

# Preventive actions to avoid questionable research practices. Use of EERM (Ethical and Efficient Research Management) during Arrival and Departure of a co-worker<sup>★</sup>

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**Abstract.** Preventive actions for scientific misconduct and questionable research practice must be taken at an institutional level but also by scientists themselves as part of their role of science managers. We have proposed the concept of “Ethical and Efficient Research Management” and a panoply of easy to use tools which are designed to favour ethical behaviour, sound data and robust methods. Through the example of the processes “Arrival” and “Departure of a co-worker”, we show here that flow charts can help visualize critical steps in an activity and how to manage these steps in an ethical and efficient way.

**Keywords:** Ethical and Efficient Research Management / quality management / questionable research practice

## 1 Introduction

Scientific misconduct (SM) and questionable research practices (QRP) occur on occasion in private and in public research institutions. When competition for limited resources and publication-orientated evaluation practice in research increase, pressure on scientists to produce and to publish results increases too. At the same time, the societal request for accountability of science is stronger than before and the availability of specific computer programs and other tools make the detection of SM and QRP easier. All these have probably contributed to an increase of the number of reported cases. Some scientists underline the fact that a researcher is a professional like any other and that today's culture is more materialistic and less concerned with moral and ethos; for this reason, we will less automatically do “the right thing even when no one is watching” [1]. These deviations were initially reported in biomedical research, but are now occurring in

all fields of science. When SM or QRP are detected in a published paper, the latter has to be amended or, if necessary, retracted by the scientific journal.

Van Noorden [2] has reported that between 2005 and 2011 the retraction of scientific articles in biomedical journals had increased more than 10 fold in 10 years. He also showed that 44% of retractions occurred because of scientific misconduct (e.g. fabrication, falsification, or plagiarism of data or information) and 28% because of scientific errors.

Cases of fraud, poor quality of data but also unethical and inefficient research management will ruin the trust of citizens in science and the trust of scientists in their managers and head of laboratory or unit. The scientific community is concerned with this phenomenon and adopted codes of conduct and structures for investigations for misconduct in most fields and places.

Preventive actions would be helpful, but are more difficult to design and to use, especially when managerial tools are missing or unknown by scientists.

The Inserm-Quality-Network (Riq) uses currently management tools from different sources such as quality management, quality control, knowledge management, project management and so forth. Certain tools have been adapted or developed for purpose of good research practice [3].

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We have developed the concept of Ethical and Efficient Research Management and its use for preventive measures against bad research practice [4]. The concept is based on the belief that sustainable management of a research team, project or collaboration, is not possible without ethical conduct of management. Ethical research management and efficient research management are thus intrinsically connected.

## 2 Scientific misconduct and questionable research practice exist in all fields of science

Initially pinned down in biomedical research, there is evidence that SM and QRP occur in all fields of science and since a long time.

As early as 1830, the British mathematician Charles Babbage wrote about fraud and defined different types of misconduct: trimming (elimination data points that do not “fit” with the mean), cooking (selecting of data which are not representative of the measurements but taken out of the context, provide a spectacular finding) and forgery (“pulling numbers out of the thin air”) [5].

In archaeology, cases of fraud have been reported as early as in the 19th century. The “Pitdown case” (1912) is a commonly quoted example of a fake and a rather sophisticated scientific fraud, since the authors Charles Dawson and Arthur Smith Woodward had modified their finds artificially and deliberately by adding artifacts and trimming down pieces of skull and teeth to more adequate size in order a match a 500 000 year old human skull. It clearly appears here that findings were not used to establish an interpretation or hypothesis, but that they were fabricated to prove a desired and “stunning” discovery.

Grieneisen and Zhang [6] surveyed 42 of the largest bibliographic databases for mayor academic fields using journals with Web of science category assignments. They found that “the PubMed retractions per year outnumbered the non-PubMed retractions until 2002, indicating the dominance of the medical literature among retractions in the past; however roughly equal numbers have appeared each year thereafter, with 1402 PubMed and 1442 non-PubMed retractions from the beginning of 2003 to 22 September 2011” (end of the study).

## 3 Who reports suspicions of scientific misconduct and questionable research practice?

In most cases, allegations of misconduct are made by coworkers; for this reason, it is particularly important that new co-workers are informed about the “Good research practice Policy” of the laboratory and who to report suspicions of fraud or questionable practice to.

Other members of the institution; reviewers of scientific publications, also have to question reported data, to note inconsistencies and redundancies or to question the names of authors when reviewing a report or a manuscript. Senior scientists are alerted either by their own observations or those of their coworkers or, at a late state, by a scientific journal or the scientific community.

Whistle blowers often hesitate to report an allegation because relationships and dependencies are strong in science. Students and young researchers do sometimes not dare report what seems SM or QRP to them, because they depend on the head of a team or institution for their research and their career. Senior researchers and reviewers may not report items of concern, because they realize that they may be in a situation in the future where they depend themselves on the favorable outcome of an evaluation. Only when rules are strict, measurable, transparent and ubiquitous, objective evaluation is possible. In the opposite case plenty of room is left for playing games.

