypothesize direct costs of \$110

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**Note:** Preliminary results were presented at the fifth biennial Research Conference on Research Integrity, Research on Research Integrity (RRI) Conference 2009.

*J Health Care Finance* 2013; 40(2):75–99  
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million for RM for 2007.<sup>7</sup> The framework we propose defines four costs elements, relies on time driven activity based costing (TDABC) to estimate costs for major time components and applies the model to documented findings of RM to estimate baseline per case costs (see Table 1).

### Methods and Model Construction

We used a sequential mixed method study design to define cost elements of RM. We reviewed Office of Research Integrity (ORI) Annual Reports, Section I and Appendix A, from 2000–2005 to identify RM case findings at research institutions receiving NIH funding. Case findings in this five-year period have two variables that permit economic cost comparisons. Beginning in December 1999, ORI adopted a 480-day target timeline for completion of investigations of allegations.<sup>8</sup> This target timeline, not in place prior to 2000, allows for an assumption of a standard measure of time input for each case finding. Secondly, during this five-year period, a common legal definition of research misconduct was employed by the ORI and NIH funded institutions to investigate allegations of misconduct. Seventeen cases of RM attributable to faculty at the assistant professor level and above in academic medical settings were identified for costing.

A series of qualitative interviews were conducted. Interviews allowed us to assess

existing practices and opinions about cost measurement in research misconduct and to develop and test a pilot questionnaire on the RM investigation and costs. Sitting and former ORI officials were interviewed by telephone to attain input on cost elements and the feasibility of measuring costs. We conducted a face-to-face interview with a former RIO of an institution receiving \$153 million NIH funding in 2005. This former RIO had overseen investigations of RM, although none of those cases were included in the sample. Based on those interviews, a preliminary cost element model was developed to be tested against case findings of faculty RM.

The RIO at an institution with an RM finding during the study period was contacted via email to agree to a telephone interview regarding cost elements of RM. The goals of the interviews were to assess RIO views regarding RM costs and to validate the preliminary cost model. We hypothesized that cost data were estimated or collected on a case-by-case basis as a component of the inquiry and investigation process. Using a research misconduct questionnaire (RMQ) displayed in Figure 1, RIOs were asked a series of open-ended questions addressing cost collection for the respective institutional case.

At the conclusion of the qualitative interviews, the quantitative economic cost model was developed to estimate costs of RM oversight at the institutional level.

**Table 1. Economic Cost Types in a Finding of Research Misconduct**

Type 1		Type 2		Type 3		Type 4		
Investigative Costs	+	Grant Award(s)	+	Voluntary Exclusion Agreement	+	Retraction Costs	=	Total Cost

**Figure 1. Research Misconduct Questionnaire**

Research Misconduct Questionnaire	
<div style="border-bottom: 1px solid black; margin-bottom: 5px;">RIO Name</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">Institution</div>	<div style="border-bottom: 1px solid black; margin-bottom: 5px;">Date</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">Case (Last Name)</div>
<p>1. Tell me about your experience handling allegations of research misconduct.</p> <ul style="list-style-type: none"> <li>• How long have you been in this position?</li> </ul> <p>2. Do you believe it is appropriate to ask the question, “how much does research misconduct in publicly funded medical research cost?”</p> <p>3. Do you or your institution estimate the costs of investigating research misconduct using the steps defined by ORI? (Receipt of allegation; Preliminary assessment; Conduct of inquiry and investigation; Institutional decision; ORI oversight review; PHS decision; Imposition of PHS administrative actions)</p> <p>4. What is the most costly element of the process in your opinion?</p> <p>5. Regarding the specific case (if appropriate):</p> <ul style="list-style-type: none"> <li>a. Duration of investigation from start to finish</li> <li>b. Was cost information collected or estimated</li> <li>c. Institutional policy for faculty salary support (% external funding)</li> <li>d. Salary level of faculty member at time of Voluntary Exclusion Agreement (if appropriate)</li> <li>e. Of the steps outlined in #3 above, which were conducted</li> </ul> <p>6. Other</p>	

## Construction of the Model and Data Collection

Costs for RM begin accruing at the point an allegation is made and conclude when the case is closed and resulting administrative action has been carried out. Institutional responsibility can be delineated in four distinct phases: receipt of allegation, conduct of inquiry, conduct of investigation, and decision and sequelae. Our model defines four costs. Type 1 costs include receipt of allegation

and conduct of inquiry. Type 2 costs describe the NIH grant award funding. Type 3 costs capture the decision and economic sequelae impact on the institution when the faculty member, found guilty, remains at the institution. Type 4 costs estimate the cost to the institution required to retract a peer reviewed publication(s) implicated in the RM.

### Type 1 Costs

Investigative costs mark the beginning point for institutional costs. The 42

CFR Parts 50 and 93, Final Rule, documents estimated annual average burden per response (AABpR) for required institutional time in-puts for the Public Health Service (PHS) prescribed process. AABpR served as the basis for time driven activity based cost estimation in Type 1 costs.

Figure 2 summarizes the categories of Type 1 investigative costs, the seven steps established for handling misconduct allegations that end in case findings, and time requirements specified by PHS to the ORI.<sup>9</sup>

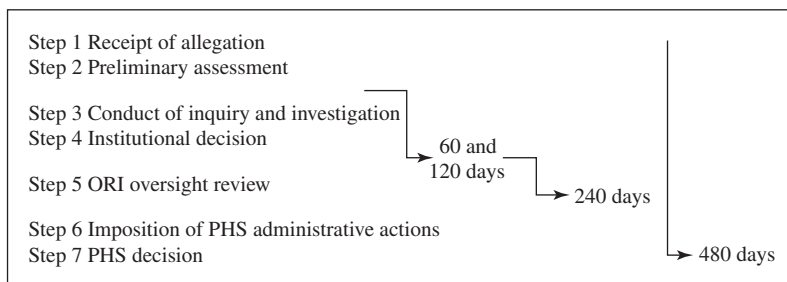
The RIO manages the inquiry into the allegation and conduct of a finding of RM. Steps 1–4 are conducted at the respective institution where the faculty member is appointed. In Step 1, the allegation is received by the RIO, who determines whether grounds exist to move forward with an inquiry in Step 2. These first two steps, accomplished in 60 days under the mandated timeline, involve primarily the RIO, limited institutional legal staff, and occasionally, institutional police personnel to sequester evidence. Steps 3 and 4 reflect continued time input for the RIO and incorporate the intensive use of faculty in the inquiry and investigation. Both an inquiry panel, and subsequently, an investigation panel are convened. Panel membership for each of the two panels is estimated at 3–5 full-tenured

professors with expert knowledge of the subject matter area of the alleged research misconduct. Step 4, institutional decision, reflects continued RIO time input as well as institutional legal counsel and senior administration time inputs for review and approval.

Historical cost and time inputs for each case via interview with the respective institutional RIO using the RMQ were used when available. For cases lacking qualitative response data, investigative costs were estimated by the authors. TDABC estimations were calculated by multiplying (1) assumed number of institutional hours spent per case by (2) an assumed institutional wage rate.

