Cardiothoracic surgery training in Israel: A critical look at the past, aiming for a better future

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ABSTRACT

Training the next generation of cardiothoracic surgeons is a global persistent challenge. Major issues, including length of training, decreasing volume of cases, shift toward high-risk, complex, and less-invasive procedures, increased specialization, and uncertainty with regard to future employment, are relevant and affect residency training programs in the United States, Europe, and other parts of the world. To produce high-quality, mature, and qualified surgeons, these challenges mandate an ongoing effort by our specialty leadership aimed at identifying creative solutions and adapting the current residency training curricula and methodology to the dynamic changes in our field. The current situation in Israel is discussed with the hope that sharing our experience might be useful and lead to adoption of some of our solutions by other countries. (*J Thorac Cardiovasc Surg* 2016;151:1508-15)

Changes in volume of CABG and valve operations, census, and population aged more than 65 years in Israel.

Central Message

We describe the measures implemented in Israel on multiple levels to maintain high-quality cardiothoracic surgery training.

Perspective

Training the next generation of cardiothoracic surgeons is a global challenge. The cardiothoracic surgery training program's structure, challenges, and threats in Israel are described. Ongoing initiatives are discussed with the hope that sharing our experience might be useful and lead to adoption of some of our solutions by other countries.

See Editorial Commentary page 1516.

The academic title Doctor originates from the Latin word “docere,” which means to teach.¹ Thus, the title Doctor of Medicine (MD) carries a dual responsibility—to provide our patients with the best of medical care and to ensure that the knowledge and expertise acquired over time in our field are transferred to the next generation of

physicians. For generations, surgical training was based on an apprenticeship model originating in Europe. The transition from this type of training that is undefined in time and structure to a structured systematic process is one of the most important contributions of the renowned surgeon William S. Halsted of Johns Hopkins.² John Alexander adopted many of Halsted's concepts and established the first formal thoracic surgery training program in the United States.³ Since that time, cardiothoracic surgery programs in the United States, Europe, and around the

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Abbreviations and Acronyms
CABG = coronary artery bypass grafting
MD = Doctor of Medicine

world have only a single common feature—they are all structured. However, the curricula vary substantially among different countries with respect to the society’s and learners’ needs, learning objectives, instructional methods (including availability and quality of lectures, clinical materials cases, case complexity, and simulation), and length of training and assessment (including and formative and summative, eg, board certification and assessment of the training program itself). Yet, training cardiothoracic surgeons has become increasingly complex and faces unique global challenges. These challenges include escalating institutional cost; declining faculty interest; expertise and dedication to education; trainees’ concerns with respect to length of training; decreasing volume of cases; shift toward high-risk, complex, and less-invasive procedures; increased specialization; and

uncertainty with regard to competence, readiness to practice, and future employment.⁴⁻⁶

Although cardiac surgery has been practiced in Israel since the late 1950s, recording of case mix and volume on a national level began only in 2008 by the Israeli Center for Disease Control, a body within the Israeli Ministry of Health. Since 2008, there has been a steady and significant decline in cardiac surgery case volume in Israel (Figure 1). For example, the absolute number of coronary artery bypass grafting (CABG) procedures decreased by 22% between 2008 and 2013 (Figure 1, A). The absolute number of valve procedures (with or without concomitant CABG) has remained relatively stable (Figure 1, A). During this time period, the Israeli population increased by 9.7% from 7.41 to 8.13 million (Figure 1, B). Thus, when measured by heart surgery procedures per million, the decline is even more pronounced, despite aging of the Israeli population (Figure 1, C). The reasons behind this substantial decline are multifactorial and beyond the scope of this article. The end result is that the clinical exposure available to cardiothoracic residents is more limited, and even more so, the number of procedures that

FIGURE 1. Changes in volume of CABG and valve operations (A), census (B), and population aged more than 65 years of age (C) in Israel between 2008 and 2013. Data from the Israeli Central Bureau of Statistics (<http://www.cbs.gov.il>) and the Israeli Center of Disease Control (<http://www.health.gov.il>).

are available and suitable for teaching is substantially declining over time.