## 4 Prevention of misconduct and questionable research practice at the institutional level

Scientific institutions are partly or fully responsible for evaluation practices. Today, evaluation of a scientist or of a team is strongly based on “productivity” e.g., the number and the visibility of publications. Although heavily debated in the scientific community, “Quality” is almost always appraised by using the impact factor of the scientific journal in which the paper was published. Career, tenure-ship and financing of projects and personnel strongly depend on the publication record of the investigator. Therefore, a large number of publications and high profile journals are aimed for by researchers. Improvement of the very methods of evaluation may offer a possible preventive action of SM and QRP at the institutional level. Evaluation committees should reflect on possible overestimation of the value of scientific publications/publication in high profile journals and take management and teaching skills into account. Creativity as such, accuracy and critical questioning are also part of good research. Team leaders and coordinators of large or complicated collaborative networks need to develop particular skills which cannot be boiled down to publication index. For a preventive measure, more differentiated criteria have to be identified and put into practice.

Scientific institutions should question the value and possible negative side effects of career incentives, including fast track promotion, and cash rewards.

Scientific institutions and evaluation bodies also have social responsibility when selecting evaluation criteria. When resources for research are rare and increasingly contract related, the question of efficient and good allocation of resources for science is posed by the citizens. Competition is clearly a motor for people, but it also holds a number of dangers such as possible incentive for SM and QRP. Therefore, increasing competition should go hand in hand with increasing awareness and practice of codes and rules of conduct. Moreover, in tomorrow's economy, additional skills are requested from scientists such as enforced skills in management, communication, knowledge management and risk assessment. These must also be taken into account when scientists are evaluated.

Scientific editors have recently adopted editing rules in a White paper, which have to be used by all scientific journals. Negative data, validation of a methodology or scientific approach is difficult to publish today. Those should also be valued by the scientific community and research organizations.

Codes of conduct such as the Singapore Statement of research integrity [7], the Montreal Statement [8], the European charter of researchers [9], the standard NF X 50-553 [10], and several guides and publications [4] are available. These have laid the groundwork for teaching at different levels (master, doctorate and life-long-learning). They can be part of classes or through an e-learning program.

## 5 Preventive actions by research management

Most researchers care about responsible conduct of research, publication and reviewing of scientific publications. Responsible conduct of research implies (in many areas) good quality of measurements, of measuring equipments and regular checks of the precision of the latter. Metrology should therefore be part of teaching of good quality research, for young researchers and through life-long learning. Metrology can be implemented in a Quality Management System and thus be part of the identification of critical equipments, preventive actions and general improvement procedures [11].

Codes of conduct exist for scientific integrity in general and different codes of conduct for various areas of science have been identified and made public. The question remains, how to translate them into daily life at the lab bench, in the office and so on.

Ethical and Efficient Research Management (EERM) is a concept of good research management and at the same time a toolbox. It contains managerial tools which are appropriate in science and used to implement good research practice.

This concept, the standards ISO 9001, "Quality management systems" [12] and NF 50-553 "Management of research activities" are based on the PDCA (Plan-Do-Check-Act) principle. This principle suggests that good planning (P), operation and traceability (D), control in order to detect errors early (C), and correction of errors and nonconforming outputs plus improvement of recurrent activities (A) are the structural elements for good research management.

In order to implement this principle, different tools are helpful. Since good quality of research and EERM have to be implemented from the beginning of a research career or a collaboration, these have to be explained, taught and practiced from the beginning of the presence of a newcomer to the lab.

Here we present how "arrival" and "departure" of a new co-worker can be treated as a process and be used when a new co-worker joins the lab and when a co-worker is leaving. Information on EERM, SM and QRP should be provided from the beginning on; therefore a special step is reserved to the latter. During his/her time in the lab, the new researcher will practice good quality research and research management (check phase, in Fig. 7) and at the moment of departure, a senior member of the lab will talk with him/her about scientific integrity and EERM, in order to identify weak points and the opportunity of improvement for the lab.

The definition of tasks, roles and responsibilities, of codes of conduct (e.g. publication policy, authorship and publication acknowledgement), helps assure fair treatment of co-workers and transparency of management.

Managers have designed "Task-charts" and "Identity cards" for each process so that the characteristics of a process can easily be visualized. Figures 1a and 1b give examples of ID cards of the process "Arrival of a new co-worker" and "Departure of a co-worker" respectively.

Like other processes, the process "Arrival/departure" is regularly checked by a "pilot" (indicators, continuous improvement).

When quality management is used in a research lab, actions will not be performed as such and individually, but are connected to an "objective", that is the goal that the action should achieve and to an "indicator" which permits objective measurement of the outcome of the action. This approach is scientific in nature, because it enables the science manager to make fact-based decisions and to step-wise improve the efficiency of the actions.

Objectives are fixed in order to give guidance to actions for improvement of the process. These objectives can be the declination of a general "value" to which all of the members of a lab adhere to.

When "values" and objectives are part of a "Quality" or "EERM" statement, it is important to inform the members of the team, its clients and interested parties, because a specific policy which supports actions to assure decent treatment of co-workers and ethical and efficient lab-management may be considered as an added value by a new-comer and improve the image of the laboratory.