Assumptions for institutional hours per case were based on time estimates for the RIO and for additional institutional personnel. 42 CFR Parts 50 and 93, Final Rule documents an estimated AABpR for Steps 1–4.<sup>10</sup> These estimates, published in 2005 with the new administrative law governing research misconduct, reflected assessments for the 1999 mandated 480 day timeline for completing the inquiry and investigation phases of an allegation of research misconduct ending in a case finding. These time estimates appear to describe the RIO oversight of processes encompassed by Steps 1–4. RIO time estimates per the *Federal Register* were augmented by assumptions of

**Figure 2. Total Time Requirement for Completing Misconduct Cases—Investigative Costs**



time spent in added institutional oversight by the inquiry panel and the investigation panel and by institutional legal staff.

For Type 1 investigative costs, Steps 1–4, an assumed institutional wage rate was calculated as an hourly cost including both a mean compensation component and a benefits component. The mean total annual compensation, excluding benefits, for full professor, basic science (\$187,500) or clinical science (\$268,800), at public medical schools as documented by the 2007 Report on Medical School Faculty Salaries<sup>11</sup> was divided by 1920 (48 weeks × 40 hours/week) hours to arrive at a base compensation hourly wage for (1) full professor basic science (PhD) of \$98, and (2) full professor clinical science (MD) of \$140. A 21 percent benefits rate was applied to the base compensation hourly wage rate to arrive at the assumed institutional wage rate of \$119 for a full professor basic science and \$169 for a full professor clinical science. RIO wage rate hours were assumed at the basic science full professor level of \$119 per hour unless the case RIO was identified as a clinical scientist or the current RIO was an MD. For three cases involving clinical faculty, the RIO wage rate hours were assumed at the full professor clinical science wage rate. The inquiry panel estimates assumed a three-person full professor faculty member group with a \$144 per hour wage rate (1.5 basic science faculty @ \$119/hour × 1.5 clinical science faculty @ \$169/hour). This same set of assumptions was made for investigation panel membership and wage rate. In cases where the respondent's institution had a publicly available document outlining a different panel membership or in cases where the institutional RIO reported a different panel membership, that panel membership number was multiplied by the \$144 per hour

wage rate. Other institutional hours were assumed to be at the basic science full professor level regardless if the respondent was a PhD or MD. Time inputs for non-faculty specialist, such as institutional lawyers, were assumed at the full professor basic science wage rate of \$119 per hour. Economic costs for an institution to complete an inquiry and investigation leading to a finding of scientific misconduct for a faculty member in this study sample were estimated to be \$102,115 in cases where a full professor basic science RIO presided and \$141,090 where a full professor clinical science RIO presided. Cases were assumed to be completed within the mandated timeline. For cases where the RIO reported an ORI approved exception from the mandated timeline, economic costs for the investigation phase (\$64,781 for PhD RIO and \$89,531 for MD RIO) were doubled. In these cases, economic costs for an institution to complete an inquiry and investigation leading to a finding of scientific misconduct for a faculty member in this study sample were estimated to be \$166,896 in cases where a full professor basic science RIO presided and \$230,621 where a full professor clinical science RIO presided. Table 2 details TDABC model estimations for institutional inputs for Type 1 investigative costs, Steps 1–4.

Time estimates and costs were also calculated for Type 1 investigative costs, Steps 5–7. Calculations were based on an estimation of a per case ORI cost in the year of the case finding. ORI is charged to oversee and administer research misconduct activities on behalf of PHS (Step 5). The scope of these duties includes recommending administrative actions (Step 6 and 7) to the PHS for approval. Therefore, for purposes of this study, time costs for Steps 5–7 were collapsed into the

Table 2. Estimated Economic Costs for Institutional Inputs for Type 1 Investigative Costs, Steps 1–4

Process Step	Time		Input	Cost		Input
	Mandated Timeline (Days)	Federal Register Average RIO Process (Hours)		Estimated Institutional Added Process (Hours)	PhD (\$119/hour)	
Receipt of allegation						
Inventory and sequester evidence		35		\$4,165	\$5,915	
Supervise respondent access to record		5		595	845	
Subtotal		40		\$4,760	\$6,760	
Inquiry						
RIO administrative oversight (50% effort) <sup>1</sup>			221	\$26,299	\$37,349	
Notify presumed respondent		1		119	169	
Respondent review & comment on report		1		119	169	
Notice to respondent of investigation		0.5		60	85	
Conduct of inquiry						
Receipt and recording of allegation			1	119	169	
Inquiry Panel assembly			1	119	169	
Inquiry Panel time <sup>2</sup>						
3 full Professors @ 2hrs X 3 mtgs			18	2,592	2592	
Panel Preparation Time (3x. 5x3 mtgs			4.5	648	648	
RIO support for Panel Inquiry			3	357	507	
Legal support			2	238	238	
ORI notice of warranted investigation		16		1,904	2,704	
Subtotal	60	18.5	250.5	\$32,574	\$44,799	
Investigation						
RIO administrative oversight (50% effort) <sup>1</sup>			394	\$46,886	\$66,586	

Notify presumed respondent	1	119	169
Conduct of investigation			
Selection of investigation panel	1	119	169
Charge to panel	1	119	169
Administration support for panel			
Investigation Panel time <sup>2</sup>			
3 full Professors @ 2 hrs X 5 mtgs	30	4,320	4,320
Panel Preparation Time (3x.5x 5 mtgs)	7.5	1,080	1,080
RIO support for panel investigation	3	357	507
Legal support	4	476	476
Record and transcribe witness interviews	15	1,785	2,535
Required documentation submitted to ORI	80	9,520	13,520
Subtotal	96	\$64,781	\$89,531
Total institutional inputs per case	180	\$102,115	\$141,090

<sup>1</sup>Assumptions for RIO administrative support:  
(1) 100% RIO time = Estimated annual burden for ORI defined tasks + institutional tasks  
(2) RIO expends 50% of each day during an investigation overseeing the investigation.  
(3) Timeline in days  
(4) RIO administrative support time = (#days x 8 hrs./ day x.5) - ORI estimated annual burden in hours

<sup>2</sup>Assumption for mixed faculty rank hourly wage rate \$144 / hr



ORI per case cost assumption. Cost per case estimates were derived from Division of Investigative Oversight (DIO), ORI annual budget figures. DIO 2006 budget figures (\$3.5–\$4.0 million) were provided by email correspondence from ORI<sup>12</sup> with instructions regarding extrapolating to arrive at historical DIO annual budget amounts applicable to each year of the study period. Following those instructions and assuming a \$3.5 million as the budget for 2006, 2000–2005 annual budgets were calculated using the historical percent increase/decrease reflected in the NIH budget.<sup>13</sup> Once calculated, those annual budget amounts were divided by the number of annual allegations for the respective year as documented by the ORI Annual Report to arrive at a per case cost. Table 3 displays estimated economic costs per case for Type 1 investigative costs, Steps 5–7.

