

The (Flow) Cytometry Core Facility: Challenges for the future

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ABSTRACT

Although both static and flow cytometers are commonly found in clinical and research laboratories, they are not always supported by adequate human and financial resources nor are they always under the specific control of an identified manager. We believe that in a multi-user environment, there need to be guidelines to allow effective use of resources and identify areas where improvements may be made. However, conditions and expectations will vary considerably from laboratory to laboratory. We feel that it is worth addressing the critical questions that will be common to all core flow managers and all laboratories with cytometric facilities. By comparing two core facilities in research establishments - one in Europe and one in North America - we find that although there are significant local differences, there are enough fundamentally similar approaches and challenges for us to be able to suggest that there are several major areas which must be addressed. These include:

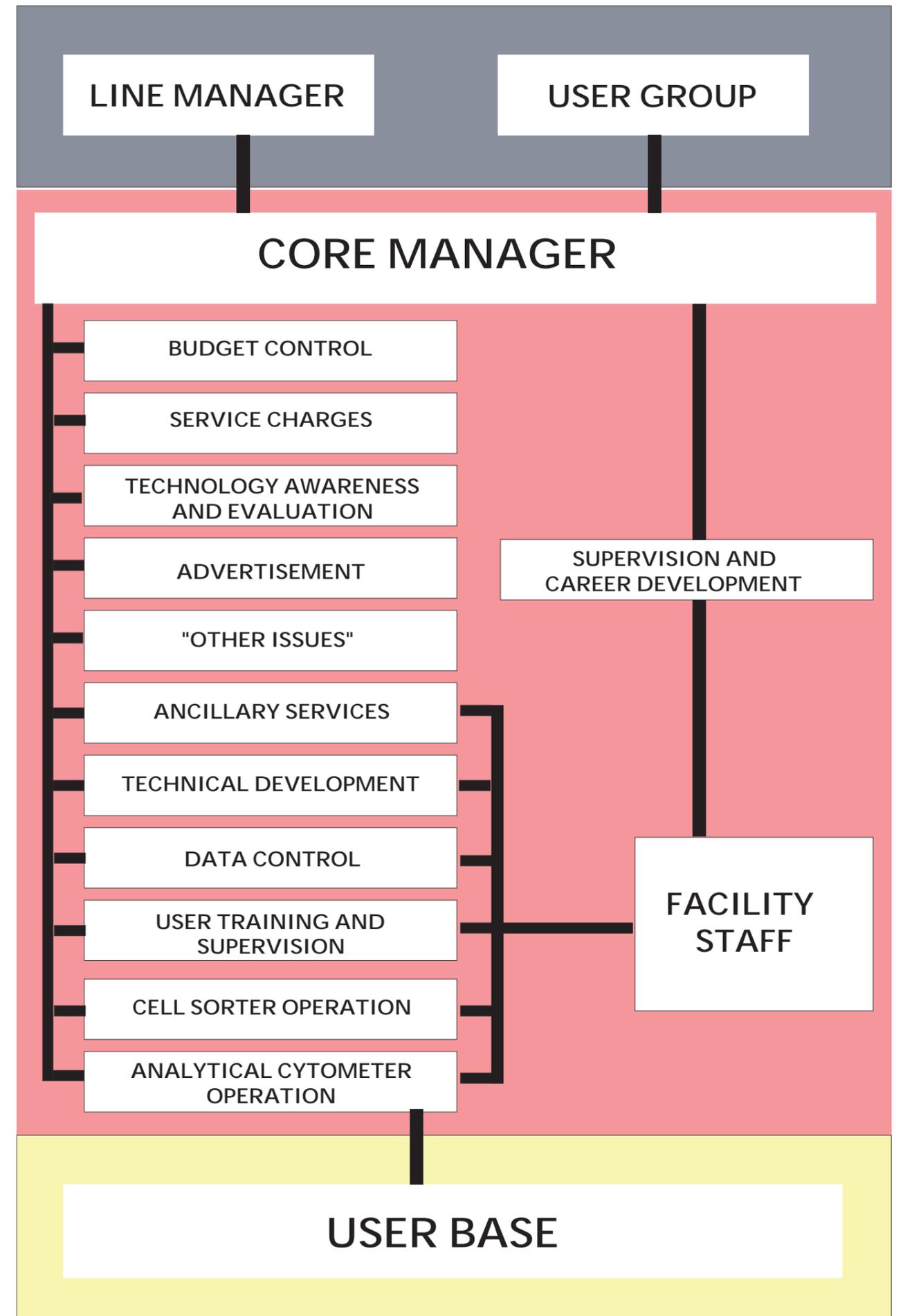
- laboratory budget (is the laboratory autonomous?)
- service contracts (Should we have them on cytometers and lasers?)
- core staff level (Is it an operator service; how much input do the Laboratory staff have to the experiments? How best can we cope with multiple users and applications? Should there be some sort of qualification or 'certificate of competence' for operators? How many staff per machine?)
- staff recruitment (presentation of cytometry as a career option)
- staff training (Standardised practice; biosafety issues)
- efficient use of the Laboratory staff time
- data analysis and storage (How to archive data and retrieve easily)
- research and development (the introduction of new and appropriate techniques; how can new techniques be developed and integrated?)
- the user base (hours/day/machine and training)
- charges for the use of equipment
- ancillary services (sample preparation, microscopy)
- integration with other core services (Confocal microscopy; monoclonal antibody production)
- advertisement of the facility (Seminars, newsletters, Intranet, internet)
- Information resources (Local cytometry groups; National and International Groups)
- Local User Group (advisory and/or executive)