Co-workers are treated like customers in the sense that their needs and expectations are taken into account. The same is true for the laboratory and its members and a "give-and-take" principle is obtained. The requirements of each group of clients are documented in the ID card as well as indicators which reflect to what degree mutual expectations have been met. In this context, it should be underlined that in the process "Arrival", efficiency of integration and information about Good research practice are prime objectives. In the process "Departure", objectify are the assurance of transmission of research results (data, materials, samples) and information from the departing person to the laboratory is crucial.

Research records and other records which are important in a publication, or, more globally, for a project or a research unit, should not only be clear, complete and accurate, but also allow easy verification and replication of work. Young researchers have to be trained and supervised in order that log-books and other records meet these requirements. Records are part of the archives of the research unit/institution and have to be stored securely. When a co-worker leaves the unit, knowledge, materials and records have to be transferred to his/her supervisor or an appropriate senior researcher. Laboratory log-books and other proof of "paternity" of research results can be copied for the departing person, but have to remain in the laboratory. It is advisable to engage discussions about expected

Figure 1°a) Identity Card		
PROCESS « Arrival of new co-worker »		
Value : « Play the game as a team »		Pilot of process : senior scientist
Clients/Interested Parties	Requirement of clients	Indicators
New co-worker	<ul style="list-style-type: none"> <li>- Easy integration into the team</li> <li>- Appropriate information on his/her rights and responsibilities</li> <li>- Information on good/questionnable research practice/EERM</li> </ul>	<ul style="list-style-type: none"> <li>- Ratio of persons leaving the team before end of contract/ total of new co-workers</li> <li>- Reported defaults and dysfunctions</li> </ul>
Laboratory	<ul style="list-style-type: none"> <li>- Easy integration into the team</li> <li>- Quick leaning</li> <li>- New competences</li> <li>- Integration as planned</li> <li>- Respect of Good professional practice</li> </ul>	<ul style="list-style-type: none"> <li>- Ratio of persons leaving the team before end of contract/ total of new co-workers</li> <li>- Reported defaults and dysfunctions</li> </ul>
University	<ul style="list-style-type: none"> <li>- Hiring according to the legal requirements</li> <li>- Good image</li> </ul>	<ul style="list-style-type: none"> <li>- No complaints of administration</li> <li>- Number of candidates for a position</li> <li>- Loyalty</li> </ul>
Sponsors and funding agencies	<ul style="list-style-type: none"> <li>- Good communication, good image</li> </ul>	<ul style="list-style-type: none"> <li>- Number of contracts, no complaints</li> </ul>

Fig. 1a. ID card of process “Arrival of a new co-worker”.

publications and authorship. When Quality management is practiced in the laboratory, actions for continual improvement are taken and the quality of integration and the “smoothness” of departure are sought to improve gradually.

Moreover, fact based decisions and rules are likely to improve compliance with regulations. Specific efforts are made to make research methods appropriate, robust and comparable to other methods and to ensure friability and availability of research data [11].

Figure 1°b) Identity Card		
PROCESS « Departure of co-worker »		
Value : « Play the game as a team »		Pilot of process : senior scientist
Clients/Interested Parties	Requirement of clients	Indicators
Co-worker	<ul style="list-style-type: none"> <li>- Professional experience, diploma</li> <li>- Evolution of CV and competences</li> <li>- Practice of good quality research and of EERM</li> <li>- Satisfaction</li> </ul>	<ul style="list-style-type: none"> <li>- Ratio co-worker who increased professional experience and obtained diploma over total</li> <li>- Satisfaction (inquiry)</li> </ul>
Laboratory	<ul style="list-style-type: none"> <li>- Seamless continuation of project</li> <li>- Transmission of knowledge</li> <li>- Reproducible data</li> <li>- Project progression as planned</li> </ul>	<ul style="list-style-type: none"> <li>- Professional objectives attained</li> <li>- Sustainability</li> <li>- Defaults in functioning</li> </ul>
University	<ul style="list-style-type: none"> <li>- Respect of legal requirements</li> <li>- Increase of good image</li> </ul>	<ul style="list-style-type: none"> <li>- Alerts from administration</li> <li>- New candidates coming from the environment of previous co-workers</li> </ul>
Sponsors and funding agencies	<ul style="list-style-type: none"> <li>- Information on the satisfactory outcome of the funded project</li> </ul>	<ul style="list-style-type: none"> <li>- Number of satisfying projects to total</li> </ul>

Fig. 1b. ID card of process “Departure of a co-worker”.

The steps of an activity or a project can be materialized on a flow chart to make it easy for everybody to gain information on how a process is set up (Figs. 2 and 5). The processes “Arrival” and “Departure of a co-worker” are used again. The flow-charts also show who (supervisor or senior researcher, head of the unit, new co-worker etc.) deals with the action (side bars), responsibilities, and records related to the different steps (orange boxes in the figures).