The surgical experience of residents also is adversely affected by the changing case mix. As in other parts of the world, patients who are referred for cardiac and thoracic surgical procedures are older and sicker and have advanced-stage structural diseases. The adoption of new technologies; less-invasive procedures, such as off-pump CABG, minimally invasive, percutaneous, and robotic valve operations, and video-assisted thoracic operations; and a shift toward more technically demanding operations, such as multiple arterial grafting and valve repair (as opposed to replacement), have been rapid and widespread in Israel compared with other parts of the world. For example, the ratio of the number of percutaneous coronary interventions to CABG procedures in 2013 was 8.6:1, the highest in the world.⁷ Thus, assisting a resident in such complex, technically demanding cases without compromising patient safety has become a major challenge.

CURRENT STATUS OF CARDIOTHORACIC SURGERY TRAINING IN ISRAEL

Number and Type of Programs

Cardiothoracic surgical procedures are performed at 13 medical centers in Israel, 2 which are satellite programs. Nine medical centers are public, 2 are private, and 2 are mixed—a unique entity that provides patients with the option to undergo operation in different settings. In 4 centers, the departments of cardiac and thoracic surgery are separate entities. In the other 9 centers, there is 1 cardiothoracic surgery department. Congenital heart surgery and heart and lung transplants are performed in 5, 3, and 2 medical centers, respectively. There are 9 cardiothoracic surgery residency training programs within the public or mixed-type institutions only. The heterogeneous nature of the institutions, departmental structure, and types of surgery performed in each institution is a major challenge with respect to providing residents with exposure to the full spectrum of diseases of the chest and cardiothoracic surgical procedures. In many instances, complete training can be accomplished only by rotating to a different institution.

Resident Recruitment Process

Residents are enrolled in the programs after graduating from a 6-year medical school and 1 year of rotating internship, the requirements for an MD diploma. The structure of the rotating internship is uniform; includes mandatory rotations in Internal Medicine, General Surgery, Pediatrics, Trauma, Intensive Care, and electives; and is independent of the trainee's interest in pursuing a career in internal medicine, surgery, or any subspecialty. Residents

accepted to Cardiothoracic Surgery training or any other training program do not get credit for the time spent in the surgical rotations during the internship. There is no central body, on a national level, that regulates the number of residents recruited each year. Potential residents apply directly to the Department Heads, who evaluate the applicants and, in most cases, have the final say. It is up to the discretion of the Department Head to decide whether applicants will be interviewed by other faculty members within the department. Israeli citizens who graduate from medical school abroad are required to complete a 1-year rotating internship in Israel, pass a national-qualifying examination to receive the MD degree, and enroll in the residency training program; subsequently, they are eligible for the Israeli Board Certificate. Foreign medical graduates who are not Israeli citizens may join the cardiothoracic surgery programs if issued a temporary license to practice medicine in Israel, but they will not be eligible for Board Certification.

Lack of national regulation and recruitment of residents for service rather than educational purposes have resulted in an excess number of graduates. At present, there are 46 cardiothoracic surgery residents in Israel. Currently, there are 66 active cardiothoracic surgeons in Israel (adult cardiac, 47; general thoracic, 13; congenital heart surgery, 6). This per capita rate of 8.1 surgeons per million is lower than in North America (United States, 14.0; Canada, 10.0), similar to that of France (8.4) and higher than in the United Kingdom (6.3).⁸⁻¹¹

Accreditation of cardiothoracic surgery training program.

The initial and subsequent accreditation of residency training programs are within the jurisdiction of the National Scientific Council of the Israel Medical Association. The Scientific Council has been authorized by the Ministry of Health to periodically evaluate and authorize the structure, outline, and curriculum of each specialty training program, based on which a set of criteria for approval and maintenance of accreditation are defined. Institutional accreditation is granted after in-depth evaluation of the program by an ad hoc Residency Review Committee assembled by the Scientific Council. The committee evaluates many factors, including infrastructure, quality of faculty, case volume and mix, departmental work flow, interdisciplinary conference schedule, and the time and resources specifically allocated for residents' education. Approval is granted for 5 years. At these time intervals, programs are reevaluated by the Residency Review Committee to ensure compliance with the entire set of requirements. Follow-up visits include confidential interviews with residents.

