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EDITORIAL

Young oncologists' perspective on the role and future of the clinician-scientist in oncology

INTRODUCTION

The clinician-scientist, or more commonly known as physician-scientist in North America, covers a wide spectrum of roles, but is essentially an individual who holds a medical degree and usually a postgraduate scientific qualification (e.g. MS/MSc/MRes and PhD) and is primarily dedicated to pursuing their academic research interests, which can range from basic science to more translational or clinical research. Clinician-scientists are important players within the contemporary multidisciplinary and interprofessional team-science approach to cancer research and cancer care. Clinical experience alongside rigorous training in research and scientific methodologies provides a strong foundation for clinician-scientists to conduct and lead research advancing the way we understand and treat patients with cancer.

Despite efforts in the past decades, there continues to be significant attrition in the overall clinician-scientist workforce globally.[1] In the United States, where there is the highest proportion of clinician-scientists and widest recognition of their role in the health care system, and therefore significantly more literature available on this subject, there are persistent reports of clinician-scientists becoming 'endangered species', with further reduction in numbers threatened by impending retirement.[2-4] Similar concerns regarding a pattern of steady decline in the clinician-scientist workforce have also been raised in other nations where there is formal recognition of the role of the clinician-scientist as a career pathway, such as Singapore, Australia, Canada, the United Kingdom and several other European countries.[1]

The reasons for the failure to engage, train and retain clinician-scientists are likely to be multifactorial, but have been frequently attributed to the lack of specific training opportunities in most countries, perceived lack of stability in the clinician-scientist career pathway and/or other more attractive alternative career options, recurrent challenges in obtaining research grants or funding and other competing responsibilities either personally or professionally.[2,5] In addition, it is also not uncommon for MD PhDs or established and successful clinician-scientists to be offered administration and leadership positions, with potentially better financial benefits, including transition to industry.[6,7] To retain clinician-scientists as an integral part of the workforce in oncology, it is of urgent priority to identify these challenges and provide robust support and incentives for aspiring clinician-scientists to pursue a career in academic research in oncology.

More recently, the coronavirus disease 2019 (COVID-19) pandemic has shed light on the critical need for rapid translation of scientific discoveries into clinical application, particularly through some exemplary work in public health strategies, clinical trials and vaccines. Nevertheless, COVID-19 has also threatened ongoing and future academic cancer research. The Cancer Research UK, the world's largest cancer charity, estimated that COVID-19 has resulted in at least a 25% reduction in their overall income, and in the United Kingdom, there was a shortfall in the total contribution of the medical research charity sector in 2020-2021 by £252 million.[8] In a global survey conducted by the American Association for Cancer Research (AACR) in January 2022 on its grant recipients across North America, Europe and Asia (awarded within the past 5 years), 99% of respondents reported the detrimental impact of the COVID-19 pandemic on research, academic career development and/or patient care.[9] This crisis period thus poignantly shows the need to reinvigorate the investment in science and research, and the support of the current and future clinician-scientists, especially in oncology where there remains ample scope to further improve the quantity and quality of life of patients.

In this position paper, we provide further impetus for change from the perspectives of young oncologists pursuing a clinician-scientist ambition, represented by members of the European Society for Medical Oncology (ESMO) Young Oncologists Committee, highlighting challenges faced and opportunities in this significant inflexion point.

THE NEED FOR CLINICIAN-SCIENTISTS IN ONCOLOGY

In recent years, the field of oncology has been dramatically transformed by the advent of novel therapies, such as targeted therapies, immune checkpoint inhibitors and advanced cellular therapies, which have revolutionised the management and significantly improved survival of patients in several subtypes of cancer. In parallel, there have also been unprecedented advances in technology platforms including next-generation sequencing and novel circulating biomarkers, which have now become readily accessible. Big data and artificial intelligence continue to evolve rapidly and will play a major role in shaping cancer research and clinical applications.