Risks and threats related to the different steps are listed by the team in the most complete fashion and inserted in the flowchart (Figs. 3 and 6). In a second step, a hierarchy of risks is established either by simple appreciation by the team or by using one of the available risk-assessment tools, such as the SWOT-analysis. Then, possible ways of management of the risk are devised (dark red boxes, Figs. 4 and 7).

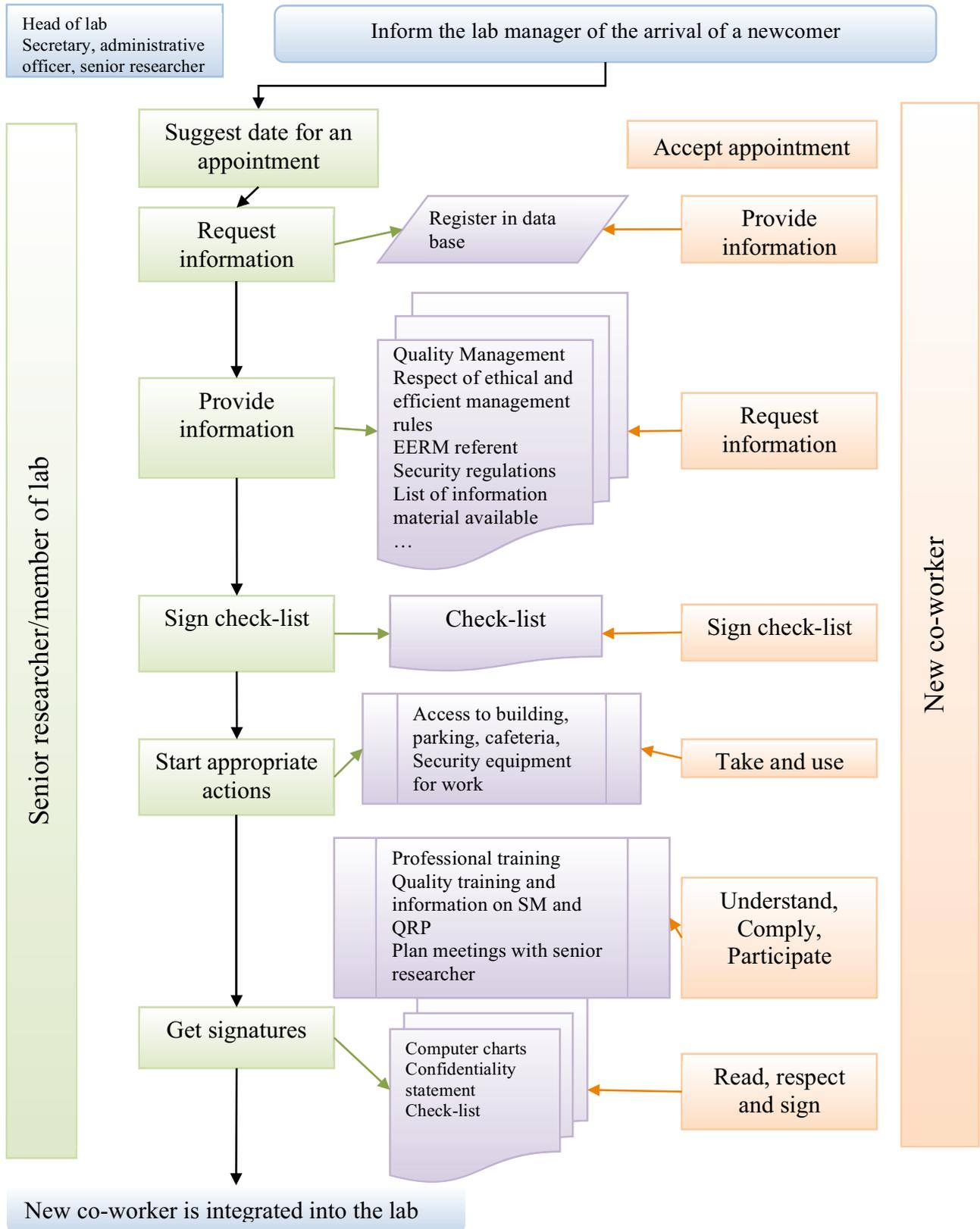


Fig. 2. Arrival of a new coworker: flow-chart.