### Type 2 Costs

Type 2 costs account for any grant award implicated in the RM finding. The study sample had 54 documented grant applications among the 17 faculty principal investigators (PIs). Grant award funding levels were confirmed using Computer Retrieval of

Information on Scientific Projects (CRISP) and NIH Awards by State and Foreign Site. Of the 54 grant applications, 31 grant applications had no evidence of funding, 19 had a confirmed grant award and 4 were funded grants awarded to a PI not cited for RM. The first and third grant award categories were excluded from the model as having no economic impact associated with the PI. The 19 confirmed grant awards for PIs in the study sample were included in Type 2 Grant Award costs.

### Type 3 Costs

Type 3 costs measure Voluntary Exclusion Agreement (VEA) administrative penalties, a contractual agreement between a respondent and the ORI. The VEA is designed using a variety of administrative actions with a variable time period (1 year to lifetime) assigned for each administrative action. Imposition of the VEA has a remedial goal (except in cases of lifetime debarment) and is meant to reflect the significance and impact of the misconduct, as well as signal whether the finding is a unique event for the particular researcher. The ORI Web site provides the following list of administrative

**Table 3. Estimated Per Case Economic Costs for Type 1—Investigative Costs, Steps 5–7**

Year	Allegations Per Year	DIO Annual Budget (Estimated \$)	Per Case Cost (Estimated \$)
2000	173	4,237,617	24,495
2001	196	3,625,466	18,497
2002	191	3,457,131	18,100
2003	179	3,733,975	20,860
2004	268	3,764,075	14,045
2005	265	3,739,259	14,110

actions with the caveat that unspecified actions can also be imposed:

- debarment from eligibility to receive federal funds for grants and contracts;
- prohibition from service on PHS advisory committees, peer review committees, or as consultants;
- certification of information sources by respondent that is forwarded by institution;
- certification of data by institution;
- imposition of supervision on the respondent by the institution;
- submission of a correction of a published article by respondent; and
- submission of a retraction of a published article(s) by respondent.<sup>14</sup>

While the VEA is designed, approved, and reviewed during the investigative phase, the VEA is implemented after the case finding has occurred and the *Federal Register* scientific misconduct notice is published. Thus, VEA costs are incurred after the conclusion of the investigative phase and represent a distinct type

of economic cost in this model. These costs are incurred by the respective research institution to monitor a researcher who remains in the publicly funded research setting subsequent to the RM finding. Costs for institutional monitoring were assumed as chargeable as an NIH supported indirect cost administrative expense estimated using TDABC methodology.

VEA costs were estimated for each of the three PIs found to be employed in 2007 at the institution where the RM finding occurred. From the sample, one RIO estimated institutional costs for VEA costs for the PI at his institution. When RIO estimates of time inputs were not available, input assumptions were made using TDABC methodology. TDABC was applied to the required institutional process and respective institutional RIO hourly wage rates (see Table 4). Table 5 reflects VEA estimates for these two cases.

#### Type 4 Costs

Retraction costs comprised the Type 4 cost in the model. Findings of RM required 7 PIs to retract 27 peer reviewed articles. Sox and

**Table 4. TDABC Calculated VEA Cost for Cases Lacking Historical Data**

Case	Administrative Action	Time Input	Total Hours	RIO Hourly Wage Rate	Estimated VEA Cost
Xiong					
	1. General certification of research activities for 36 months	2 hours/ month for 36 months	72	\$ 119	\$ 8,538
	2. Formal written apology	1 hour	1	\$ 119	119
	3. Certify publications for 36 months (2002–2004 publication date)	28 publications @ 1 hour/publication	10	\$ 119	1,186
	4. Certify grant applications for 36 months	33 grant applications @ 1 hour/application	33	\$ 119	3,913
	5. Review of formal essay of publication quality on plagiarism	1 hour	1	\$ 119	119
					\$ 13,874

Continued ...

**Table 4. TDABC Calculated VEA Cost for Cases Lacking Historical Data (Continued)**

Padgett					
1. General certification of research attribution for 36 months	2 hours/ month for 36 months	72	\$ 119	\$ 8,538	
2. Certify grant reports and applications for 36 months					
PI on two R29	2 grants @ 2 reports/ grant @ 1 hour/report	4	\$ 119	474	
PHS funding credit on publication with 2003 publication date	5 grant reports @ 1 hour/report	5	\$ 119	593	
				\$ 9,605	

**Table 5. VEA Costs—Sample Economic Cost Time Inputs for Type 3**

Sample Administrative Action	Time Input	Total Hours
General certification of research activities for 36 months	2 hours/month for 36 months	72
Formal written apology	1 hour	1
Certify publications for 36 months (2002–2004 publication date)	28 publications @ 1 hour/publication	10
Certify grant applications for 36 months	33 grant applications @ 1 hour/application	33
Review of formal essay of publication quality on plagiarism	1 hour	1
Certify grant reports and applications for 36 months		
PI on two R29	2 grants @ 2 reports/grant @ 1 hour/report	4
PHS funding credit on publication with 2003 publication date	5 grant reports @ 1 hour/report	5

Rennie have documented that responsibility for retraction ultimately lies with the institution where RM occurs.<sup>15</sup> Following this logic, we assumed that each RIO expended two hours per retraction to monitor compliance and applied the respective RIO hourly wage rate to estimate retraction costs. In the case of Eric Poehlman, the institutional RIO reported additional retraction costs to review all articles published by Poehlman during

his employment at that institution. These estimates were added to the cost estimates for the mandated article retractions.

#### **Total Cost**

A per case cost for each case finding of RM attributable to a faculty respondent in the study population was calculated using the model. These were summed and a total cost for findings of RM among faculty respondents for

2000–2005 was calculated. Total costs for each of the four cost types were also calculated.

## Results

### Qualitative Interviews

Each of the five key informants agreed to be interviewed. Regarding specific economic cost considerations in RM, one consistent view emerged. Economic costs were not considered nor measured. In conducting the inquiry and investigation leading to an RM finding, the emphasis was on adhering to the mandated administrative law process while being sensitive to the 480 day completion timeline. The authors finalized the RMQ for use in RIO interviews at the conclusion of the key informant interviews.

RIO interviews using the RMQ were conducted after key informant interviews. The 17 findings of research misconduct in the study sample originated at 16 different publicly funded institutions with 16 distinct RIOs. One institution had two cases in the study sample. Twelve RIOs consented to the interview, 2 declined and 2 did not respond to the request. Of respondents, 6 were served as case RIO and 6 assumed the position subsequent to the finding. Time in RIO position among these 12 varied from four months to 26 years.