Structure of Residency Training Program

Cardiothoracic surgery training in Israel is based on 3 integrated residency tracks: cardiac, thoracic, and

TABLE 1. Curriculum of cardiothoracic surgery training program tracks in Israel

	Cardiac track	Thoracic track	Cardiothoracic track
Total length of training	6 y	6 y	7.25 y
CT surgery	4 y*	4 y†	5 y
General surgery†	1 y	1 y	1 y
Anesthesia/critical care	3 mo	3 mo	3 mo
Cardiology	3 mo	Not required	3 mo
Pulmonary medicine	Not required	3 mo	3 mo
Basic science research	6 mo	6 mo	6 mo

CT, Cardiothoracic. *In centers where there are separate departments for cardiac and thoracic surgery, residents are required to spend 3 years in cardiac surgery and 1 year in thoracic surgery. †An alternative option to 1 year in general surgery is 9 months in general surgery and 3 months in vascular surgery. ‡In centers where there are separate departments for cardiac and thoracic surgery, residents are required to spend 3 years in thoracic surgery and 1 year in cardiac surgery.

cardiothoracic. The length of training ranges from 6 to 7.25 years. The curriculum and case log requirement for each track are depicted in Tables 1 and 2. The 1-year rotation is, at present, a mandatory requirement for Board Certification. However, there is no mandate to log the general surgery cases.

Responsibilities of the Trainee

Once accepted into a training program, the resident must register in the Scientific Council and is issued a training curriculum log book. It is the joint responsibility of the Department Head and the trainee to ensure that the training progresses according to schedule and document it in the log book. It is mandatory that the trainee will spend the first year of the residency in the primary department. Starting at the very beginning of training, residents are actively engaged in all aspects of patient care, in and out of the operating room. The level of responsibility and case complexity are commensurate with the stage of training, but always under faculty supervision.

The number of weekly work hours is set at 41.5 with no formal maximum duty hour restriction. The residents are

TABLE 2. Case log requirements

	Cardiac track	Thoracic track	Cardiothoracic track
CABG operation	40	Not required	40
Valve operation*	10 + 5	Not required	10 + 5
Congenital heart operation†	10	Not required	10
Any cardiac operation‡		20	
Any pulmonary resection	15	60	60
Anatomic		30	30
Nonanatomic		30	30
Esophageal operation†	Not required	5	5
Pulmonary diagnostic procedure	Not required	20	20

CABG, Coronary artery bypass grafting. *Performance of 10 and participation in an additional 5. †Participation only.

required to take a minimum of 4 and a maximum of 6 in-house calls per month. They must be off-service and leave the hospital by 10:00 AM after the call. A resident who takes a call on a Friday (the first weekend day) is entitled to receive a fully compensated free day during the following week. A continuous full (2-day) weekend call is prohibited.

In addition to clinical responsibilities, residents are required to participate in weekly educational conferences, including journal clubs, seminars, guest lectures, and morbidity and mortality conferences. The type, content, frequency, and quality of these conferences are completely up to the individual programs. There is no national organized curriculum.

Assessment of Trainees

The trainees are assessed locally by periodical faculty evaluations using uniform evaluation forms designed by the Scientific Council. The evaluation forms are submitted to the institutional Graduate Medical Education Supervisor. At present, there is no national-level in-training annual examination or an alternative evaluation tool, such as simulation sessions, to assess competency.

Board Examinations

There are 2 Board examinations: written and oral. The written examination is taken in the midst of training and has 2 components: general surgery and cardiothoracic surgery. The general surgery component of the cardiothoracic surgery residents is the same as that of general surgery residents. The 2 components of the examination are constructed by the Examination Committees of the Israel Society of General Surgery and the Israel Society of Cardiothoracic Surgery, respectively. The examinations consist of multiple choice questions covering relevant basic-science, theoretic, and clinical topics. The trainee must pass both components. The number of annual written Boards examinees ranges from 1 to 6, with an average success rate in the general surgery and thoracic surgery components of 92% (80%-100%) and 72% (50%-100%), respectively.