It is the responsibility of Laboratory managers to ensure that cytometry is recognised as a key technology that demands the involvement of experienced personnel and that this experience is recognised and encouraged. This presentation does not provide an easy answer, nor should it, but is designed to identify the key areas and offer a realistic approach to the factors that need to be considered in the management and running of a core facility.

INTRODUCTION

Flow cytometry has become an essential and widespread resource for the study of biological cells. However to fully exploit this technology, a great deal of experience and expertise is needed but this is not always available. The flow cytometry core facility provides centralised instrumentation with experienced staff to oversee the use of equipment, ensure the smooth operation of cytometers and have valuable input into the experiments that are carried out. Core facilities are also cost-effective in that they can limit duplication of resources and provide a central and recognised source of expertise. However, even in those places where such a core facility exists there are no guidelines as to how it should be run and requirements and expectations will differ greatly. In the absence of guidelines from users, we, as core managers, should be taking the initiative - we have the experience and expertise to know what people want and should be in a position to give it to them. Having said that, do we ourselves know exactly what we want or how to go about getting it?

We need to have an understanding of what we would need in an ideal world and an idea of how close we can get to that in the real world. There are a number of areas that we consider to be of great importance in both standardizing the approach as far as is possible between core Laboratories and allowing for individual and local variations. We would stress though that all the following areas are considered from the point of view of Research Laboratories, we recognize that Clinical Laboratories may well have different priorities and may actually have further points that must be considered e.g. accreditation and quality control and assurance. In addition there are differences between Research Laboratories depending on their field of work. We would also say that these points are raised to encourage discussion and in no way represent a definitive statement. It also is true that some of the points raised here are not "cytometry" specific but are more general Laboratory Management considerations but nonetheless they are important to the role of the Core Manager.



CORE STAFF LEVEL

As Laboratory Managers working in the field we know from experience what level of staffing we need - we also need to be in a position to convince the line managers and those with the financial responsibility that we know best but how do we get that influence?

The level of staffing (i.e. numbers) will depend on

- the types of Cytometer in the facility - i.e. the number and type of analytical cytometers and cell sorters
- the amount of input that users need to operate the cytometers
- the level of training required
- the amount of intellectual input the staff have to both users experiments and their own work
- whether any techniques are run for the users

There also has to be time for discussion with users, information dissemination, general administration and the learning and introduction of new techniques. As both analytical benchtop cytometers and cell sorters become more complicated there is a need for both experienced and well-trained operators and there will be a need for greater input with advice of experiments (choice of fluorochromes, filter combinations, 'alternative' techniques etc.).