All RIOs interviewed expressed a positive belief about the importance of estimating costs of research misconduct. RIO attitudes about estimating costs did not differentiate between economic costs, measured using the four types of costs defined in this study, or societal costs. However, none of the RIOs reported collecting cost data. One RIO employed a chargeback scheme for allocating annual department costs. The method appeared to employ a straightforward cost

accounting model whereby the 30 percent of annual departmental costs attributable to research misconduct issues was allocated to users based on the number of cases generated by the user work unit. The RIO referred to this approach as a “forensic” model. Ten RIOs reported that the most costly institutional aspect of a finding of misconduct was “faculty involvement” in the inquiry and investigation phases. RIOs (10) described the faculty committee structure of from three to five tenured full professors participating in the inquiry phase and a different faculty committee structure of from three to five tenured full professors participating in the investigative phase. All RIOs emphasized the intensity of their administrative oversight of all phases of the process. One case RIO indicated he spent 100 percent of his time on the case, a case which surfaced shortly after he assumed the RIO position. Other case RIOs (5) felt the intensity waxed and waned depending on the phase of the inquiry or investigative process. Two case RIOs recalled that the case had exceeded the mandated timeline for institutional inquiry and investigation, but were not able to recall the excess time spent. When probed about time spent by faculty or themselves, the issue of confidentiality was the most mentioned constraint on providing information beyond publicly available records for each case. In only one case, that of Eric Poehlman, was a public record of the institution’s investigation report available to estimate institutional resource inputs for Type 1 model costs.

One case RIO interviewed oversaw the VEA for the respondent subsequent to the RM finding. He was able to reconstruct the process and estimate the institutional hours involved for the VEA. Additionally, in the *Poehlman* case, the RIO described the institutional process and estimated costs. It

is important to note that both of these RIOs indicated that they had not estimated the time inputs until accepting the authors' interview request. Several RIOs emphasized the importance of undetermined cost of the lost time in research direction and the inestimable societal cost of RM. One RIO discussed the harm to the community trust when the case finding (*Poehlman* case) was disclosed and recounted phone calls from angry clinical trial participants from the community. Both he and another institutional official interviewed described the subsequent added challenge that institutional researchers continued to encounter when recruiting clinical trial participants from the community.

### Economic Costs of Research Misconduct

Case findings of RM by a faculty, instructor rank or above, in closed cases reported in the ORI Annual Report 2000–2005 were estimated for the economic cost of misconduct. The model used to estimate economic costs was developed as a product of this research effort. For the model, economic costs were categorized as one of four types and time inputs were estimated using TDABC: investigative costs, grant award(s), VEA costs, or retraction costs. Cost types were summed to arrive at a total cost per case finding. All cases were found to have measureable costs based on the model's assumptions. Based on model assumptions, no cases were found to have all types of

cost. Table 6 summarizes the cost types and their distribution among the study sample.

### Type 1—Investigative Costs

All cases in the study sample had calculated economic costs for Type 1 investigative costs. Based on model assumptions, Type 1 investigative costs for the cases in the sample totaled \$2,526,458 (see Table 7). The per case Type 1 economic cost ranged from a low of \$116,160 (*Sultan* case) to a high of \$320,860 (*Gelband* case). In the *Gelband* case, the case RIO reported during the telephone interview that while he had not estimated "internal" costs at the time of the investigation, he was able to use time records for faculty and general counsel and, using 2007 dollars, conclude that the yearlong process consumed \$300,000 in time costs for investigative costs, Steps 1–4. This historical economic cost was combined with the estimated Steps 5–7, attributable to the ORI economic costs, to arrive at the Type 1 cost. For the remaining 16 cases, economic costs were estimated by TDABC methodology. Type 1 investigative costs for Steps 1–4 for two cases, *Radolf* and *Poehlman*, were doubled based on the RIO interview report that each of these cases had exceeded the 120 day timeline for inquiry and investigation and ORI had approved a time extension. Thus variation in investigative costs for these 16 cases is dependent on (1) RIO terminal degree (PhD vs. MD), (2) DIO ORI annual budget and annual investigative caseload, and (3) completion of the process

**Table 6. Economic Cost Types and Distribution Among Study Sample**

Type 1 Investigative Costs	Type 2 Grant Award(s)	Type 3 VEA	Type 4 Retraction Cost	Total Cost
17 cases	9 cases	3 cases	7 cases	17 cases

**Table 7. Estimated Economic Costs of Research Misconduct by Investigator by Year of Case Finding**

	Type 1 Investigative Costs	Type 2 Grant Award	Type 3 Voluntary Exclusion Agreement Cost	Type 4 Retraction Cost	Total Cost
Hartzer	\$ 126,610	\$ -	\$ -	\$ -	\$ 126,610
Duan	\$ 165,585	\$ 544,836	\$ -	\$ 678	\$ 711,099
Dreyer	\$ 165,585	\$ -	\$ -	\$ -	\$ 165,585
Xiong	\$ 120,612	\$ -	\$ 13,874	\$ -	\$ 134,486
Padgett	\$ 120,612	\$ -	\$ 9,604	\$ -	\$ 130,216
Ruggiero	\$ 120,612	\$ 48,662	\$ -	\$ 949	\$ 170,223
Pandurangi	\$ 120,612	\$ -	\$ -	\$ -	\$ 120,612
Arnold	\$ 120,612	\$ -	\$ -	\$ 237	\$ 120,849
Jacoby	\$ 159,587	\$ 282,332	\$ -	\$ -	\$ 441,919
Prasad	\$ 120,215	\$ 1,254,109	\$ -	\$ 237	\$ 1,374,561
Yao	\$ 120,215	\$ 106,652	\$ -	\$ 237	\$ 227,104
Ganz	\$ 122,975	\$ -	\$ -	\$ -	\$ 122,975
Radolf	\$ 187,756	\$ 447,190	\$ 74,880	\$ -	\$ 709,826
Gelband	\$ 320,860	\$ 543,217	\$ -	\$ 1,897	\$ 865,974
Sultan	\$ 116,160	\$ -	\$ -	\$ -	\$ 116,160
Kammer	\$ 116,225	\$ 745,346	\$ -	\$ -	\$ 861,571
Poehlman	\$ 201,626	\$ 1,963,453	\$ -	\$ 27,541	\$ 2,192,620
Total	\$ 2,526,458	\$ 5,935,797	\$ 98,358	\$ 31,776	\$ 8,592,390

exceeding the mandated timeline (*Radolf*, *Gelband*, and *Poehlman* cases).

#### **Type 2—Grant Award(s)**

A total of 54 grant applications were referenced in the 17 case findings (see Table 7). Grant applications were slotted into one of three categories for costing by the model. Grant applications with no evidence of funding were assigned a zero dollar value. Thirty-one grant applications fell into this

category or 57.4 percent of grant applications referenced in RM findings. Grant applications funded for an investigator PI found guilty of RM during the study period were estimated at the total dollar award and adjusted by the CPI to 2007 dollars. Nineteen grant applications with a total award funding of \$5,390,961 comprised this category, or 35.2 percent of grant applications. The third category consisted of grant applications for another investigator who was not the PI was cited for scientific

misconduct. This category accounted for 7.4 percent of grant applications with four funded grant applications totaling \$5,644,062. Three investigators in the study sample, Duan, Jacoby, and Gelband, were found guilty of falsifying and/or fabricating data included in a grant application for another investigator's funded grant. Costs for this category were excluded from the per case cost estimations.