The trainee is eligible to take the oral Boards during the last year of training and thereafter. The oral Board Examinations are held twice a year in a neutral location. The structure of the oral Examination consists of a 1-hour evaluation of the trainee by 3 subcommittees. The assigned committee faculty members and the content of examination are adjusted to the training track of examinee. The examination consists of clinical case presentations, followed by in-depth discussion on topics related to the main theme of the case. Assessment of the examinee clinical skills by simulation or other methodology is not performed. All examinees are asked identical questions by each subcommittee. To ensure security, the questions

change each exam session. The number of annual oral Boards examinees ranges from 1 to 6, with an average success rate of 74% (50%-100%). A trainee who failed the oral Boards for the first time is eligible for a second attempt within 6 months. After 2 consecutive failures, there must be a minimum of a 1-year interval up to the next examination. During the 1-year interval, the individual must return to his/her training program and is not allowed to practice cardiothoracic surgery independently.

A trainee can take the written and oral Board examination up to 4 years beyond the final date of his/her residency as documented in the Residency Log Book. An exception may be granted only in unusual circumstances and must be approved by the Department Head, the Institutional Graduate Medical Education supervisor, and the Chair of the Scientific Council Board Examination Committee.

Board Certification

The principal components required for Board Certification include the following: (1) completion of the training program curriculum for the specific track; (2) performance of the required case volume and mix; (3) passing the written and oral Board Examinations; (4) final sign-off by the Department Head; and (5) approval by the Scientific Council. The Board Certification in Cardiothoracic Surgery is issued by the Ministry of Health. Most trained surgeons seek an additional 1 to 3 years of advanced clinical training abroad in subspecialties, such as heart failure and transplants, aortic surgery, and pediatric cardiac surgery. It is only at this stage of their career that surgeons practice independently.

CHALLENGES AND OPPORTUNITIES TO IMPROVE

Ongoing challenges with regard to training the next generation of cardiothoracic surgeons in Israel can be categorized into 3 levels: national, individual training program, and trainee.

National Level

Regulation of the number of trainees. Lack of national regulation of the number of residents enrolled in cardiothoracic surgery training programs creates a serious problem of excess of surgeons in a small country. Objective assessment of cardiothoracic surgery workforce needs on the basis of a population-adjusted cardiac and thoracic surgical volume of procedures should be performed by the Israeli Centers for Disease Control. These estimates then can serve as guidelines to the Scientific Council to regulate the number of residents recruited annually. A parallel national-level, closely related initiative is to integrate into our clinical system midlevel caregivers, such as physician assistants and nurse practitioners. Delegation of clinical responsibilities to midlevel practitioners will allow

allocation of a larger proportion of the residents' time to education rather than service, without compromising patient care.

Performance assessment. At present, assessment of individual trainee performance and progress is delegated to training programs. In a country with an integrated surgical residency type of training, this results in a relatively high attrition rate because of inadequate training, suboptimal resident skills and performance, or loss of interest in the field.¹² Many residents (estimated up to 30%) drop out after spending 2 to 3 years in training, a substantial waste of their time. Annual assessment of performance by the Scientific Council using in-training examinations and questionnaires may provide useful objective metrics to assess individual trainee performance, satisfaction, and interest in the field. It would be an effective tool to advise the trainee as to what is best for his/her future early on and prevent program directors from keeping borderline residents for service purposes, rather than true commitment for education.

National-level training workshops. To cope with increasing demands and time constraints of both faculty and residents, as well as the escalating cost, the Israeli Society of Cardiothoracic Surgery initiated a series of industry-supported, national-level training workshops starting 4 years ago. To ensure maximal resident participation, these 1- or 2- day workshops take place during the weekends with no fee and an ultimate Department Heads commitment to provide alternative coverage of the clinical service. Each workshop covers specific topics in adult cardiac surgery, pediatric cardiac surgery, and general thoracic surgery. The faculty of each workshop is assembled by the Israel Society of Cardiothoracic Surgery, and participation is on a voluntary basis. The curriculum of each workshop includes background lectures, such as surgical anatomy and physiology, current practice guidelines, technical aspects of operative procedures, and management of intraoperative and postoperative complications. In many of the workshops, "hands-on" wet laboratories are included. These simulation tools range from simple artificial models of coronary anastomoses and valve repair, use of animal heart specimens, use of simulators to enhance catheter and interventional radiologic skills, to advanced methods such as performing off-pump CABG procedures in live animals. Participation of residents has been satisfactory, and residents' feedback assessed by questionnaires at the end of each workshop was enthusiastic. Unfortunately, the impact of these workshops on rates of success in Board Examinations or other measures of quality of training has not been assessed to date.

