Increased Productivity of Cytogenetic Technologists Due to Implementation of the ASI's 81 Slide Loader and Metaphase Finder.

Tishome Persaud, CG(ASCP); Pauline Brenholz, MD,FACMG; Rosemarie Schmidt, MS CG(ASCP), DLM; Randi Bambach, CG(ASCP).
Cytogenetics, Esoterix Laboratories, New York, NY.

Abstract

In the current medical environment, productivity coupled with accuracy is paramount in providing good patient care. Automated metaphase finder significantly reduces time to ascertain analyzable metaphases, competing with traditional methods based on microscopic analysis. The 81 Slide Loader and Metaphase Finder (MF) of Applied Spectral Imaging (ASI) can run continuously, providing a gallery of stored digital metaphase images ready for analysis, thereby reducing the amount of time spent by technologists scanning slides for metaphases, and ultimately increasing technologists' productivity. Eleven technologists were subdivided into categories based on number of years of experience: 3 technologists had 1-4 years of experience, 5 had 5-9 years, and 3 had 10+ years of experience. Productivity data, in the form of completed bone marrow/leukemic blood half-cases (10 cells per sample) per day, was averaged for 3 months using conventional microscopic analysis. The MF was then introduced to these technologists and their productivity followed for another 3 months. Technologists with 1-4 years of experience increased their productivity from 3.9 to 6.4 cases/day (62.2%). Those with 5-9 years of experience increased from 4.0 to 5.4 cases/day (33.8%), and technologists with 10+ years of experience increased from 4.8 to 6.4 cases/day (26.7%). An inverse relationship was present between the technologists' number of years of experience and the percentage of productivity increase. This could be in part due to less experienced technologists being slower in analyzing cells using the microscope, compared to more experienced technologists who are at their peak productivity using the microscope. The smaller increase in productivity of more experienced technologists could further be explained by the fact that they analyzed more complex cases, and therefore spend less time looking for metaphases and more time karyotyping and preparing complex cases for supervisor review. The average productivity of all 11 technologists was increased by 39.6%, and therefore the MF clearly contributed to the efficiency of our laboratory. Additionally, the generated gallery of metaphases helped our supervisors to review cases more efficiently, improving their productivity as well.

Introduction

Providing superior patient care requires a strong mixture of accuracy and turnaround time. Modern technology allows cytogenetic laboratories to improve accuracy by increasing resolution, and maximize turnaround time by decreasing sample processing time. As early as 1964, in an effort to increase productivity, the idea of automated karyotyping machines arose.[1] In 2008, Philippa mentions an automated metaphase locating and karyotyping system built by The National Aeronautics and Space Administration (NASA) in 1976.[2] However, in 1991, 27 years after the idea of automated karyotyping arose, Korthof and Carothers studied the clinical effectiveness of commercially available systems and concluded that automated karyotyping remained a highly interactive process that required improvement.[3] The attention then shifted to semi-automated systems and since then there has been a continuous evolution of metaphase finders, improving the resolution of banded chromosomes. We studied the effects of such semi-automation on technologists' productivity by implementing an 81 Slide Loader and Metaphase Finder (MF) into our cytogenetic laboratory.

Methods

Eleven technologists, from our laboratory, with a wide range of experience, participated in this study. Their productivity, in the form of completed bone marrow and leukemic blood half-cases (10 cells per sample) per day, was averaged over three months, employing conventional microscopic analysis. The MF was then implemented in our laboratory. Slides were prepared in the same way as for conventional microscopic analysis. The MF used in our laboratory has nine trays holding nine slides each. It takes approximately 20 minutes to scan each slide (3 hours per tray). Running during the day and overnight, it scans all nine trays (81 slides) in 27 hours. The MF captures a predetermined number of images for each slide and stores the images. The eleven technologists accessed metaphase images from their desktop computers, which are linked to the MF's stored images. Technologists' productivity was re-measured in the following three months using the same criteria as for microscopic analysis.