With these recent advances and the wealth of data available, this is an exciting era to pursue a career in

academic research. The next-generation clinician-scientists are technologically primed with opportunities to make cancer a more treatable disease, and are in a position to delve further into remaining gaps in the understanding of malignant disease to then advance the field of oncology even further.[10] Hence, there is an urgent need to maintain and grow the clinician-scientist workforce to sustain the demands placed by the avalanche of research data coupled with the repertoire of therapeutic agents in both early- and late-stage clinical trials. The validation of the utility of translational technology platforms and biomarkers needs constant back and forth between the bedside and bench. In addition, important work with precious patient samples,[11] which have been pivotal in our understanding of tumour evolution and trajectory, has led to fruition by clinician-scientists who are fluent in the languages of science and medicine.

Many more pressing clinical questions remain unanswered, especially why some patients with cancer continue to face resistance to innovative therapeutic interventions while others benefit. We still struggle to understand the susceptibility of certain individuals to cancer, and the interpatient, intertumoural and intratumoural heterogeneity. With more novel therapies improving survival outcomes, research into long-term toxicities and survivorship has also become increasingly critical. As clinician-scientists are positioned between the vast amounts of data from the laboratory and patient bedside, artificial intelligence-guided technologies could also be developed and deployed to help address these challenges. Taken together, tackling these fundamental questions may result in meaningful improvement in outcomes for patients with cancer, and can only become reality with real investment in a new generation of clinician-scientists and academic oncologists.

THE CURRENT STATE OF THE CLINICIAN-SCIENTIST WORKFORCE IN ONCOLOGY

The clinician-scientist workforce currently only constitutes a very small fraction of the oncology community. While clinician-scientists make up slightly >1% (~9000 in total) of the overall clinical workforce in the United States [total population size ~337 million (Worldometer)],[12] many other countries have much less. In a recent comprehensive survey that longitudinally tracked trainees' career trajectory on the dedicated integrated clinician-scientist training pathway in the United Kingdom [total population size ~69 million (Worldometer)], where clinicians opt to take protected time out of clinical duties for scientific research, it appears that only ~10 individuals per year nationally eventually become successful in obtaining independent grants or continue to advance their career as clinician-scientists in oncology.[13]

In most countries around the world, one of the biggest setbacks is that the formal definition and recognition of the role of clinician-scientists in hospitals, institutes and/or universities remain much to be desired.[1] It is still not uncommon for clinician-scientists to be questioned whether they are 'real doctors' or 'true basic scientists',[14] and these preconceptions can be discouraging especially for young aspiring researchers.

Table 1. Factors which may be resulting in attrition in the clinician-scientist workforce

Personal	▪ Inadequate financial incentives ▪ Other competing responsibilities requiring job stability, such as caring roles (e.g. child care, single parenting, dependents)
Professional	▪ Overwhelming clinical demands ▪ Administrative burden ▪ Burnout ▪ Prolonged period of training before achieving independence compared with peers ▪ Concerned about 'losing clinical skills' by risking too much time away from seeing patients ▪ Perception of unstable career pathway (e.g. lack of security of a permanent clinical position) ▪ Difficulties in securing grants for ongoing/further research ▪ More attractive opportunities (e.g. leadership positions in health care, industry)
Institutional	▪ Lack of ancillary support (e.g. infrastructure, administrative/technical) ▪ Lack of or insufficient mentorship ▪ Lack of necessary collaborations or technology platforms to deliver pipeline of work ▪ Funding issues
National/ International	▪ National shortage of doctors/oncologists to provide clinical care ▪ No formal recognition of the role of the clinician-scientist ▪ Lack of investment in science and/or research ▪ Lack of formal training for this career path

FACTORS LEADING TO ATTRITION IN THE CLINICIAN-SCIENTIST WORKFORCE

There are many potential factors that may lead to the attrition of the clinician-scientist workforce (Table 1). Most commonly reported of all is the overwhelming clinical demands placed on cancer services in almost all countries, especially with the rising incidence of cancer diagnoses and improved survival resulting in overall more patients to care for. This inadvertently places a strain on providing funding for cancer care in general. Many countries have not been able to rapidly adapt to the growing demand on service provision and the majority still have an insufficient number of oncologists to provide equitable care for all patients with cancer.[15] As a result, it is unsurprising that training and supporting clinically orientated physicians have been prioritised around the globe.