In two instances, legal proceedings provide the basis for grant awards cost estimates. *US ex rel Yong Wu v. Thomas Jefferson University* required a payment of \$544,836 (2007 dollars) in the whistleblower case associated with the Duan research misconduct find-

ing for falsification.<sup>16</sup> In the *Poehlman* case, *US v. Eric Poehlman* cites that NIH paid Poehlman grant awards totaling \$1.7 million, assuming 2005 dollars.<sup>17</sup> This figure was adjusted to 2007 dollars and then reduced by identified fund grant applications to arrive at the unidentified grant applications' cost of \$1,073,963 (see Table 7–Poehlman).

Table 8 displays, by investigator, grant applications cited in the respective finding of research misconduct and provides grant award costs in 2007 dollars.

Grant award(s) cost per case ranged from \$48,662 (*Ruggiero* case) to \$1,963,453 (*Poehlman* case). The magnitude of the grant

**Table 8. Grant Applications Cited in Findings of Research Misconduct and Grant Award(s) by Case Finding**

Investigator	Year	Institution	Grant Application	Amount Awarded(\$) <sup>1</sup>
Hartzer	2000	Oakland university	-	-
Duan	2000	Thomas Jefferson	RO1 AI36552-01 <sup>2</sup>	-
			RO1 AI36552-02 <sup>2</sup>	-
			Unidentified grant of applications	544,836
Dreyer	2000	Harvard	KO8 DO0013 1-01A1	-
Xiong	2001	UTHSC	RO1 GM64353-01	-
Padget	2001	Ohio State Univ.	1RO1 AG20102-01 <sup>3</sup>	-
Ruggiero	2001	Harvard	1RO3 MH58586-01	48,662
			F32 MH12868-01	-
			F32 MH12868-01A1	-
			1R01HL065220-01	-
Pandurangi	2001	U Missouri - Columbia	1R01 HL62517-01A2	-
Arnold	2001	Tulane	1 R29 DK52420-01	-
Jacoby	2001	Harvard	1 PO1 N837409-01A1 <sup>4</sup>	-
			5K08N801887-03	139,326
			5K08N801887-05	143,006
Prasad	2002	U of Kentucky	RO1 N834264-01A1	249,125
			5R01034264-02	244,153
			5R01034264-03	248,211
			5R01034264-04	254,073
			5R01034264-05	258,548
			RO1 N841918-01	-

Continued ...



**Table 8. Grant Applications Cited in Findings of Research Misconduct and Grant Award(s) by Case Finding (*Continued*)**

Yao	2002	UNC - Chapel Hill	1R01HL067416-01 <sup>3</sup>	-
			1R01HL068250-01 <sup>3</sup>	-
			1R01HL066230-01A1	-
			1K08HL03881-01	106,652
Ganz	2002	Case Western Reserve	RO1 DK058674-01A2	-
Radolf	2003	U of Conn - Health Center	R01 AI29735-11	447,190
Gelband	2003	U of Florida	R29HL52189-01A2	-
			R01HL56921 <sup>2</sup>	-
			F32HD08496	-
			R01/R37HL49254	-
			F32HL08531	42,270
			5 F32HL008531-02	42,393
			5 F32HL008531-02	43,029
			P01DK41315	-
			R01HL69034-01	-
			R01HL52189-05	415,525
Sultan	2004	Harvard	1 PO1 AI060332-01 <sup>2</sup>	-
Kammer	2005	Wake Forest Univ.	2R01AR39501-12A1	448,904
			1R01AR46526-01A2	296,442
Poehlman	2005	University of Vermont	1R01AG17906-01	-
			1R01AG17906-01A1	-
			R01AG13978-01	-
			R01AG13978-01A1	354,171
			PO1AG16782-01	-
			1R01AG18238-01	219,266
			1R01AG18238	-
			PO1AG16782-01A1	-
			1R01AG19800-01	-
			2M01RR00109-33	-
			2R01DK052752-05 <sup>5</sup>	-
			2R01AG07857-06	244,003
			7R01AG07857-07	-
			5R01AG07857-09	-
			5R01AG07857-08	-
			Unidentified grant applications	1,073,963

<sup>1</sup> Award is Total Cost adjusted to 2007 dollars.

<sup>2</sup> Case respondent is not PI on funded grant. Funded grant award for R01 AI036552-01 is \$223,773. Funded grant award for R01 AI036552-02 is \$297,980.

<sup>3</sup> Grant application identified as “withdrawn”. Withdrawn grant may have been funded, however, if funded, the amount is protected by federal privacy laws applying to both grant applications and “withdrawn” approved and funded grants.

<sup>4</sup> Case respondent is not PI on funded grant. Funded grant award for 1 P01 N837409-1-01A1 is \$1,242,049.00.

<sup>5</sup> Case respondent is not PI on funded grant. Funded grant award for R01HL56921, a multi-year funded award, is \$3,880,260.



award cost was driven by the grant award type, which specifies allowable costs, and the number of funded grant applications. R03, investigator-initiated small grant awards (*Ruggiero* case), and F32, post-doctoral stipends during research training (*Gelband* case), have estimated costs between \$42,270 and \$48,662. K08 awards, mentored clinical scientist research career development awards (*Jacoby* and *Yao* cases), have estimated costs \$106,652 and \$143,006 to support salary, benefits, and research development support. R01, research program awards, have estimated costs that range from \$219,266 (*Poehlman* case) to \$448,904 (*Kammer* case).

### Type 3—Voluntary Exclusion Agreement

VEA costs totaled \$98,358. Of the 17 cases, 3 cases were estimated for VEA cost based on model assumptions. These respondents were study sample case respondents found to be employed during and after the VEA period at the institution where the finding was recorded. RIO interviews confirmed that an untenured faculty member often elected to resign at a time contemporaneous with the institutional finding. Exact details of timing of resignation and severance package were protected by privacy disclosure agreements. Therefore, no estimates of these economic costs were made.