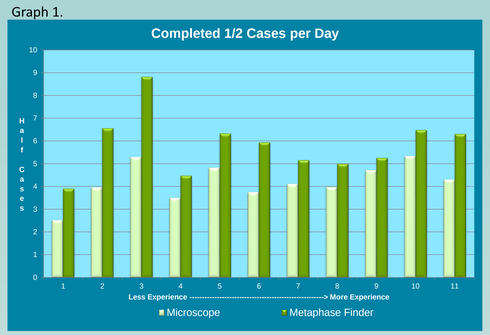
Results

Comparison of Productivity in Our Laboratory Using Microscopic and Metaphase Finder Methods

Technologist	Years of Experience	½ Cases per Day with Traditional Microscope	½ Cases per Day with Metaphase Finder	% Increase per Day
1	2	2.5	3.9	54.5
2	3	3.9	6.6	65.7
3	4	5.2	8.8	66.5
4	5	3.5	4.5	28.0
5	5	4.8	6.3	31.3
6	5	3.8	5.9	58.4
7	7	4.1	5.1	25.5
8	8	3.9	5.0	25.9
9	13	4.7	5.2	11.7
10	13	5.3	6.4	21.6
11	13	4.3	6.3	46.7
Average	7.1	4.2	5.8	39.6

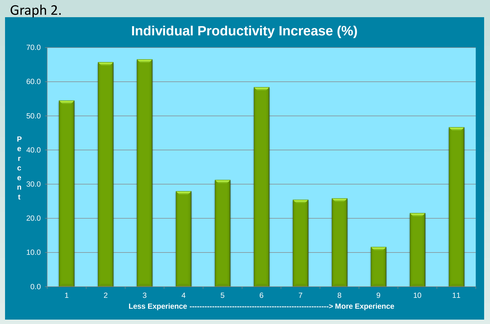
Participation of 11 technologists by increasing experience, daily productivity using microscopic analysis vs the MF, and increased productivity percentage.

Graph 1.



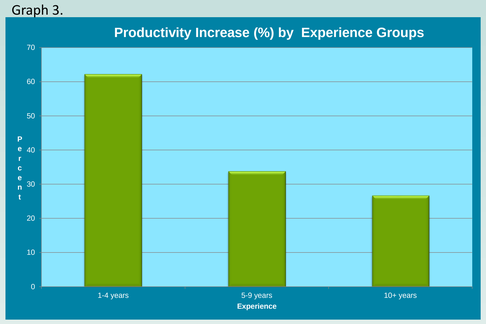
The daily average completed half-cases by individual technologists.

Graph 2.



Percent increase in productivity of the individual technologists.

Graph 3.



Technologists with 1-4 years of experience increased their productivity by 62.2% per day, those with 5-9 years of experience increased by 33.8% per day, and technologists with 10+ years of experience increased by 26.7% per day.

Conclusion

Our data indicates that all our technologists, separated into three groups by experience, significantly increased their productivity when using the MF. Furthermore, all of the eleven technologists individually increased their productivity, leading to an overall productivity increase (39.6%) in our laboratory. An inverse relationship exists whereby technologists with lesser experience have a greater increase in productivity, and vice versa. Since more experienced technologists spend less time searching for metaphases, their productivity was increased by a smaller percentage when the MF eliminated this part of the analysis. In addition, more experienced technologists analyze more complex cases, and therefore spend less time looking for metaphases and more time preparing complex karyotypes for supervisor review. The gallery of images generated by the MF also helped our supervisors and directors to review cases more efficiently, improving their productivity as well. The stored digital images can be annotated and shared among users on a network, offering greater flexibility in utilization of the metaphase images for diagnosis. Furthermore, these images can be enlarged and enhanced by adjusting features such as zoom, contrast, and sharpness, allowing for more accurate analysis. In conclusion, the use of automated MFs in laboratories increases productivity, efficiency, and accuracy, giving the laboratory a potential competitive edge in precision, demand for speedy results, and turnaround time.

References

1) Ledley RS. High Speed Automatic Analysis of Biomedical Pictures. Science. 1964, 146:216-223.

2) Phillipa CM, Caroline MO, Zoe D. An Evaluation of the Effectiveness of a Semi-automatic Metaphase Locating and On-screen Karyotyping System. The Journal of the Association of Genetic Technologists. 2008, 34(4):177-187.

3) Korthof G, Carothers AD. Tests of Performance of Four Semi-automatic Metaphase-finding and Karyotyping Systems. Clinical Genetics. 1991, 40(6):441-451.