As a guideline, we recommend that there should always be a designated person in charge of a facility (even if it is a single machine) and above that there should be 1 person per sorter and 0.5 per analytical cytometer if the lab is to be in a position to move forward. Sorters should be operated by trained staff only and benchtop users will need training, guidance and advice.

USE OF STAFF TIME

This again is a general management consideration. There needs to be efficient allocation of work on a daily and weekly basis and a pro-active approach to this should be encouraged. However, there are also longer term aims such as development of new technology and techniques which may both move the Laboratory forward and provide challenge and interest for staff. This is a management role that will be common to any manager not just of a flow facility but which needs to be borne in mind.

RECRUITMENT AND TRAINING

We want to be in a position to present cytometry as a career option rather than a technical service. But what level of education should we be looking for - College level? School leaver? Ph.D.? How can this be assessed before recruitment and based on future needs?

A Core manager certainly needs both experience and a broad knowledge base but this is less of a requirement for an operator, although the position still has to be made attractive. If we are looking for experience, do we accept a "lower" level of academic qualification or do we look for academic excellence but less practical experience? This, of course, depends on certain constraints e.g. how urgent is the need and what level of remuneration is offered.

We should consider ourselves to be akin to IT professionals in that we need to promote the idea that cytometry is an acquired and desirable skill. Allied to this though is the idea of a formal Cytometry qualification or at least approved and recognized training. It would be desirable to have a standardized training but apart from the basic ground rules of how cytometers work, most labs will be more interested in training for their own particular applications. This is a difficult area as each Cytometry Laboratory is likely to be unwilling to train outside users especially if their own workload is high. Bodies such as ISAC and, for example the Royal Microscopical Society in the UK, may be able 'approve' sites or procedures or issue guidelines for, for example, Biosafety, but there is no Cytometry degree yet, so when "experience" is such an ephemeral quality, who can decide what level of remuneration an operator deserves?

The following quote from a Research Fellow shows that the acceptance of experience and its subjective assessment is there but maybe we also need to show that we have a degree of control over what is considered 'the right approach: "I do not think academic qualifications give a good indication of whether an individual will make a good operator. A good attitude with regard to helping customers, an interest in how things work and an aptitude for fixing things along with a broad knowledge of biology and science is what is required."

ANCILLARY SERVICES

The number of users and the level of the usage is important. It will have implications for the number of hours cytometers are used and the number of hours that staff have to be involved in training and advice. Some users will be self-sufficient, others will need full time help, others will be in training or need occasional guidance - we are all familiar with the situation where a user, believing themselves correct, is using the cytometer sub-optimally. Most users will need some degree of input into analysis and interpretation and advice for future directions. The Manager needs a broad knowledge at least of who to go to if techniques other than cytometry are needed, for example, confocal microscopy or electron microscopy. In addition, the Core Laboratory should provide certain other facilities which will aid the running of the Lab and help expand the knowledge base of the staff. Simple techniques such as sample preparation, the use of a fluorescence microscope, routine cell culture, basic molecular biology applications etc. will both expand the knowledge of the core staff and enable the Core facility to provide a more efficient service. However, this will all require both finance and staff time.

DATA ANALYSIS AND STORAGE

Over the last few years, data file sizes have increased as experiments have become more complex and this has had implications for data storage. FACS data represents a large investment of time and money and it should be archived carefully. Although storage media are now more readily available and cheaper in real terms, what is the best way to archive data?

- Should users each be responsible for their data?
- Should there be central storage?
- If so, which is best: CDs, JAZZ, ZIP, Tape?
- Is it also best to have a backup system such as Retrospect?

Allied to this point though is how much control should the Core Manger have over the data that comes out of the Lab? We have all seen flow cytometry data in the literature that we consider to be flawed, so we would recommend that there is also a system in place so that the Laboratory Manager or the appropriately experienced staff should be able to aid with the presentation and, perhaps more importantly, the interpretation of the data. If we are promoting cytometry as the powerful technology it is, we need also to show that we know exactly what it does!