For many young oncologists, there have been concerns about the stability of the career trajectory of a clinician-scientist, especially when one is starting out on their training. Often, enthusiastic trainees take the initiative to navigate through some dedicated research experience either within an integrated postgraduate PhD or post-specialisation fellowship. Although this is often supported, there will be worries that protracted time out of clinical practice may result in them being deskilled and risk becoming less favourable candidates if they in turn choose to pursue a more clinically orientated career in the future. Moreover, such deviation from the 'normal pathway' can prolong training significantly, which may have implications

on competing responsibilities. This is not helped by the fact that clinician-scientists may be less renumerated than fellow colleagues in more clinical positions or private work in some countries.

One of the strongest discouragements for an early career clinician-scientist is the highly competitive (with extremely high failure rate) and tedious nature of the application for research grants. Many countries do not yet readily fund research centrally, and one may have to apply to several national or international charities or foundations to obtain funds for research. While improvements to streamline procedures have been made in recent times, these processes are at best of times convoluted and come with prolonged periods of uncertainty. In most academic research systems, even when funding is successfully attained, the financial security may only be temporary with grants often lasting for 12 months to a maximum of 4-5 years at a time. Moreover, even at a senior level, many can run into the insecurity and fear of facing risks that ongoing or future research may not be able to proceed without sufficient funding, not least with labile economic uncertainties faced by funders. Thus without long-term systemic vision, there potentially is another critical bottleneck in the career of an aspiring mid-career clinician-scientist.

Conducting robust scientific research inevitably requires a strong multidisciplinary and interprofessional team with the support of adequate research infrastructure. As such, clinician-scientists who are hosted in large and well-funded academic institutions tend to be at an advantage to progress in their career. By contrast, those working in smaller or less well-resourced places may have unequal attainment at the same stage and may have their ambition extinguished prematurely.

UNDERREPRESENTED MINORITY CLINICIAN-SCIENTISTS

The clinician-scientist workforce particularly suffers from a gender gap and the lack of representation from minority ethnic groups. Available large national reports with data from established programmes in the United States and the United Kingdom have revealed that traditionally, those pursuing the clinician-scientist career pathway tend to be disproportionately male and of white ethnicity.[12,13] The underlying reasons for the lack of a diverse clinician-scientist workforce in most nations remain unclear and likely to be complex and multifactorial. There may be a lack of visible representation at the top of the field and therefore potential mentorship, perceived bias and discrimination or stereotyping, and potentially socioeconomic factors discouraging current underrepresented minorities from pursuing MD PhD programmes.[16-18]

Several initiatives and campaigns have been started in recent years, including popular social media campaigns (e.g. #BlackinScience and #WomeninSTEM on Twitter), to widen participation and encourage inclusion and representation. Indicative actions by influential major research funders are also critical, for example in the United Kingdom, the Wellcome Trust has recently launched the 'Reimagine Research Culture' campaign, and Cancer Research UK held its first national Black in Cancer Conference (@BlackinCancer on Twitter). The National Academies of Sciences, Engineering and Medicine (NASEM) in the United States has created an *ad hoc* committee that aims to produce a consensus report regarding the improvement of representation of women and underrepresented minorities in clinical trials and research. Tackling the challenges in cancer and health care in general requires a huge collaborative effort and engagement from a diverse workforce. Initiatives to provide opportunities specifically for those from underrepresented or minority community should be lauded.

CHALLENGES AND OPPORTUNITIES IN LOW- AND MIDDLE-INCOME COUNTRIES

In addition to all issues above, there are also unique challenges faced by colleagues working in low- and middle-income countries (LMICs). For many, the key priority is to deliver the best possible clinical care for patients, in often an already understaffed and under-resourced working environment. This leaves little time and funding for academic research. Those who want to embark on a research career in LMICs may face challenges, which include precedence of clinical priorities, competing administrative and teaching responsibilities, low institutional support for research, lack of provision of laboratory space, insufficient mentorship, sense of insecurity in obtaining further funding and difficulties in striking a good work-life balance.[19-21]