VEA costs were a function of the type of administrative action imposed and the duration of the action. VEA costs for Xiong and Padgett were calculated using the approach described in the previous section. General certification of research activities was estimated at 2 hours per month for each month of the certification period at the RIO hourly wage rate. Both Xiong and Padgett were subject to a 36-month certification period. For Xiong, additional administrative actions

were reviewed against his current curriculum vitae (CV) to identify (1) funded and unfunded grants, and (2) publications that were subject to institutional certification for the 36-month period. The CV was available from an Internet search. Economic costs were estimated using TDABC assuming a one-hour time input by the institutional official (RIO basic science wage rate \$119/hour). Other required administrative actions were assumed at one hour time input per action. For Padgett, details of his VEA published in the misconduct finding were reviewed. He was subject to two administrative actions for a 36-month period. No CV was found using the Internet search approach or by accessing the faculty site at the university where he is employed. However, an OVID search identified a first-author publication falling into the certification period that acknowledged research support from five NIH grants. A CRISP search identified him as PI on two R29 grant awards during the certification period. Table 4 displays the VEA administrative actions, time input assumptions, and wage rate used to arrive at VEA cost for these two cases. VEA costs for the five-year certification period in the *Radolf* case were estimated by the case RIO during the interview. The case RIO reported that for the five-year certification period two full professors with annual salaries and benefits expense of \$200,000 (2007 adjusted salary level) each spent four to eight hours per certification on 60 certifications. VEA costs for the *Radolf* case totaled \$74,880 (60 hours  $\times$  6 hours  $\times$  2 faculty at \$104/hr) assuming an average of 6 hours per certification per faculty member.

### Type 4—Retraction Costs

Retraction costs for the study sample were estimated at \$31,776. A total of 27 articles

published by 7 investigators was identified for retraction in the study sample. The range of retraction cost was \$237 (*Arnold, Prasad, and Yao* cases with 1 retraction per case) to \$28,252 (*Poehlman* case with >10 retractions). The model calculated \$7,386 Type 4 retraction costs in the seven cases where retractions were mandated by the RM finding. In all cases except the *Poehlman* case, retraction costs was driven by the number of retractions and the RIO hourly wage rate (assuming two hours per retraction).

The *Poehlman* case included additional costs in the retraction costs category based on RIO interview results. The model calculated retraction costs of \$3,388 for the 10 articles mandated for retraction in the misconduct finding. The RIO indicated that the University of Vermont (UoV) determined a review of all *Poehlman*'s peer reviewed published articles would be appropriate given the scope and length of his misconduct.

Faced with the daunting task, a UoV faculty committee decided to restrict the review to all of *Poehlman*'s articles published during his employment at UoV. The faculty committee convened and agreed upon a strategy to validate all articles published during *Poehlman*'s UoV employment. A total of 110 articles met this criterion and were evaluated for falsification and fabrication and categorized as valid, questionable, or fraudulent. The RIO estimates of the number of personnel, salaries and fringe, and time inputs were used to calculate an additional \$24,153 to supplement the \$3,388 calculated from model assumptions (see Note 1 in Table 8). Thus, retraction costs for *Poehlman* total \$27,541 (model calculated costs of \$3,388 + \$24,153 expanded review costs).

Table 9 displays by case the number of mandated retractions, RIO case wage rate, and calculated cost per case assuming a two-hour time input.

**Table 9. Retraction Cost by Investigator**

Case	# Articles Retracted	RIO Hourly Wage	Retraction Cost
Duan	2	\$ 169	\$ 678
Ruggiero	4	\$ 119	\$ 949
Arnold	1	\$ 119	\$ 237
Prasad	1	\$ 119	\$ 237
Yao	1	\$ 119	\$ 237
Gelband	8	\$ 119	\$ 1,897
Poehlman <sup>1</sup>	10	\$ 169	\$ 3,388
<sup>1</sup> Additional costs to review 110 publications for retraction per RIO:			
Committee chair: 2%× \$226,875 × 24 months			\$ 9,075
1 support staff: 5%× \$50,820 × 24 months			5,082
7 faculty @ 1 hr × 12 months			9,986
			\$ 24,153

### Total Cost

Total economic cost of research misconduct for the 17 cases in the sample using model assumptions was calculated to be \$8,592,390. Table 10 displays the total economic costs for the 17 cases examined as well as the per case cost by investigator in order of year of case finding. Investigative costs for the study period were \$2,526,458 or 29 percent of total economic costs. Grant award costs of \$5,935,797 represented 69 percent of total economic costs. VEA costs and retraction costs were 1 percent and less than 1 percent, respectively, of total economic costs. Using the model, the per case economic cost for a finding of scientific misconduct among faculty ranges from \$116,160 to \$2,192,620, with a median cost of \$170,223.

The minimum cost of \$116,160, as estimated in the *Sultan* case, represents a “floor” for economic costs of research misconduct predicted by the model. In the *Sultan* case no grant award, VEA, or retraction costs were estimated. A total of six cases, including the *Sultan* case, had only investigative costs predicted by model assumptions. The range for these cases was \$116,160–\$165,585. The median economic cost was \$170,223 in the *Ruggeiro* case, which included investigative, grant award, and retraction costs. The maximum economic cost predicted by the model is \$2,192,620, estimated in the *Poehlman* case. Poehlman’s case cost represents the “ceiling” and does not include VEA cost because he was debarred for life from receiving public funds. Table 10 summarizes

**Table 10. Per Case Economic Cost of Research Misconduct by Investigator Rank**

Rank	Investigator Case	MD/PhD	Year	Misconduct Type	Total Cost
Professor (N=4)	Radolf	MD	2003	Fabrication/Falsification	\$ 709,826
	Kammer	MD	2005	Fabrication/Falsification	\$ 861,571
	Prasad	PhD	2002	Fabrication/Falsification	\$ 1,374,561
	Poehlman	PhD	2005	Fabrication/Falsification	\$ 2,192,620
Associate Professor (N=5)	Ganz	MD	2002	Fabrication/Falsification	\$ 122,975
	Hartzer	PhD	2000	Falsification	\$ 126,610
	Dreyer	MD/PhD	2000	Fabrication/Falsification	\$ 165,585
	Yao	MD/PhD	2002	Falsification	\$ 277,104
	Gelband	PhD	2003	Falsification	\$ 865,974
Assistant Professor (N=7)	Sultan	MD/PhD	2004	Falsification/Plagiarism	\$ 116,160
	Pandurangi	PhD	2001	Falsification/Plagiarism	\$ 120,612
	Arnold	PhD	2001	Fabrication/Falsification	\$ 120,849
	Padget	PhD	2001	Plagiarism	\$ 130,216
	Xiong	PhD	2001	Falsification/Plagiarism	\$ 134,486
	Ruggiero	PhD	2001	Fabrication	\$ 170,223
	Duan	MD	2000	Falsification	\$ 711,099
Instructor (N=1)	Jacoby	MD/PhD	2001	Falsification/Plagiarism	\$ 441,919

by investigator by rank the type of misconduct finding and the associated per case cost.

## Discussion

This study relied on a sequential mixed methods design and TDABC to estimate the economic costs of RM in faculty in an academic medical setting found to have committed RM as reported by the *Federal Register* and ORI Annual Reports from 2000–2005. Estimating the economic costs of RM is a complex measurement task that begins by defining distinct cost components. This study proposed and tested an economic cost model based on the federal administrative law policies and procedures for investigating and arriving at a determination of RM. Using TDABC methodology, the model identified and included economic

costs borne by publicly funded institutions carrying out the required steps in a finding of RM for a faculty member. Results of this research study have revealed that the neither ORI, the federal agency responsible for oversight of research misconduct, nor individual institutions in the study sample record economic costs or employ a measurement scheme to accumulate economic costs of RM. The cost model and the resulting estimated per case economic costs provide a prototype of the economic costs of a finding of RM for a faculty member engaged in publicly funded medical research.