Program Level

Faculty. Maintaining high-quality cardiothoracic training on a program level is threatened by a loss of faculty

TABLE 3. Revised cardiothoracic surgery residency training program in Israel

A. Modular integrated 5-track cardiothoracic surgery training program				
Common basic training module				
4 y				
Adult cardiac surgery, 33 mo				
Pediatric cardiac surgery, 3 mo				
General thoracic surgery, 3 mo				
Cardiology, 3 mo				
Basic science research, 6 mo				
Written board examination				
Advanced training module				
2 y				
5 subspecialty tracks				
Adult cardiac	Hybrid	Pediatric cardiac	General thoracic	Intensive care
Adult cardiac surgery	Interventional cardiology, 12 mo	Pediatric cardiac surgery, 18 mo	Thoracic surgery, 21 mo	Adult general surgical
2 y	Interventional radiology, 3 mo	Pediatric cardiology, 4 mo	Pulmonary medicine, 3 mo	intensive care, 18 mo
	Vascular surgery, 3 mo	Pediatric ICU, 2 mo		Cardiac surgery
	Adult cardiac surgery, 6 mo			intensive care, 6 mo
Oral boards examination tailored to the specific subspecialty				
B. Separate general thoracic surgery track				
Adult cardiothoracic surgery, 42 mo*				
General surgery, 12 mo†				
Pulmonary medicine, 3 mo				
Adult general surgery intensive care, 3 mo				
Basic science research, 6 mo				

ICU, Intensive care unit. *Four years in programs where the cardiac and thoracic surgery service are within 1 department. In hospital with separate services, 3 years in general thoracic surgery and 1 year in cardiac surgery. †An alternative is general surgery (9 months) and vascular surgery (3 months).

genuine interest and commitment to education. This phenomenon is not unique to Israel and is secondary to multiple factors, including a strong emphasis on the practitioner short-term patient outcomes and clinical performance, giving teaching skills and commitment a relatively low weight in faculty academic promotion and lack of financial reimbursement for time and effort dedicated to education.⁵ Opportunities to improve include creating academic tracks, recognizing excellence and outstanding commitment to student and resident education, and reimbursing faculty for educational activities. A step in that direction has been initiated by the Hadasah Hebrew University Medical School, which has created a “clinical” academic track. In this track, faculty clinical and educational skills, commitment, and achievements are weighted heavily compared with the traditional “full” tracks, in which the emphasis is on basic science research, grant support, and peer-reviewed publications.

Changing case mix and complexity. Adjustment of training programs to decreasing case volume and increasing case complexity without compromising efficiency and patient safety is another major challenge. Simulation has become an effective tool to resolve some of these

conflicts.¹³ However, the cost of routine use of simulators on an individual program level might be prohibitive. The workshop initiative taken by the Israeli Society of Cardiothoracic Surgery is a step in the right direction. However, it must be standardized with respect to content, resident and faculty participation, and evaluation of resident and faculty performance to ensure a relevant, high-quality educational experience. Long-term funding of such activities remains a major challenge.

Rotations. Ensuring adequate training of cardiothoracic surgery residents during their rotations in other departments is a major challenge, given even less faculty enthusiasm in training noncategorical residents and the decreasing number of cases available for resident teaching. This problem is particularly pertinent in the 1-year long rotation in general surgery.

Trainee Level

Recruitment. As in other countries,^{4-6,11,12} attracting the “best and the brightest” to our specialty has become a major challenge in Israel. Many factors deter potential candidates from pursuing careers in cardiothoracic surgery. These include the length of training, concerns with regard to job opportunities given the decreasing

TABLE 4. Summary of revisions to the Cardiothoracic Surgery Training Program in Israel

Current structure	The problems	Suggested solutions
Recruitment directly after medical school to a mandatory 6-7 1/4-y program	Inability to adequately assess trainee skills Trainee immaturity Trainee uncertainty regarding final personal goal	Short basic module allowing thorough skills assessment Offer career path change within the program Minimize dropouts
Mandatory 1-y general surgery rotation	Inadequate training experience due to lack of interest in training noncategorical residents and decreased case volume adequate for training	Elimination of this requirement
3 tracks: Cardiac, General Thoracic, and Cardiothoracic	Limited ultimate career options Mandatory fellowships in subspecialties Lack of cardiothoracic nonsurgical ICU track Long training process Insufficient exposure to new procedures Limited experience with new required skills Lack of national-level structured advanced training opportunities Inadequate case log requirement	Addition of 2-y, 5-track advanced training modules offering focused training and Board Certification in Adult Cardiac, Pediatric Cardiac, Hybrid, General Thoracic, and Intensive Care subspecialties Integrate track-specific simulator sessions in the advanced training module Increase the number of procedures required for Board Certification Adjust case mix required for Board Certification to fit the 5 subspecialties