Nevertheless, these challenges also bring unique opportunities stemming from experience working in challenging environments which may direct one to think more creatively. Collaboration and partnership with more advanced and established centres could be a potential avenue for success. For example, the research and implementation of economical but reliable technology point-of-care platforms to test for human epidermal growth factor receptor 2 (HER2), oestrogen and progesterone receptors in breast cancer will allow patients to benefit from timely adequate treatments and at the same time allow validation of a novel technique which may be applicable to a broader population.[22] Inreach from regional collaboratives within LMICs is also desirable. For instance, the Asian Oncology Early Phase 1 Consortium composed of Japan, China, South Korea, Singapore and Taiwan was formed in 2017 with the main objective to drive the momentum towards international collaborative phase I trials across Asian countries, and to realise an efficient clinical development of early-phase drugs serving the neighbouring region, including LMICs.[23] Future similar efforts may help capacity building, share expertise with experience in understanding local challenges and strengthen the foundation of research in other LMICs.

Although some LMICs have begun incorporating training through higher degrees and a dedicated academic pathway, these opportunities are still few and far in between. In some countries, young oncologists are offered the opportunities to go for exchange programmes or a period of overseas sabbatical or experience with partner institutes

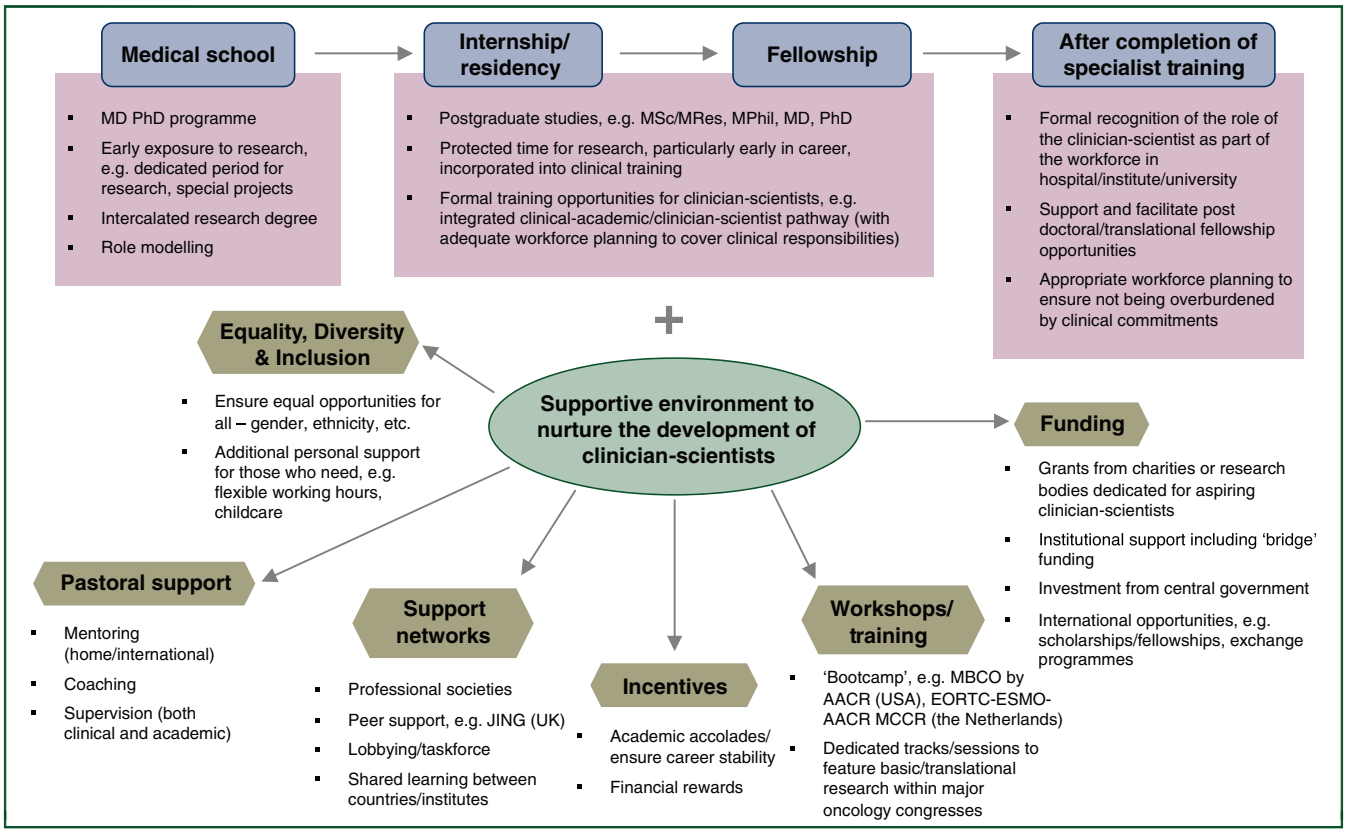

Figure 1. Proposed framework to support the development of current and future clinician-scientists.