Predicting cost fluctuation in findings of misconduct relies on two major components of the economic cost: investigative cost and grant award(s). The type of misconduct (see Table 10) is not relevant to economic costs. However, Table 11 identifies drivers

**Table 11. Drivers of Economic Costs of Research Misconduct**

Investigative Costs	Grant Award	VEA	Retraction Costs
Repeated misconduct	Repeated misconduct	Admission of Misconduct	Repeated misconduct
Complexity of grant specific aims	Discovery date of misconduct	Tenure status	
	Concurrent with grant application process		
	Pre-award		
	Concurrent with active grant period		
	Post grant project period expiration		
	NIH Award Type		
	Career development awards (K series)		
	Research training/fellowships (T/F series)		
	Research grants (R series)		
	Program project and center grants (P series)		

of economic cost. Model estimation for investigative cost identified two dependent variables: (1) RIO rank and resulting wage rate, and (2) completion of finding within the 480-day timeline. Repeated misconduct and complexity of grant specific aims for a funded grant both impact completion of the finding within the mandated timeline. These factors expand the scope of the inquiry and investigation potentially increasing the cost for completion with the timeline. If the timeline is exceeded, investigative costs increase. Model estimation for grant award(s) cost depended on the funding status and number and type of funded grant awards. Cases where an investigator is guilty of repeated misconduct, such as in the *Poehlman* case, will result in increased economic costs from multiple grant awards. Additionally, timing of the discovery of the misconduct can influence the grant award cost. As previously discussed, in this model unfunded or withdrawn grants are assumed to have no grant award cost. Presumably, the misconduct in these instances was discovered sufficiently early in the pre-award process to avoid economic cost impact. Misconduct discovered during or after grant funded research triggers economic costs. Grant award type is associated with the funding level. Because award type can be linked to the investigator's rank, the higher the rank of the investigator, the greater the economic cost of the grant award in the per case cost. Repeated misconduct is the most significant factor impacting economic costs in the study sample. If the investigator is suspected of repeated misconduct, the scope of the inquiry and investigation expands to a broader time period and to multiple grant applications and funded awards, potentially increasing investigative costs, grant award(s), and retraction costs.

Interview results emphasized the complexities of cost modeling for a finding of RM. The issue of the economic costing of the grant award was explored at length. When queried about the impact of an RM finding on the validity of the publicly funded research efforts, interviewees discussed the uncertainty involved in concluding which portion of that grant is invalidated by the fact of RM. Because a grant application proposes multiple study aims, the nature of misconduct may impact one aim or overlap many or all of the aims. It seemed to be their view that determining the economic cost impact of a funded grant would require a separate deliberation by scientific experts in the research discipline to determine the economic cost component of misconduct by study aim. In other words, the nature of the public good produced by any particular grant is sufficiently complex that while misconduct was involved, that misconduct might invalidate only a portion of the publicly funded research product. Further, ORI interviewees reflected on whether the type of misconduct, plagiarism vs. fabrication/falsification, might differ in invalidating the research effort and outcome. In contrast, the Department of Justice, in prosecuting Eric Poehlman in US District Court, took the view that the economic cost of a funded grant award is the total dollar award.<sup>18</sup>

The RMQ used in RIO interviews was developed and refined during the key informant interviews. As a data gathering technique the telephone-administered questionnaire offered a cost effective approach to elicit RIO responses. Generally, RIO willingness to cooperate was gratifying even though the results regarding collection of cost data were disappointing. The author had hypothesized that at least some institutions

would have a financial incentive to record associated time and expenses, given typical annual budget justification processes and resource constraints. One RIO stated that “there are no costs of misconduct except to the faculty member whose career is over.” The attitude regarding cost represented by this RIO offers an outlier perspective. The remainder of RIOs interviewed remarked that faculty, legal, staff, and their own time carried a substantial opportunity cost for their respective institutions. Cost for court reporters was mentioned by RIOs who oversaw cases closed toward the end of the study period. Apparently, during the study period ORI had initiated the recommendation that a court reporter be utilized for transcribing testimony. When requested by the author, several of the RIOs interviewed appeared to be able to informally estimate time spent by different actors for each case. Nevertheless, actual opportunity costs were consistently unmeasured.

The model developed in this study to measure economic costs of findings of RM defines categories of economic costs and estimates economic cost types. In the absence of historical economic cost data, the guiding principle for model development was to rely on TDABC and err on the side of conservative cost estimation for each of the four cost types in the model. This is perceived by the authors not as a limitation of the study, but rather as an intentional device to mitigate inflating the impact of economic costs of research misconduct.

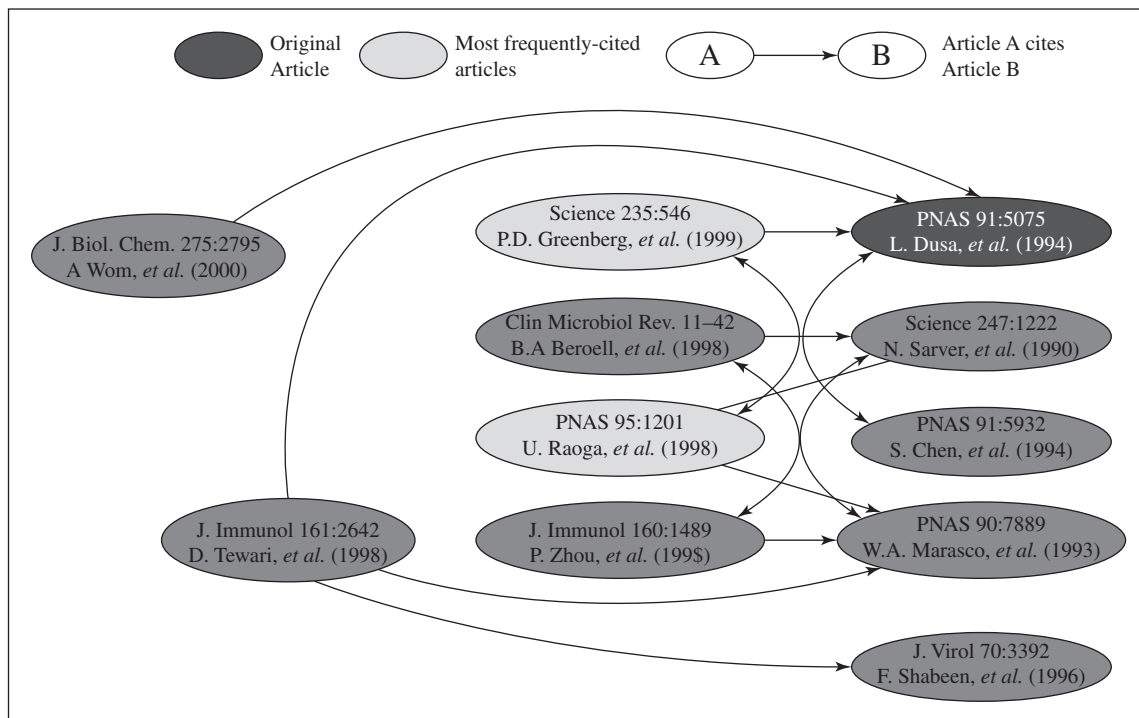
Type 3 VEA cost modeling was based on assumptions estimating costs of the administrative penalties assessed to the faculty member in the finding of research misconduct. While each of the 17 misconduct findings had assessed penalties, only the