RESEARCH AND DEVELOPMENT

Part of the remit of any core facility, cytometry or not, should be the introduction of new techniques appropriate to the needs of the users and the aims of the Institute. This requires interaction with local users, other cytometrists and workers in the same fields. It is true to say that the Core Laboratory staff are the people who are probably in the best position to get an overview of how cytometry fits in to a particular field of investigation as we are able to monitor what is going on in the world of cytometry. This enables the import of new techniques as necessary but we also have to be receptive to the demands of the user - this is where the experience and knowing how to deal with users is vital. It would be prudent for the core manager and/or staff to attend as many in-house seminars as possible to be aware of the research interests of the user base. Allied to this is whether and when core staff should be co-author on users publications. This does vary with the investigator concerned but there should be a reasonable expectation that if a core member has provided input into experimental design, running of samples (particularly sorted samples) and analysis of results then they should be considered as a co-author on subsequent papers. Even incidental advice should at least warrant acknowledgment, and the core manager should strive to make sure this is done

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The role of the Cytometry Laboratory as an instigator should be promoted. We can either show the users what they could (or perhaps should) be doing or wait for them to ask for the introduction of new techniques. This is where we need to take a proactive role in the promotion of the facility, for example, by:

- Regular update seminars (at least yearly; certainly after ISAC meetings!)
- news letters
- Intranet if available (or local email shots)
- Publicly accessible WWW pages

Occasional flow cytometry seminars informing the user base of new techniques that may be of use are invaluable - the importance of publicity to a Core Facility cannot be overstated!

INFORMATION RESOURCES

As a core facility we need to be able to access information readily. There are a number of ways in which we can do this:

- Local Cytometry groups
- National and International groups
- Mailing list such as that run by Purdue University
- Library - we should have some reference books
- Cytometry
- Local user groups (advisory or executive)

We need to be able to quickly and efficiently answer users questions or be able to know where to go to ask the relevant people.

LAB BUDGET AND USAGE CHARGES

The concept of charging for machine usage is probably the major difference between North America and Europe, and the authors have different approaches. In the UK, we do not directly charge for use of the service but do monitor usage hours. In the US usage is monitored and administrative staff decide the recharge rates and change them depending on the amount of use to make the facility break even.

There are a number of points that again need to be considered:

- Who decides the level of charge?
- What is charged? Machine usage certainly but what about set up time for sorters? Analysis time? Consultation time with core staff? Sample preparation and post-sort processing time?
- How is usage logged e.g. by computer program (Fileguard, MacLogin etc.) or by written sheets relying on user co-operation.
- What level of expense is incurred by running the Lab?
- Are costs for tubes, media, sheath fluid, dyes and assay kits and development passed on?
- Should the income generated cover the cost of salaries, service contacts, lab supplies?

A core facility should be able to finance its own experiments but there also has to be an agreement as to what degree users experiments are subsidized and should these factors be taken into consideration when calculating charges. We would consider that the aim of the core facility is not to make money but to provide the best service possible. This will depend though on whether there is local pressure to recoup outlay costs (for contracts, consumables, salaries etc.) or whether there is a central tenet that a Core Facility is there to provide a service with the cost being a secondary consideration.

SERVICE CONTRACTS

Many operators and managers feel they need the security of a manufacturers service contract but are they a good thing? They can certainly be viewed as expensive especially if the manager is able to do routine repairs (or know a man who does). The alternatives to service contracts are:

- Splitting the laser contracts from the cytometer (applies mainly to cell sorters).
- Third party service contracts or insurance.
- Have only a Preventative Maintenance agreement and pay for repairs as and when necessary.
- Should we, as a cytometry community, try to establish a basic maintenance training course or workshop for core Laboratory managers or staff?

The decision may well depend on the expertise of the staff and their willingness to adapt and the level of budget available.

FINAL COMMENTS

The management of a core Cytometry Facility has, of course, many common factors with the management of any other facility in whatever field. However we do think that cytometry does present some peculiar challenges, not least because we feel that the level of expertise and skill needed to be either a manager or operator is not sufficiently regarded at the moment. The core manager has to be many things: administrator, politician, financier, scientist, repairman, counselor and so on. The points raised here are not put forward as the solutions but as a guide for discussion - the more input we receive from people in the relevant positions, the better informed can be a collective ideal of what we have the right to demand and expect and what is expected of us. To this end, we have appended a questionnaire to this poster, please take the time to fill one in and return to either of the addresses mentioned.