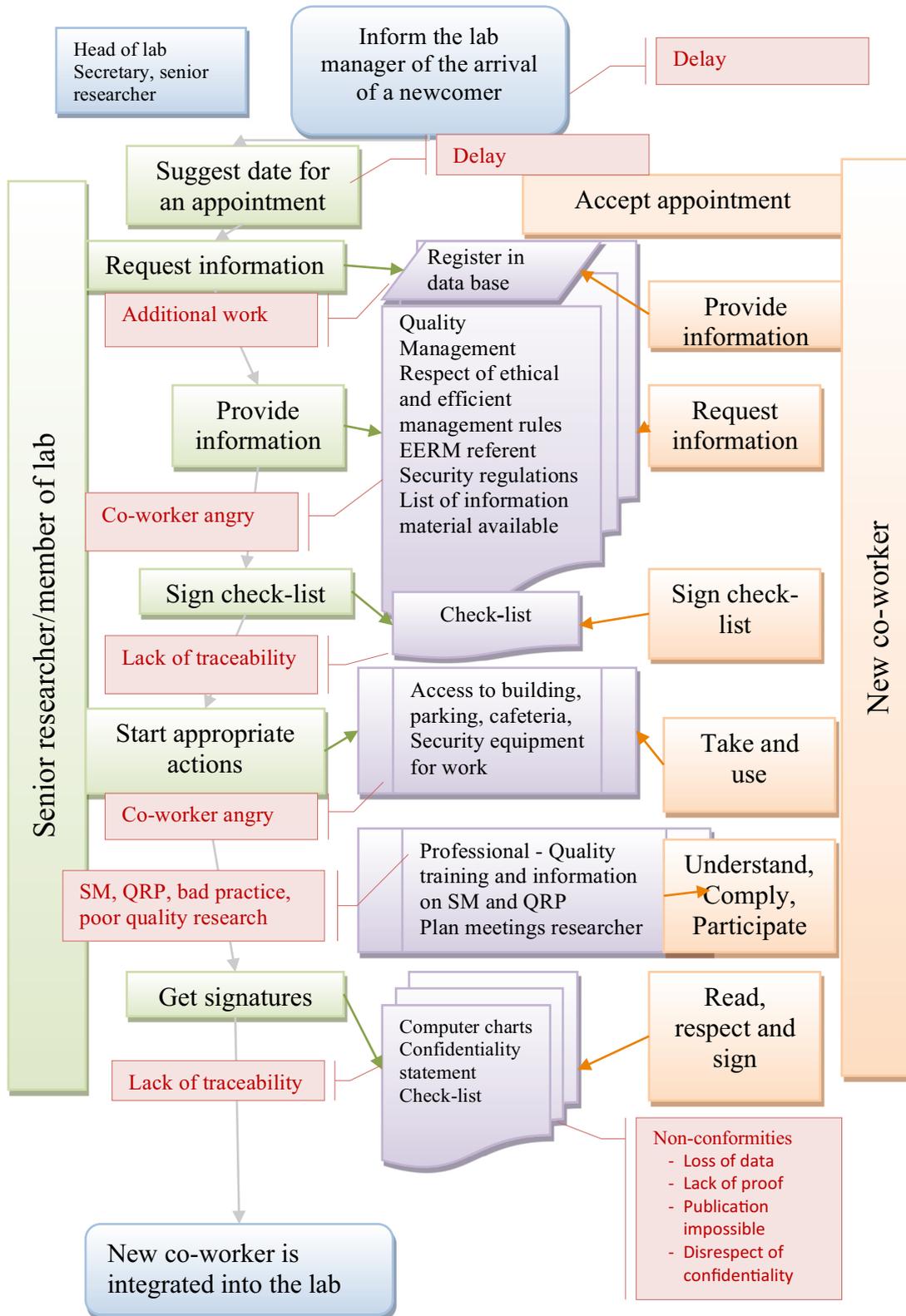


Fig. 3. Arrival of a new co-worker: flow-chart with risky steps (indicated in red).