three cases where faculty remained at their institution after the finding were modeled for this economic cost. As discussed above, several RIOs reported that non-tenured faculty members resigned at a time near to the formal finding. Even if known, costs for severance packages would most likely be excluded from the cost model developed here because the economic costs model are from the perspective of the NIH. Severance packages would, presumably, not be paid with public funds. Estimating costs for remediation for 3 of 17 investigators guilty of RM is a provocative finding in the study. Several of the RIOs interviewed commented that the fact of proven misconduct marks the end of a faculty member’s career. Even though the numbers in the study sample are small, they confirm that being found guilty of misconduct does not always terminate a publicly funded researcher’s career.

Type 4 retraction costs represent a floor for this cost type. The economic costs reflected in the study sample, \$31,776, are minimal at less than 1 percent of total economic costs. However, the issue of retraction is central to maintaining the integrity of the scientific literature.<sup>19</sup> In the *Duan* case, the two retracted articles were cited by a total of 13 publications. Citation maps (Figures 3 and 4) for each of these retracted articles visualize the web of influence for misconduct in this single case. In these 13 publications, authors acknowledged sources of public funding totaling \$7,314,689. It would be irresponsible to suggest that the 13 articles and the \$7.3 million in publicly funded medical research are invalid. But it would be equally irresponsible to claim that harm of the *Duan* misconduct magically disappeared when the case finding was published in the *Federal Register*. Retraction cost, as demonstrated



Figure 3. Duan Citation Map for Retracted PNAS Article



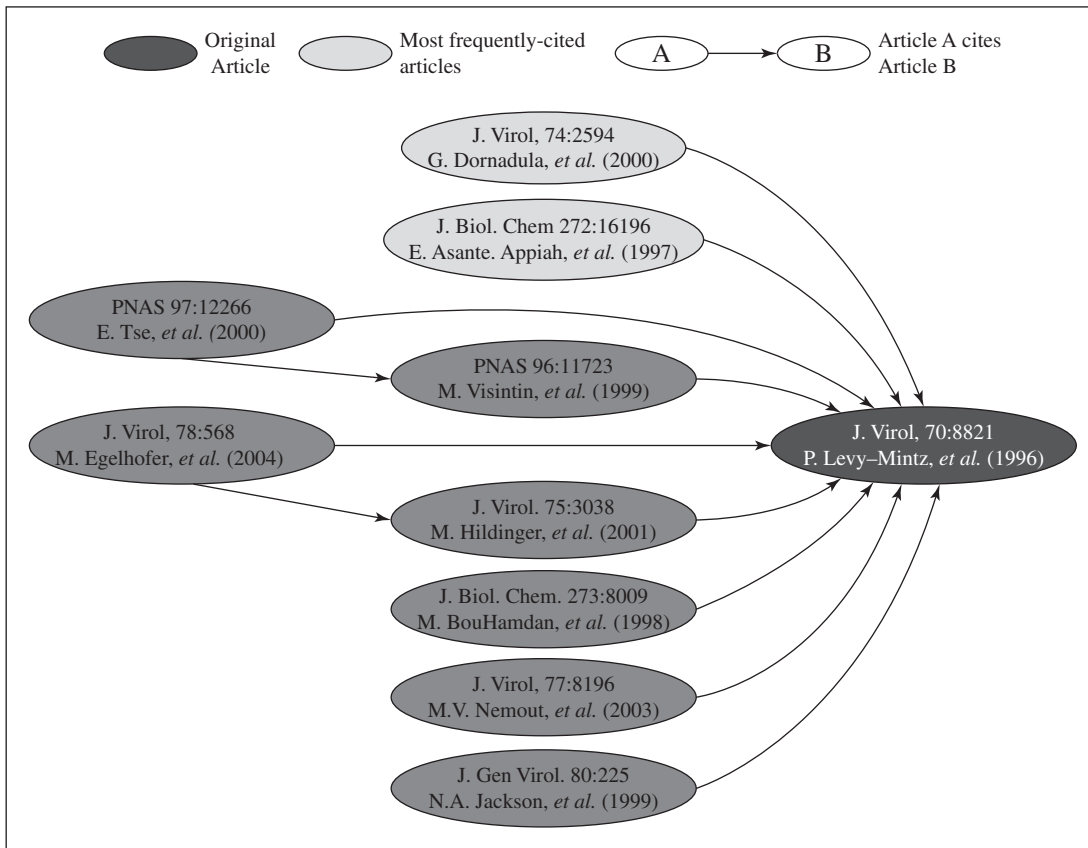
by these selected citation maps, barely begins to measure the impact of a retracted article. Despite the ORI's effort to improve the efficiency of misconduct investigations by introducing the mandated timeline, the lag between discovery of misconduct and associated article retraction has an economic impact not measured by this model. For instance, the Prasad article mandated for retraction in the 2002 finding of misconduct was published in 1999 and retracted in 2002. A SCOPUS search shows that the article has been cited four times, two instances of which are in articles published after the published retraction. Issues regarding the Poehlman retractions have been discussed previously.

Sox & Rennie<sup>20</sup> suggest that retraction efforts should extend beyond the specific

articles cited in a finding of misconduct, "Experience strongly suggests that authors who have committed scientific fraud hardly ever acknowledge every fraudulent article...Treat every article as suspect until proven otherwise." Scrutinizing every article of each of the published articles of faculty in the study sample would substantially increase retraction costs and would provide added assurance that the scientific literature was thoroughly corrected.

This study highlights the complexity of measuring economic costs of RM. Inherent in that complexity is the urgency to address the cost issue in an era of reduced funding for research. Michalek, *et al.*, based their \$110 million annual estimate of direct cost on one case study. Our research

Figure 4. Duan Citation Map for Retracted J Virol Article



underscores the variability of cost per case and thus heightens the importance of recording RM costs on a case-by-case basis to arrive at the true cost of RM findings. When RM costs are recorded, we propose the next logical step of identify a funding mechanism for cost recovery. Recovery of economic costs might heighten the

deterrence prospect in RM. In the current climate of NIH budget reduction, 5 percent for 2013 and 8.2 percent for 2014, required by the across-the-board sequester cuts,<sup>21</sup> estimates of the economic costs of RM provide a missing crucial component of public policy debate on research integrity and public investment.

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