and/or countries. There is of course the risk of a 'brain drain' with the opportunities which then become available. However, data are lacking regarding the mobility of clinician-scientists in oncology from LMICs, and the direct and/or indirect impact on their home countries. Initiatives that aim to attract these clinician-scientists back to their country of origin, such as 'reintegration' fellowships coupled not only with salary but also with resources to implement their research, would provide realistic alternative to staying abroad.

SUPPORTING THE DEVELOPMENT OF CURRENT AND FUTURE CLINICIAN-SCIENTISTS

Global effort to support young oncologists and aspiring clinician-scientists is no small feat and requires collaborative and interdisciplinary support from all parties (Figure 1). Different countries and regions will undoubtedly face varying challenges in cancer care and encounter specific issues and limitations. Here, we provide a non-exhaustive summary of some of the key strategies which may help provide a supportive environment to nurture current and future clinician-scientists.

First, there needs to be a global effort in formally recognising and clearly defining the role of the clinician-scientist, and acknowledging the contribution and great potential they could bring to the community. A culture shift is required to recognise and elevate the professional status of clinician-scientists. Four key recommendations have been set out by the International Expert Group on the Clinician-Scientist Workforce to (re-)establish the identity of clinician-scientists by relevant bodies in oncology:

- 'define a shared vision for integrating research and clinical training;
- generate a framework in which to set standards, track cadres of clinician-scientist trainees and fund trainees within a national context;
- credential trainees for successful completion of clinician-scientist competencies; and
- introduce new reward, promotions, and funding models and elicit changes in how clinician-scientist impact is defined and rewarded'.[1]

The commitment to implement these consensus recommendations will be a critical starting point for most settings. To begin with, major international oncology societies with strong influence such as the ESMO and the American Society of Clinical Oncology (ASCO) could join forces in assimilating a 'clinician-scientist curriculum' as part of the next update in the training curriculum recommendations for oncology.[24]

The journey to become a clinician-scientist may begin even before qualifying as a clinician. To increase the number of clinician-scientists, medical schools in countries such as the United States, Canada, the United Kingdom, Sweden, Switzerland, Germany, Austria, South Africa, Japan, Singapore, the Philippines, Australia and New Zealand have established MD PhD/MB PhD programmes to dedicate 3-4 years for conducting rigorous scientific/research training.[25]

The success of these programmes is yet to be adequately assessed due to the short duration of follow-up in most programmes. Nevertheless, a large US report of ∼5000 MD PhD alumni surveyed since the programme started in the 1950s showed that as many as 80% are involved in research in some form in their careers, providing clear evidence that this route of training can have favourable returns.[26] With such promising results, such programmes should continue to be funded and supported. In addition, for those who may be undecided about an academic career this early on, opportunities for a brief period in research such as experience in a small project or a funded year out of medical school for a 'taster' should also be encouraged.

With increasing clinical responsibilities even early in residency training in oncology, there needs to be 'protected' research time to facilitate adequate time and space for trainees to hone in on their research on top of their clinical training. The investment in attracting more to choose a career as a clinician-scientist requires robust workforce planning. Serious initiatives to integrate a clinician-scientist pathway with careful dedication of clinical time to ensure sufficient experience in caring for patients with cancer, and simultaneously protecting the academic development have been the model which appear to function in some settings. A potentially effective model, as an example in the UK's National Institute for Health and Care Research (NIHR) Integrated Academic Training (IAT) programme,[27] is to embed the aspiring clinician-scientist as a supernumerary clinical trainee to facilitate the development of adequate clinical experience and robust research training in parallel.