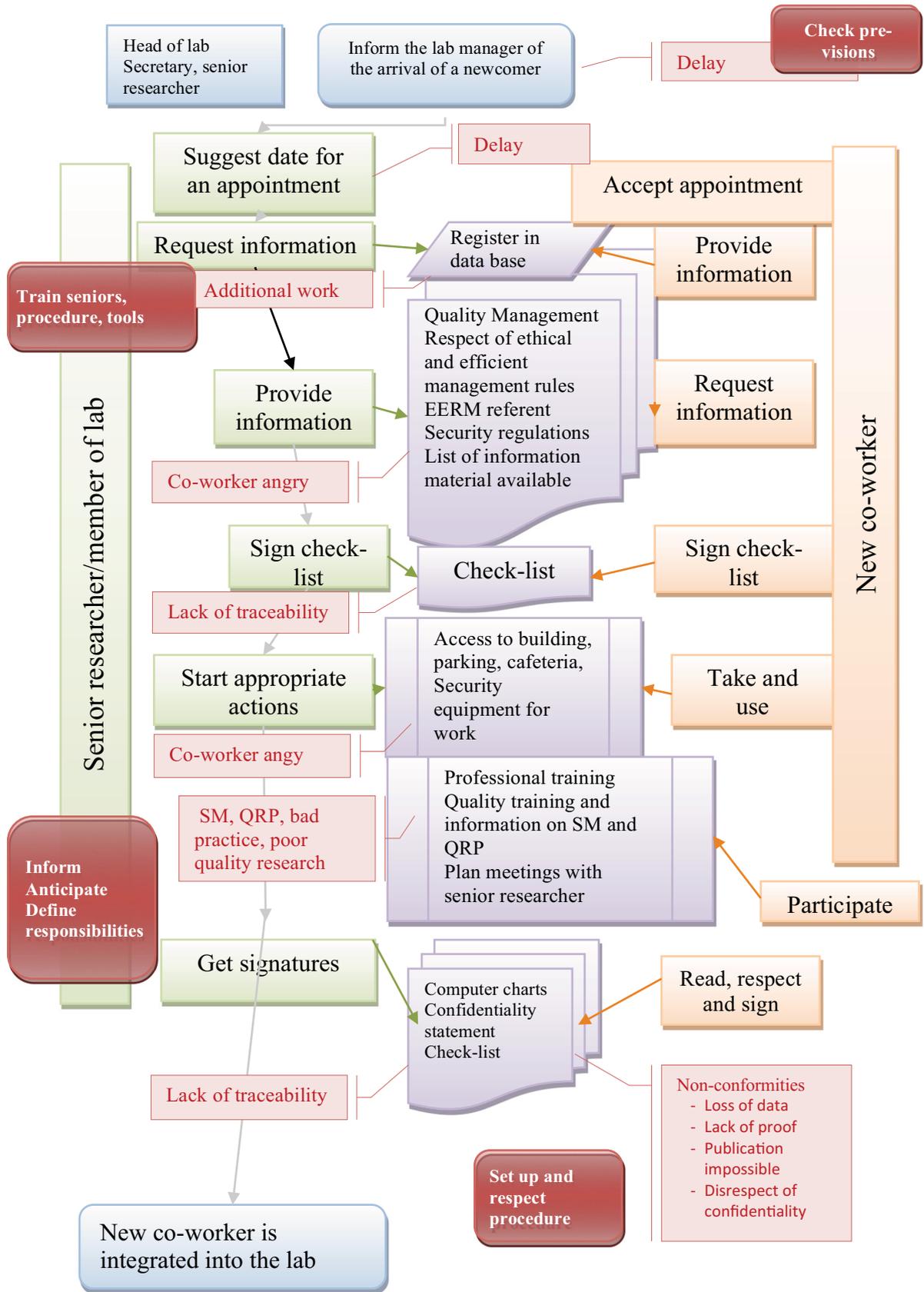


Fig. 4. Arrival of a co-worker: flow-chart including risky steps and management of the risk (dark red).

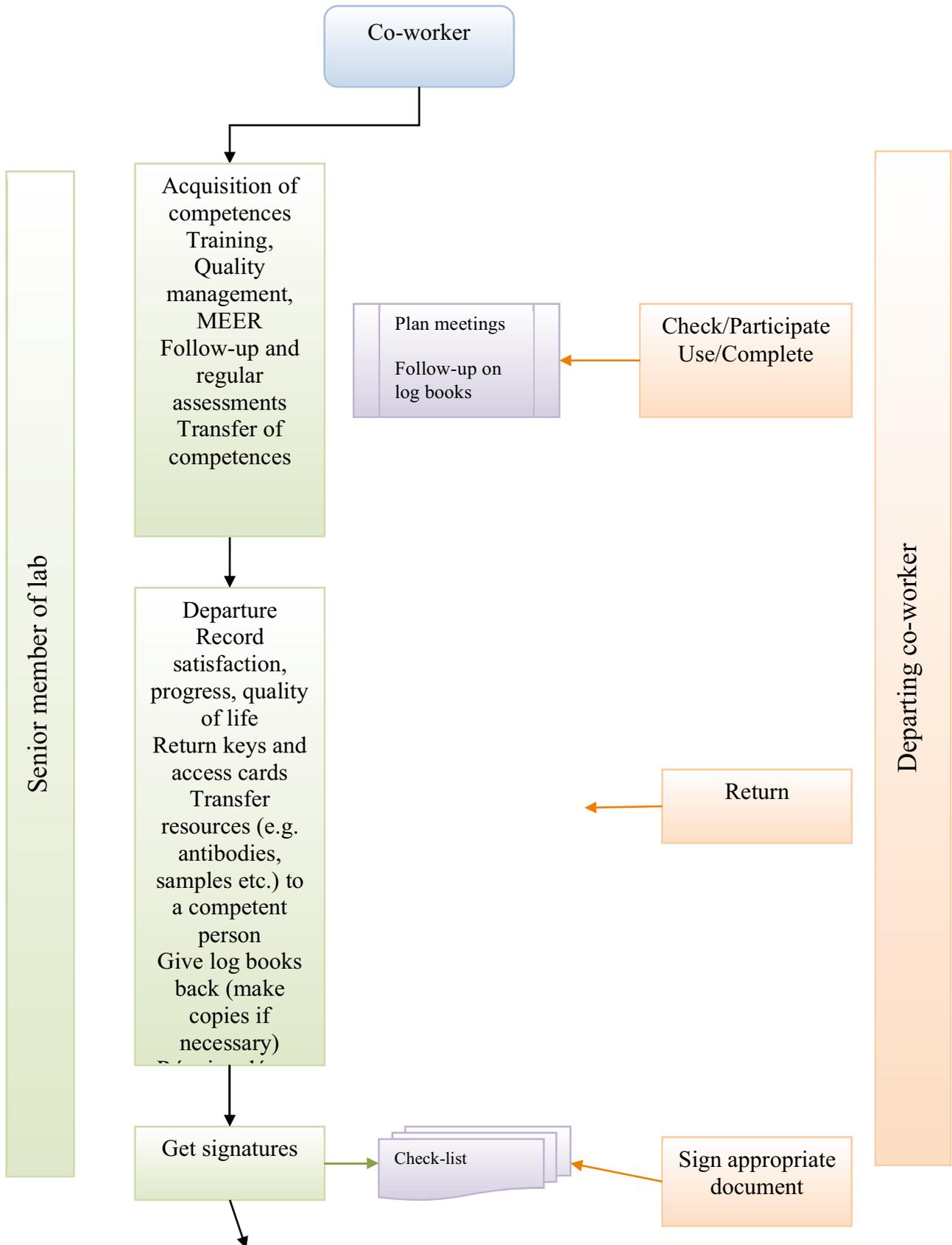


Fig. 5. Departure of a co-worker: flow-chart.