ICU, Intensive care unit.

volume of cases and excessive number of surgeons, career-long intense commitment to the specialty leaving little time to anything else in life, uncertainty about the future of our specialty coupled with the perception that interventional cardiology and radiology will eventually replace cardiac and thoracic surgery, decreasing reimbursement, and declining prestige. There are no magic solutions to this problem. An effective method is to afford medical students with a wider exposure to our specialty in the early years of medical school. This can be achieved by having cardiothoracic surgery faculty participate in medical school courses, mentor students in MD theses or other research activities, and integrate more senior students in the clinical service at a “sub-intern” level.

Retention. The major difficulties in recruiting residents underscore the importance of retaining those who have shown interest and were deemed adequate, and at the same time identify those who are not going to be successful as early as possible. An inherent weakness of an integrated cardiothoracic surgery training program is that trainees are enrolled at a very early stage in their professional career.^{4,12} Thus, many recruits are young, immature, and not yet ready for a lifelong commitment to a very demanding profession. In addition, their base knowledge is narrow, and it is virtually impossible to precisely assess their manual skills, decision-making capabilities, and the ability to handle complex, high-stress situations. Effective and practical methods to assess these qualities at an early stage of training are lacking. The most effective method to retain residents is to provide them with highest-quality training by skilled and dedicated faculty.¹⁴

INITIATIVE TO REVISE THE CARDIOTHORACIC SURGERY TRAINING PROGRAM STRUCTURE

In an effort to respond to the challenges described and adapt to the dynamic changes in our specialty, the Israel Society of Cardiothoracic Surgery has worked jointly with other Professional Societies and the Scientific Council to radically revise cardiothoracic surgery training in Israel. The proposed new modular structure is described in Table 3A. After intense discussions and revisions, the proposed outline was approved by the Professional Societies involved and the Scientific Council, and presently is in its final stage of approval by the Ministry of Health. The components of the newly designed program include a common 4-year period module of basic training, including exposure to adult cardiac, pediatric cardiac, and thoracic surgery; elimination of the 1-year rotation in general surgery; and advanced training 2-year modules providing the trainee with the option to specialize and receive Board Certification in 5 different fields of interest. The initial 4 years of basic training within our specialty and elimination of the rotation in general surgery put a lot of responsibility on our faculty, who must acquire the skills to teach trainees the basic principles of surgery. However, in this respect, cardiothoracic surgery is following in the footsteps of many other surgical subspecialties, particularly given the limited value of the general surgery rotation to rotating cardiothoracic surgery residents. The multiple career options available are an extremely attractive feature of this revised integrated modular program. An additional, totally separate general thoracic surgery track that is similar to the current program remains an available option

(Table 3B). Adjustment of the case mix and volume to be in line with the changing practice is an integral part of the revised program. For example, in the Adult Cardiac Surgery track, the number of index cardiac cases required almost quadrupled from 55 to 190 (Table 2) and includes valve repair and aortic operations. The required index case mix includes moderate complexity (Society of Thoracic Surgeons level II-III) cases in the Pediatric Surgery track and transcatheter aortic valve implantation and percutaneous coronary interventions in the hybrid track. Table 4 summarizes the proposed revisions to the training programs in Israel and their impact on residents' education.

CONCLUSIONS

Educating the next generation of cardiothoracic surgeons in Israel, similar to many other countries, has become increasingly complex given the dynamic nature of our society and healthcare system, and the unique features of our specialty. A tremendous continuous effort is required to respond to the challenges and maintain high-quality training programs. However, we believe that the measures already implemented on national, program, and trainee levels, including a radical revision of the training program structure, are all steps in the right direction.

Conflict of Interest Statement

Authors have nothing to disclose with regard to commercial support.

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