All efforts in creating a supportive environment to nurture the next generation of clinician-scientists should also be coupled with strong commitment for mentoring by established investigators. There are role models in the field who may be able to provide mentorship in various aspects of the journey to become a clinician-scientist, be it to navigate a specific process unique to the country, for example, obtaining funding for research, or trying to develop an expertise or establish a niche in the field. One should be encouraged to have more than one mentor, and this can be done either informally or formally. In fact, ESMO and ASCO have recently established virtual/remote mentoring schemes dedicated to support young and aspiring oncologists, including clinician-scientists.

Workshops dedicated to support the development of clinician-scientists in oncology, such as the renowned annual AACR Molecular Biology in Clinical Oncology workshop which is especially designed for early-career clinician-scientists, can serve as an excellent starting point to expose young colleagues to the international scientific community. In these workshops, trainees have the opportunity to not only learn some of the fundamental principles of biomedical research but also benefit from an external peer review on project proposals and promising ideas. Workshops such as these are also important in fostering networking, allowing further near-peer support from colleagues experiencing the same challenges in developing their career. Many support networks for fellow early career researchers are often useful as clinician-scientists gradually carve their niche career directions and may benefit by learning from experiences of others who may have been through the same.

On a global arena, research conducted by clinician-scientists should be given more visibility at international and national oncology congresses, especially in traditionally more clinically orientated ones. Aspiring clinician-scientists should be proactive in seeking the chance to share their work and obtain feedback from international peers. Indeed, dedicated tracks and sessions featuring basic and translational research are often inspiring for young researchers and will encourage potential collaboration with those working in similar areas.

Above all, one of the most important factors is the financial investment in clinician-scientists. Central support from the governments is most welcomed, and will signal prioritisation of the contribution of clinician-scientists to advancing cancer research and therapies. There should also be more streamlined and personalised support for aspiring clinician-scientists at different stages of their careers through research organisational grants and charitable funding; for example, simplifying the application processes with a focus on supporting the development of the young researcher rather than the project or subject area. Importantly, there should also be fair salary during the period of academic career development, and adequate renumeration when in senior posts, on par with fellow fully clinical colleagues. Taking it a step further, one key area for consideration for single-payer or public health care systems (mostly Europe and Canada) is for national health systems to incorporate clinician-scientists as substantive staff—fully recognised and financially accounted for within the overall workforce.

Finally, efforts in striving for more equality and diversity in the clinician-scientist workforce should continue to be a priority for all parties. Representation is key, and efforts by many have shown that change is in progress and the future is hopeful. Mentorship and role models from underrepresented minorities who have successfully become clinician-scientists may inspire and help others navigate this path. Notably, high-impact journals such as *Nature Medicine*[28-30] have more recently featured the biographies and career journeys of successful women in science and those of underrepresented minority groups, and these show to the young aspiring clinician-scientists that opportunities are available and that ambitions can be tangible.

CALL TO ACTION

Clinician-scientists can play an important role in bridging gaps in biomedical research and can thus serve the community on a larger scale. Becoming a clinician-scientist, being always at the cutting-edge of knowledge, can potentially be extremely fulfilling on both a personal and professional level, and impactful for patients. Hence there needs to be formal recognition by regulatory bodies and health care systems, and deliberate planning to sustain the current and future clinician-scientist workforce.

All parties play a role in the development of clinician-scientists to ensure that significant discoveries in science continue to be translated into patient benefit in a timely manner. This is particularly important in oncology, with discoveries and advances presenting opportunities and challenges at a faster speed than ever before. The ESMO has recently launched the inaugural 'José Baselga Fellowship for Clinician Scientists' to provide springboard funding for aspiring young oncologists at the beginning of their research career. In addition, ESMO has also established the International Cancer Foundation (ICF) with a wide global mission to advance cancer care, including specific provision for research training and fellowships for investigators from LMICs. Therefore, with this position paper, we hope to further emphasise the clear need for and support required to secure the future of clinician-scientists in oncology.