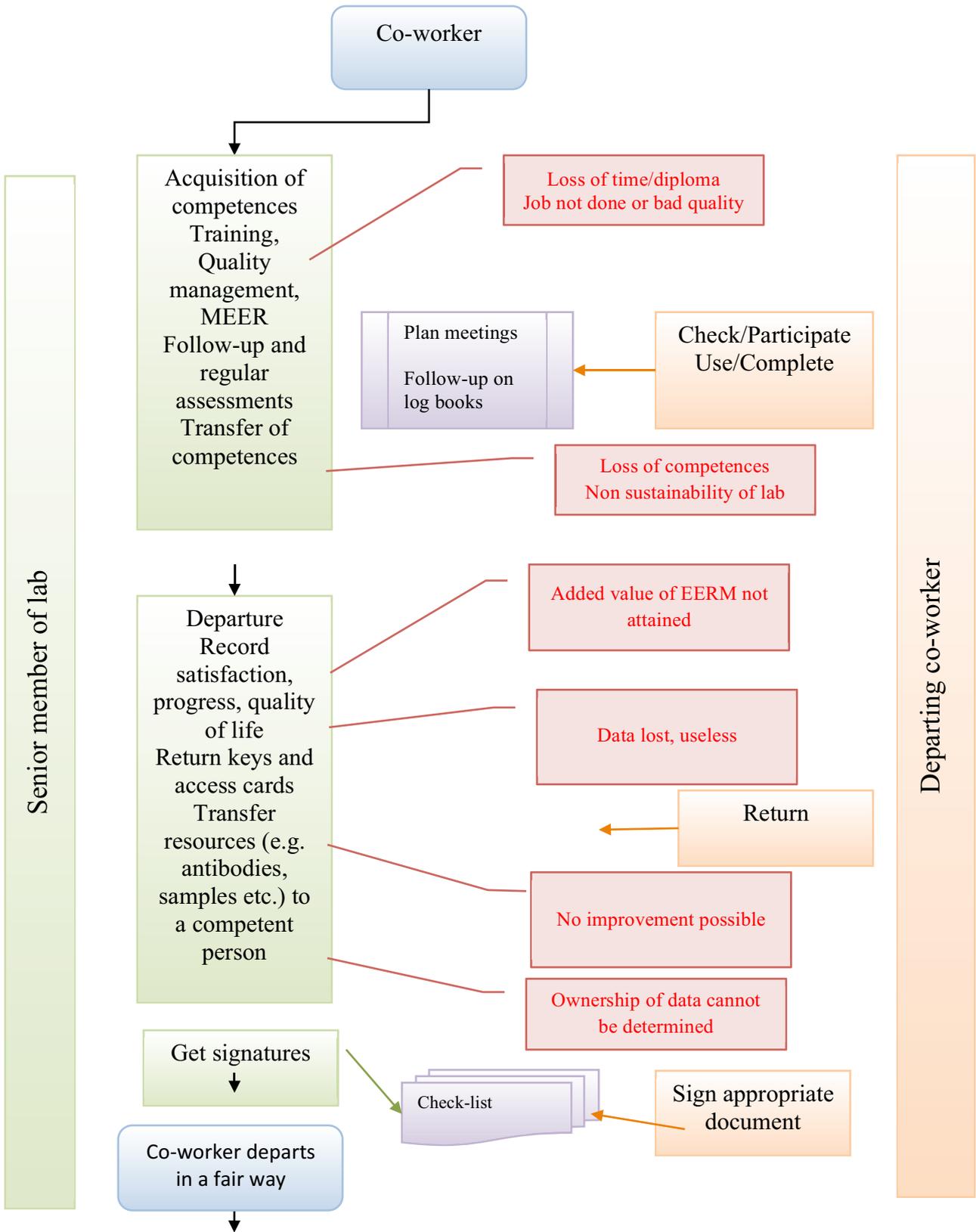


Fig. 6. Departure of a co-worker flow-chart with risky steps (indicated in red).