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RSB has received travel grants from Pfizer, AstraZeneca and Novartis; and honoraria for speaker or advisory board participation from Novartis, Lilly, AstraZeneca, Daiichi Sankyo, Roche, GSK, Clovis Oncology, Seagen and Accord, outside the submitted work; declares nonfinancial interests, including being an ESMO Young Oncologists Committee member and Spanish Society of Medical Oncology — Scientific Secretary. PS has received travel grants from MSD, Roche, Novartis and Pierre Fabre, honoraria for lectures from Swixx BioPharma, Sandoz and BMS, and advisory board honoraria from Sandoz; outside the submitted work; Declares nonfinancial interests, including being an ESMO Officer; Polish Society of Clinical Oncology — Member of Board of Directors. PS serves as a member of the ESMO Young Oncologists Committee. AMS has received speaker honoraria from AstraZeneca, as well as travel and congress support from PharmaMar, MSD and Lilly, outside the submitted work; and also serves as a member of the ESMO Young Oncologists Committee. ATV has received travel grants from Roche, Novartis, Pfizer, Elly Lilly and Zentiva; honoraria/consultation fees from Amgen, Astellas, AstraZeneca, Elly Lilly, Novartis, Pfizer, Roche, BMS, Servier, Merck, Viatris, Oktal and Bausch; institutional grants from Novartis and Pfizer; participated in clinical trials by Roche and Novartis, all outside the submitted work; reports nonfinancial disclosures, including being an ESMO Young Oncologists Committee member, ESO (European School of Oncology) team member, ESO Certificate of Competence module scientific co-director and OncoWay Croatian NGO vice-president. HZ serves as a member of the ESMO Young Oncologists Committee. MBCO has received speaker

honorarium from Pfizer, outside the submitted work; also serves as a committee member of the Philippine Society of Medical Oncology (PSMO) and the Philippine College of Physicians (PCP). SCA has no conflicts of interest to declare. RC serves as a member of the ESMO Communications Committee. PV has received speaker honoraria from Roche, Novartis and MSD, as well as travel grant funding from Roche. SB reports grants from AstraZeneca, GSK and Lady Garden Foundation Charity; and personal fees from AstraZeneca, GSK, Amgen, Clovis, Eisai, Epsilogen, Immunogen, Mersana, MSD, Novartis, Novocure, OncXerna, Pfizer, Regeneron, Roche, Shattuck Labs and Takeda, all outside the submitted work; and was previously the ESMO Director of Membership. EA has received honoraria and served on the advisory board of Roche/GNE; and received travel grants from Roche/GNE and GSK/Novartis. The institute he works for has received research grants from AstraZeneca, Lilly, MSD, Novartis, Pfizer, Roche-Genentech, Synthon, Radius and Servier, outside the submitted work; and also serves as the current ESMO Director of Membership. AC has received institutional research funding from Genentech, Merck Serono, Bristol Myers Squibb, Merck Sharp & Dohme, Roche, BeiGene, Bayer, Servier, Lilly, Novartis, Takeda, Astellas, Takeda and FibroGen; and advisory board or speaker fees from Amgen, Merck Serono, Roche, Bayer, Servier and Pierre Fabre in the last 5 years, outside the submitted work; and serves as the current ESMO President. ML reports advisory role for Roche, Lilly, Novartis, AstraZeneca, Pfizer, Seagen, Gilead, MSD and Exact Sciences; speaker honoraria from Roche, Lilly, Novartis, Pfizer, Sandoz, Libbs and Takeda; and travel grants from Gilead, outside the submitted work; and serves as the current Chair of the ESMO Young Oncologists Committee. JM has served as an advisor for AstraZeneca, Amunix/Sanofi, Daiichi Sankyo, Janssen, MSD, Pfizer and Roche; is a scientific board member for Nuage Therapeutics; is involved in several investigator-initiated and company-sponsored clinical trials; has participated in speaker bureaus for AstraZeneca, MSD, Pfizer, Illumina and Guardant; is the principal investigator of research projects funded by institutional grants from AstraZeneca and Pfizer, all outside the submitted work; and also serves as the current Chair of the ESMO Translational Research and Precision Medicine Working Group. TA reports institutional grants from SkylineDx, NeraCare and Sanofi; institutional grants and personal fees from Novartis; personal fees from BMS, CeCaVa and Pierre Fabre, all outside the submitted work; and also serves as the current Chair of the ESMO Fellowship Development Committee and was previously the Chair of the ESMO Young Oncologists Committee.

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