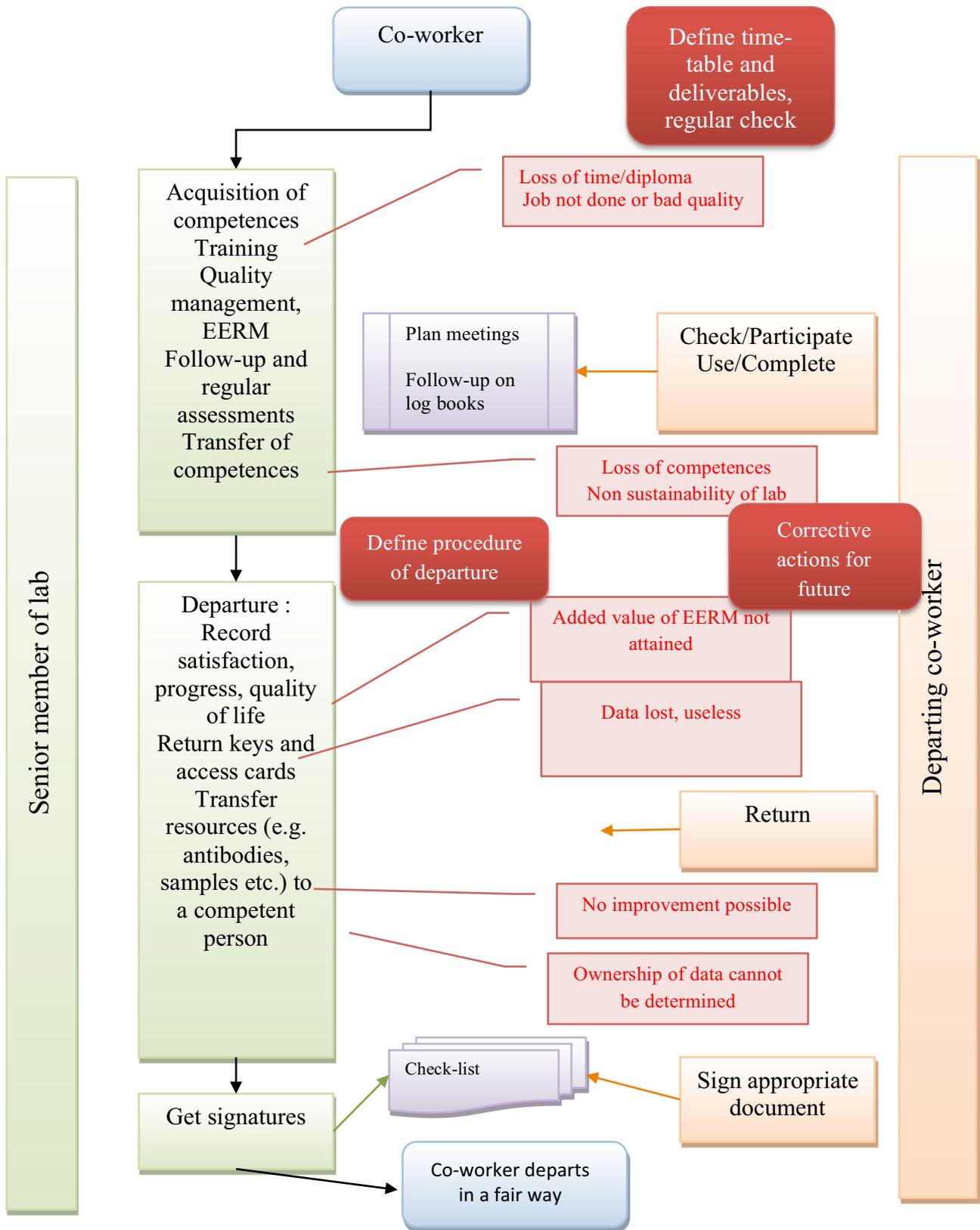


Fig. 7. Departure of a co-worker flow-chart with risky steps and management of the risk (dark red).

These flow-charts are useful to visualize steps of the process and accompany the actions as a reminder and an alert. Their usefulness depends on their appropriateness and acceptance by the stakeholders. For this reason, an EERM management system has to be designed by the team in order to have maximum usefulness. Like in a Quality management system, the documentation of the system must be in conformity with the actions; the records document the way actions are really performed and not what should be done.

## 6 Conclusion

Honesty, accountability, professional courtesy and fairness, and good stewardship are the four principles of research integrity, according to the Singapore Statement, and the gold standard in public and private research. In order to diminish possible deviations, such as SM or QRP, corrective and preventive actions at the institutional and at the operational level are necessary. Here we show what has been done and what can be done to help sustain, as much as possible, decent research practice. Supervisors, heads of a laboratory or unit and senior researchers have become research managers too. For this reason, research management and its tools must be made available, useful and acceptable to these research managers. The use of the process orientated approach which offers quality management, the PDCA cycle of the new ISO management standards and some simple tools for risk management were declined here to show that Ethical and Efficient Research Management (EERM) is easy to perform and can be used when Codes of conduct for good research management are to be put into practice. It is important to learn the right way of doing things from the beginning on, therefore the process “Arrival” of a new co-worker gives an opportunity to teach and to talk about good research practice, which its technical and methodological aspects and the implementation of metrology and with its managerial aspects. The process “Departure” gives an

opportunity to the lab to have the opinion of the departing co-worker with respect to the added value of EERM and his/her quality of life in order to further improve the management system of the lab.

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